Enhancing Effective Teaching and Learning Delivery in Technical Vocational Education and Training [TVET] through Artificial Intelligence

by

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Abstract

Artificial intelligence (AI) will sooner or later become an indispensable technology. This study focused on enhancing effective teaching and learning delivery in Technical Vocational Education and Training [TVET] through artificial intelligence. Three research questions and three null hypotheses tested at 0.05 level of significance guided the study. The study adopted survey research design. The study was conducted at Faculty of Vocational Technical Education, University of Nigeria, Nsukka. A 34-item structured questionnaire titled "Enhancing Effective Teaching and Learning Delivery in Technical Vocational Education and Training [TVET] through Artificial Intelligence (ETLSDAI)" developed by the researchers was used for data collection on 70 purposively sampled people made up of 20 lectures and 50 students of the Faculty of Vocational Technical Education, University of Nigeria, Nsukka. The questionnaire was face-validated by three experts from the Faculty of Vocational and Technical Education, University of Nigeria, Nsukka. A Cronbach Alpha reliability method was used to determine the internal consistency of the questionnaire items and indices of the instrument yielded 0.85 reliability coefficient value was obtained using SPSS version 22. This showed that the instrument was reliable and appropriate for administration. All the 70-questionnaire administered to the respondents were returned. This represents a return rate of 100%. Mean and standard deviation were used to answer the research questions; while z-test was employed to test the null hypotheses at 0.05 level of significance. The major finding of the study was that artificial intelligence enhances the effective teaching and learning delivery in Technical, Vocational Education and Training [TVET] at University of Nigeria, Nsukka. Based on the finding, it was recommended that artificial intelligence should be incorporated in the teaching and learning of TVET courses at the Faculty of Vocational and Technical Education, University of Nigeria, Nsukka.

Keywords: Artificial intelligence, effective teaching, learning delivery, TVET

Introduction

Artificial Intelligence in Technical Vocational Education and Training (TVET) is growing and offering valuable insights to TVET educators, administrators and policymakers. Artificial intelligence is the ability of a digital computer-control robot to perform tasks commonly associated with intelligent beings (Purdy,2020). According to Alake **(2020)** artificial intelligence is a technology that behaves intelligently using skill associated with human intelligence,including the ability to perceive,learn,reason and actautonomously.Artificial intelligence machines could mark exams while teachers take on higher roles. It could be taught to think and do things that humans do. It could handle routine matters and elevate teachers to be mentors to the students. It is transforming the global economy and have a major impact in education (Walsh, 2020).

Artificial intelligence programs equip the students and lecturers with new skill sets needed in the job market. It enhances the role of teachers and helps them with the ability to curate learning experiences while holistically supporting a learner's growth and emotional well-being in the classroom. It brings growth, impact, and potential to change human lives. It is the current game changer on skills, business operations and education activities (Neneh,2019). It is contributing meaningfully to teaching and learning.

Teaching is about using various approaches and activities to help learners

gain the skills, knowledge and understanding they need for a particular reason, while learning is about gaining and using new knowledge to demonstrate a change (Isabel, 2023). This change might relate to the performance of a skill, the demonstration of understanding and a change in behaviour and attitudes. Artificial intelligence enhances teaching and learning in technical vocational education and training (TVET) institutions.

Technical vocational education and training (TVET) is academic and vocational preparation of students for jobs involving applied science and technology. It is education and training that prepares youth for world of work. It develops work related skills and mastery of knowledge and scientific principle. It provides broad based technical skills and knowledge on which different occupations can be based on. It provides continuous vocational training to the work force. It has the power to re-skilling individuals to enable them be employable. It facilitates sustainable economic growth and develops in an individual personal capabilities and broad-based knowledge to ensure critic-creative thinking. It provides strategies for lifelong learning (Oguejiofor et al, 2022). According to UNESCO (2015), TVET refers to aspects of the educational process involving, in addition to general education, the study of technologies and related sciences, and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupants in various sectors of economic and social life. It is education and training which affords knowledge and skills for employment.

The roles of artificial intelligent toTVET cannot be overemphasized. It is a silver bulletfor better instruction delivery. It empowers students for better understanding of concepts. It is upon this that the study is set to analyse enhancing effective teaching and learning delivery in technical vocational education and training (TVET) through artificial intelligent in university of Nigeria, Nsukka.

Purpose of the Study

The general purpose of this study was to determine how artificial intelligent could enhance the effective teaching and learning delivery intechnical vocational education and training (TVET) at theFaculty of Vocational and Technical Education, University of Nigeria, Nsukka. Specifically, the study seeks to determine the:

1. role ofartificial intelligent for effective teaching-service delivery in TVET atUniversity of Nigeria, Nsukka.
2. role ofartificial intelligent for effective understanding of concepts in TVET atUniversity of Nigeria, Nsukka.
3. how artificial intelligent could help TVET lecturers discharge their administrative duties effectively at University of Nigeria, Nsukka.

Research Questions

The following research questions were posed to guide the study:

1. What are the roles of artificial intelligentfor effective teaching-service delivery in TVET at University of Nigeria, Nsukka?
2. What are the roles of artificial intelligentfor effective understanding ofconcepts in TVET atUniversityof Nigeria, Nsukka?
3. How do artificial intelligenthelps TVET lecturers to discharge theiradministrative duties effectively atUniversityof Nigeria, Nsukka?

Hypotheses

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

1. There is no significant difference between the mean responses of lecturers and students on the roles of Artificial Intelligentfor effective teaching-service delivery in TVET at University of Nigeria, Nsukka.

2. A significant difference does not exist between the mean responses of lecturers and students on the roles of Artificial Intelligent for effective understanding of concept in TVET at University of Nigeria, Nsukka.

3. **Ho3**: A significant difference does not exist between the mean responses of

lecturers and students on how Artificial Intelligent helps TVET lecturers to discharge their administrative duties effectively at University of Nigeria, Nsukka.

Methodology

The design adopted in this study was a descriptive survey research design. The study was conducted at faculty of vocational technical education, university of Nigeria, Nsukka. The population for the study was 70 people, which comprised 20 lecturers and 50 students purposely sampled from the faculty of vocational technical education, university of Nigeria, Nsukka**.** The instrument for data collection was thirty-four structured items questionnaire tagged "Enhancing Effective Teaching and Learning Delivery in Technical Vocational Education and Training (TVET) through Artificial Intelligent(ETLDAI)"constructed by the researchers using a four point responses scale of very great extent (4), great extent (3), low extent (2) and very low extent (1).The instrument was face validated by three experts from Faculty of Vocational and Technical Education, University of Nigeria, Nsukka. Their corrections and suggestions were used to produce the final instrument. Three research questions and three null hypotheses guided the study.A Cronbach Alpha reliability method was used to determine the internal consistency of the questionnaire items and indices of the instrument yielded 0.85 reliability coefficient value was obtained using SPSS version 22.

The instrument was administered by hand with the aid of three research assistants. All the 70-questionnaire administered to the respondents were returned. This represents a return rate of 100%. Mean and standard deviation were used to answer the research questions, while z-test statistical tool was used to test the null hypotheses at 0.05 level of significance. To take decision on the items, real limit of numbers was assigned to response options as follows: very great extent (VGE) 4.00 -3.50, great extent (GE): 3.49-2.50, low extent (LE):2.49-1.50 and very low extent (VLE) 1.49 -1.00. Therefore, any item with mean value of 2.50 and above was uphold and rejected if below 2.50.

The z-test was used to test the hypotheses at 0.05 level of significance. The z-test was considered suitable because according to Uzoagulu (2011) the z-test is more appropriate when the sample size (n) is more than 30. The z-critical (z-table) value for accepting or rejecting the null hypotheses was ±1.96.

Results

Data for the study were presented and analyzed based on the three research questions and three null hypotheses that guided the study. The details are contained in the Tables 1 to 3.

Research Question 1 and Hypothesis 1

Table 1
Mean, Standard Deviation and z-test Analysis of Respondents on the Roles of Artificial Intelligent for Effective Teaching-service Delivery in TVET at University of Nigeria, Nsukka.

S/N	Item statements	Lecturers		Students		Overall			Decision
		X1	SD1	X2	SD2	X3	SD3	z-cal	
	Roles of artificial intelligent for effective teaching delivery in TVET								
1	Reshapes traditional teaching methods	3.81	0.35	3.72	0.44	3.77	0.35	± 0.26	A & NS
2	Powers intelligent tutoring system	3.90	0.31	3.87	0.34	3.89	0.33	± 0.34	A & NS
3	Accommodates diverse learning styles and pacing	3.61	0.55	3.53	0.45	3.57	0.50	± 0.63	A & NS
4	Provide real-time feedback& guidance to students	3.80	0.36	3.70	0.41	3.75	0.39	± 0.95	A & NS
5	Early intervention strategies and monitoring student performances	3.91	0.30	3.88	0.34	3.90	0.32	± 0.33	A & NS
6	Identify students' learning gaps	3.82	0.34	3.70	0.44	3.77	0.39	± 0.98	A & NS
7	Allow lecturers for timely and targeted support to students	3.80	0.36	3.71	0.42	3.76	0.39	± 0.84	A & NS
8	Encourages collaboration in teaching and learning	3.90	0.30	3.87	0.34	3.89	0.32	± 0.34	A & NS
9	Empowers lecturers to provide personalized, efficient and dynamic learning experiences to their students in the classroom.	3.60	0.54	3.53	0.45	3.57	0.49	± 0.55	A & NS
10	Empowers lecturers for better technical skills	3.61	0.55	3.53	0.45	3.57	0.50	± 0.63	A & NS
11	Catalyst for creating more accessible learning	3.60	0.55	3.53	0.45	3.57	0.50	± 0.55	A & NS
12	Enriching teaching experiences	3.81	0.35	3.72	0.44	3.77	0.35	± 0.26	A & NS
	Cluster mean	**3.76**	**0.41**	**3.69**	**0.41**	**3.72**	**0.41**	± 0.56	**A & NS**

Key: *A=Agreed, NS=Not Significant, X1=Mean of lecturers, X2= Mean of students, SD1 = standard deviation of lecturers, SD2 = standard deviation ofstudents, X3 = Average mean, SD3 = Average standard deviation, z-cal = z-test calculated, z-table (z-critical) value = ±1.96.*

The findings in Table 1 shows the response of the respondents on roles of artificial intelligent for effective teaching-service delivery in TVET at university of Nigeria, Nsukka. The result revealed that all the items had their weighted mean values

ranged from 3.53 to 3.91. Since the values are above the bench mark of 2.50; it indicates that the respondents agreed that all the items identified are the roles of artificial intelligent for effective teaching-service delivery in TVETat university of Nigeria, Nsukka.The cluster mean value is above the bench mark. The z-test analysis from table 1 shows that all the items had their z-calculated values less than the z-table value of ±1.96. This implies that there is no significant difference in the mean ratings of the responses of the respondents on the roles of artificial intelligent for effective teaching-service delivery in TVET at university of Nigeria. Nsukka. Hence the null hypotheses for all the items were upheld.

Research Question 2 and Hypothesis 2

Table 2
Mean Standard Deviation and z-test Analysis of Respondents the Roles of Artificial Intelligent for Effective Understanding of Concepts inTVET at University of Nigeria, Nsukka.

S/N	Item statements	Lecturers		Students		Overall			Decision
		X1	SD 1	X2	SD2	X3	SD 3	z-cal	
	Roles of artificial intelligent for effective understanding of concepts in TVET								
1	Personalizes learning experiences	3.72	0.38	3.70	0.44	3.71	0.41	± 0.18	A & NS
2	Accommodates diverse learning style& pace.	3.81	0.36	3.80	0.48	3.81	0.42	± 0.10	A & NS
3	Provide real-time feedback & guidance to students	3.72	0.38	3.70	0.44	3.71	0.41	± 0.18	A & NS
4	Foster interactive learning environments	3.65	0.55	3.64	0.46	3.65	0.48	± 0.02	A & NS
5	Personalize learning experiences for each student	3.62	0.30	3.61	0.41	3.62	0.36	± 0.10	A & NS
6	Help students learn in difficulty areas	3.70	0.38	3.62	0.41	3.66	0.39	± 0.94	A & NS
7	Prevents students from falling behind	3.89	0.30	3.61	0.45	3.76	0.37	± 0.75	A & NS
8	Contributes more efficient, adaptive & student-center educational landscape.	3.70	0.38	3.60	0.41	3.65	0.39	± 0.94	A & NS
9	Provide a chatbot for students to answer queries	3.64	0.38	3.60	0.41	3.63	0.39	± 0.38	A & NS
10	Virtual tutor to students	3.62	0.30	3.61	0.41	3.62	0.36	± 0.10	A & NS
11	Enhancing learning experiences	3.81	0.36	3.80	0.48	3.81	0.42	± 0.10	A & NS
	Cluster mean	**3.72**	**0.37**	**3.66**	**0.44**	**3.69**	**0.40**	**± 0.34**	**A & NS**

The findingsin Table 2 show the response of the respondents on theroles of artificial intelligent for effective understanding of concepts in TVET at university of Nigeria, Nsukka. The result shows that all the items presented had their weighted mean values ranged from 3.60 to 3.89. These values are above the bench mark of 2.50 indicating that the respondents agreed that the items identified are the roles of artificial intelligent for effective understanding of concepts in TVET at university of Nigeria, Nsukka.

The cluster mean was above the bench mark of 2.50. The z-test analysis from table 2 shows that all the items had their z-calculated values less than the z-table value of ±1.96. This implies that there was no significant difference in the mean ratings of the responses of the respondents on roles of artificial intelligent for effective understanding of concepts in TVET at university of Nigeria, Nsukka. Therefore, the null hypotheses for all the items were accepted.

Research Question 3 and Hypothesis 3

Table 2

Mean Standard Deviation and z-test Analysis of Respondents on How Artificial Intelligent helps TVET Lecturers to Discharge their Duties Effectively

S/N	Item statements	Lecturers		Students		Overall			Decision
		X1	SD 1	X2	SD2	X3	SD 3	z-cal	
	How artificial intelligent helps lecturers to discharge their administrative duties effectively								
1	Automates lectures' administrative tasks	3.72	0.38	3.70	0.44	3.71	0.41	± 0.18	A & NS
2	Provides valuable data-driven insights	3.80	0.36	3.80	0.48	3.81	0.42	± 0.10	A & NS
3	Assist in creating customized learning materials	3.65	0.55	3.64	0.46	3.65	0.48	± 0.02	A & NS
4	Aids in tailoring diverse learning content styles	3.81	0.36	3.80	0.48	3.81	0.42	± 0.10	A & NS
5	Facilitates data-driven decision-making for lecturers	3.70	0.38	3.62	0.41	3.66	0.39	± 0.94	A & NS
6	Helps to analyze students' performance data	3.90	0.30	3.61	0.45	3.76	0.37	± 0.75	A & NS
7	Gives lecturers high-quality skilling opportunities	3.81	0.36	3.80	0.48	3.81	0.42	± 0.10	A & NS
8	Enhance data-driven decision making	3.62	0.30	3.61	0.41	3.62	0.36	± 0.10	A & NS
9	Fosters administrative innovations	3.91	0.30	3.61	0.45	3.76	0.37	± 0.75	A & NS
10	Virtual assistance to lecturers	3.64	0.38	3.60	0.41	3.63	0.39	± 0.38	A & NS
11	Aids in development of intelligent content recommendation system	3.80	0.36	3.78	0.48	3.81	0.42	± 0.10	A & NS
	Cluster mean	**3.76**	**0.37**	**3.69**	**0.45**	**3.73**	**0.41**	**± 032.**	**A & NS**

The findings in Table 3 show the response of the respondents on how artificial intelligent helps TVET lecturers to discharge their administrative duties effectively at university of Nigeria, Nsukka. The result shows that all the items presented had their weighted mean values ranged from 3.60 to 3.90. These values are above the bench mark of 2.50 indicating that the respondents agreed that the items identified are how artificial intelligent helps lecturers to discharge their administrative duties effectively in TVET at university of Nigeria, Nsukka.

The cluster mean was above the bench mark of 2.50. The z-test analysis from table 3 shows that all the items had their z-calculated values less than the z-table value of ±1.96. This implies that there was no significant difference in the mean ratings of the responses of the respondents on how artificial intelligent helps TVET lecturers to

discharge their administrative duties effectively at university of Nigeria, Nsukka.

Discussion of Findings

Analysis of study with respect to the roles of artificial intelligent for effective teaching-service delivery in TVET at university of Nigeria, Nsukka is in agreement with Bostrom (2024). The study showed that artificial intelligent reshapes traditional teaching methods, powers intelligent tutoring system, accommodates diverse learning styles and pacing, provide real-time feedback and guidance to students, helps in early intervention strategies and monitoring student performances, identify students' learning gaps, allow lecturers for timely and targeted support to students, encourages collaboration in teaching and learning, empowers lecturers for better technical skills, catalyst for creating more accessible learning, enriches teaching experiences and empowers lecturers to provide personalized, efficient and dynamic learning experiences to their students in the classroom.

The study also found that personalizes learning experiences, accommodation of diverse learning style and pace, provision real-time feedback and guidance to students, fostering interactive learning environments, personalize learning experiences for each students, helping students learn in difficulty areas, preventing students from falling behind, contribution of more efficient, adaptive and student-center educational landscape, provision of chatbot for students to answer queries, virtual tutor to students and enhancing learning experiences are the roles of artificial intelligent for effective understanding of concepts in TVET at university of Nigeria, Nsukka. The finding is in consonance with, Purly (2020) and Rost (2024) in their analysis that artificial intelligent could aid for better understanding in the classroom environment.

Furthermore, the study found that automation of lectures' administrative tasks, provision valuable data-driven insights, assisting in creating customized learning materials, aids in tailoring diverse learning content styles, facilitating data-driven decision-making for lecturers, helping to analyze students' performance data, high-quality skilling opportunities for lecturers, enhancing data-driven decision making, fostering administrative innovations, virtual assistance to lecturers and aids in development of intelligent content recommendation system are how artificial intelligent helps lecturers to discharge their administrative duties effectively. This finding agreed with Bostrom (2024) that artificial intelligent could help in discharging some administrative functions.

On the analysis of the hypotheses, the study found that there was no significant difference in the mean ratings of the responses of the respondents on the roles of artificial intelligent for effective teaching-service delivery and effective understanding of concepts in TVET at university of Nigeria, Nsukka. The study also showed that there was no significant difference in the mean ratings of the responses of the respondents on how artificial intelligent helps TVET lecturers to discharge their administrative duties effectively**.** The three null hypotheses for the study were upheld.

Conclusion

The artificial intelligent era has already given rise to significant changes in the way people think and interact with each other. The rate of its innovation has exceeded very high above average. It has created solution to most of human needs and challenges. It helps the education systems to be prepared and equipped to respond to both job-specific skills and the transversal skills required to navigate new ways of working and to the renewed requirement for lifelong learning and continuous up-skilling. Its role in TVET is transformative. It offers personalized learning, administrative efficiency, and innovative teaching tools. It empowers lecturers and enriches learning.

Recommendations

Based on the findings from the study, it was recommended that:

1. Artificial intelligence should be incorporated in the teaching and learning of TVET courses at University of Nigeria, Nsukka.

2. The government and school authority should sponsor university lecturers for up-skilling on the use of artificial intelligence.

3. There should be a provision of artificial intelligence tool in the classroom environment for effective teaching and learning.

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