

ENHANCING TECHNICAL VOCATIONAL EDUCATION AND TRAINING (TVET) THROUGH ACCESSIBLE AND INCLUSIVE DIGITAL LEARNING ENVIRONMENT AS PATHWAYS TO NATIONAL DEVELOPMENT IN NIGERIA

By

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Abstract

The study examined strategies for enhancing Technical Vocational Education and Training (TVET) through accessible and inclusive digital learning environment as pathways to national development in Nigeria. Three research questions were answered with corresponding null hypotheses that were formulated and tested at 0.05 level of significance. The study employed the descriptive research survey design and was carried out in Rivers State. The population of the study was all 31 lecturers and 458 students of Industrial Technology Education. Due to small population size of lecturers, it was a census study while stratified random sampling technique was used to select 86 final year students. Hence, the sample for the study was 117 respondents (Lecturers = 31; Students = 86). The instrument for data collection was self-structure questionnaire tagged "Strategies for Enhancing Technical Vocational Education and Training Digital Learning Questionnaire (SETVETDLQ)" which was designed and patterned after a modified 4-point rating scale of agreement. The instrument was validated and tested for reliability using test-retest method. A reliability coefficient of .83 was established using Pearson Product Moment Correlation. Data collected was analysed using descriptive statistics of Mean with Standard Deviation to answer the research questions while the null hypotheses were tested with z-test. The study found that the use of adaptive technologies, universal design principles, and inclusive teaching practices are strategies for enhancing accessible and inclusive digital learning environments as pathways for national development in Nigeria. Based on the findings of the study, it was recommended among others that Government and stakeholders of TVET should ensure proper implementation of comprehensive professional development programs to enhance the digital literacy and pedagogical skills of TVET educators.

Keywords: Accessible, Digital Learning Environment, Inclusive, Strategies and TVET.

INTRODUCTION

In an era marked by rapid technological advancements, the education sector is undergoing a transformative shift. This shift is particularly significant in Technical Vocational Education and Training (TVET), where the integration of digital learning environments has the potential to revolutionize the way skills and knowledge are imparted. TVET is critical for national development, providing the necessary skills for a productive workforce that drives economic growth and innovation. However, in Nigeria, the full potential of TVET remains largely untapped due to challenges related to accessibility, inclusivity, and the adoption of modern educational technologies. TVET plays a pivotal role in equipping individuals with practical skills and competencies required in various industries. It bridges the gap between education and the labor market, addressing unemployment and fostering economic development. Effective TVET systems are associated with higher employment rates, increased productivity, and enhanced economic competitiveness (UNESCO, 2015). In Nigeria, however, the TVET sector faces numerous obstacles, including outdated curricula, inadequate infrastructure, and a shortage of qualified instructors (Okoye&Okwelle, 2013). Technical Vocational Education and Training (TVET) refers to the educational and training processes that equip individuals with practical skills, knowledge, and attitudes necessary for employment in various sectors of the economy. TVET encompasses formal, non-formal, and informal learning and aims to develop competencies in technical fields such as engineering, construction, information technology, and other vocational areas. It plays a crucial role in addressing unemployment, enhancing productivity, and fostering economic development by preparing a skilled workforce (UNESCO, 2015).

One of the primary challenges in Nigeria's TVET system is the lack of access to quality education for all students. This issue is exacerbated by socio-economic disparities, geographic isolation, and insufficient educational resources. Many students, particularly those in rural areas, have limited or no access to modern educational tools and technologies, which hinders their ability to acquire the necessary skills for the labor market (Federal Ministry of Education, 2018). In addition to accessibility issues, inclusivity remains a significant concern. The traditional TVET system often fails to accommodate the diverse learning needs of students, including those

with disabilities. Inclusive education practices are essential to ensure that all students, regardless of their physical, cognitive, or sensory abilities, can benefit from TVET programs (UNESCO, 2018) and this is achievable if digital learning environment are made accessible and inclusive in TVET.

Digital learning environments, supported by adaptive technologies, can transform Nigeria's TVET system by making education more accessible and inclusive. These environments utilize online platforms, virtual simulations, and digital resources to deliver high-quality education. They offer several advantages, including the ability to reach a wider audience, reduce costs associated with physical infrastructure, and provide real-time feedback to learners (Kearney, Schuck, Burden, & Aubusson, 2012). Inclusive digital learning environments refer to educational settings that utilize digital technologies to provide equitable access to learning for all students, regardless of their physical abilities, socio-economic status, geographic location, or learning preferences. These environments are designed to accommodate the diverse needs of learners, ensuring that everyone has the opportunity to participate fully and effectively in the educational process. Key features of inclusive digital learning environments include accessibility, flexibility, personalization and supportive tools through incorporating assistive technologies such as screen readers, speech-to-text software, and language translation tools to help students overcome barriers to learning.

Accessing inclusive digital learning environments can significantly enhance Technical Vocational Education and Training (TVET) by making it more accessible and effective for a diverse student population. TVET can access and utilize these environments for national development by developing robust digital infrastructure, integrating universal design principle, providing professional development for educators, utilizing assistive technologies, creating inclusive educational policies, leveraging online platforms and resources among others. By adopting inclusive digital learning environments, TVET can play a crucial role in national development through the following pathways which include enhancing workforce skills, reducing unemployment and underemployment, promoting social inclusion, driving innovation and competitiveness and supporting lifelong learning which provide flexible and accessible

opportunities for individuals to update their skills and knowledge throughout their careers. this is crucial for adapting to the rapidly changing demands of the labor market.

For digital learning environments to be effective in TVET, a multi-faceted approach is required. This approach should involve developing robust digital infrastructure, building capacity among educators, and creating inclusive educational policies. Collaboration between government, educational institutions, and industry stakeholders is essential to ensure the successful integration of strategies capable of achieving desire aim of TVET (Akinyemi & Bassey, 2019). These strategies as identified in this study include the use of adaptive technologies, use of universal design principles and the use of inclusive teaching practices can make TVET accessible and inclusive.

Adaptive technologies offer a promising solution to these challenges by creating accessible and inclusive digital learning environments. These technologies include software and hardware designed to accommodate the diverse needs of learners, enabling personalized learning experiences. Adaptive technologies are specialized software and hardware designed to accommodate the diverse learning needs of individuals, particularly those with disabilities. Examples of adaptive technologies include screen readers for visually impaired students, speech-to-text applications, adaptive keyboards, educational software that personalizes learning experiences based on the user's abilities and preferences, and interactive learning platforms that adjust to individual learning paces (Obi, 2019). The integration of adaptive technologies in TVET can significantly enhance learning outcomes by providing flexible, personalized, and engaging educational experiences. These technologies can help overcome barriers to education, making it possible for all students to participate fully in TVET programs. Moreover, adaptive technologies can facilitate remote learning, which is particularly important in regions with limited access to traditional educational infrastructure (Okolie, Igwe, & Elom, 2019). Adaptive technologies aim to create inclusive learning environments by providing accessibility solutions that enable all learners to participate fully in educational activities (Obi, 2019).

Another strategy that enhances digital learning environment in TVET for accessibility and inclusivity is the use of Universal Design Principles (UDP). The Universal Design Principles (UDP) are a set of guidelines that aim to create products, environments, and systems that are usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. These principles, originally developed in the field of architecture, have been widely adopted in education to promote accessibility and inclusivity. Universal Design in Education (UDE) emphasizes creating learning experiences that accommodate the diverse needs of all students, including those with disabilities, thereby ensuring equal access to education (Center for Universal Design, 1997).

Universal Design Principles offer a promising solution to the challenges facing Nigeria's TVET system. By integrating these principles into digital learning environments, educators can create more accessible and inclusive educational experiences. Universal design can help overcome barriers to education by providing tools and strategies that accommodate various learning needs and preferences. For example, providing multiple means of representation, engagement, and expression can ensure that all students have equal opportunities to learn (CAST, 2011). The implementation of universal design in TVET can enhance learning outcomes by making education more flexible, personalized, and engaging. These principles can also facilitate remote learning, which is crucial for students in areas with limited access to traditional educational infrastructure. By leveraging universal design, TVET programs can reach a broader audience and provide equitable educational opportunities (Okolie, Igwe, & Elom, 2019).

Similarly, accessibility and inclusivity TVET is also achievable through digital learning environment of inclusive teaching practices. Inclusive teaching practices are educational strategies and methods designed to accommodate the diverse learning needs of all students, ensuring that every learner, regardless of their background, abilities, or disabilities, has equal access to education. These practices involve creating a supportive learning environment, using diverse instructional methods, and providing appropriate accommodations to remove barriers to learning (Florian & Black-Hawkins, 2011).

Inclusive teaching practices offer a promising solution to challenges of TVET accessibility and inclusiveness this practices involve using a variety of instructional methods and materials,

providing appropriate accommodations, and creating a supportive and flexible learning environment that is learners' friendly. For instance, incorporating assistive technologies, using differentiated instruction, and providing alternative assessment methods can significantly enhance the learning experiences of all students (Hehir, 2002). Inclusive teaching practices can be particularly effective in TVET, where the diverse learning needs of students must be met to ensure successful skill acquisition. By adopting inclusive teaching practices, educators can create more engaging, personalized, and effective learning experiences that cater to the unique needs of each student. This approach not only enhances learning outcomes but also promotes equity and social inclusion (Florian & Black-Hawkins, 2011).

The use of adaptive technologies, use of universal design principles and the use of inclusive teaching practices in digital learning environments holds immense potential for enhancing TVET in Nigeria. By addressing issues of accessibility and inclusivity, these technologies can contribute to the development of a skilled and empowered workforce, driving national development. To realize this potential, it is imperative to adopt comprehensive strategies that integrate adaptive technologies into the TVET system, ensuring that all learners have the opportunity to acquire the skills needed for the modern economy. This study therefore seeks to examine if the use of these strategies could enhance TVET through accessible and inclusive digital learning environment as pathways to national development in Nigeria.

Statement of the Problem

Despite the significant advancements in digital technology and its potential to transform education, Technical Vocational Education and Training (TVET) in Nigeria continues to face substantial challenges. These challenges include limited access to digital learning resources, inadequate infrastructure, and a lack of inclusive educational practices. The disparity in access to quality education, especially in the technical and vocational fields, impedes the nation's efforts toward sustainable development and economic empowerment.

Digital learning environments offer a promising solution to bridge this gap, providing flexible, scalable, and inclusive education opportunities. However, the successful implementation of such environments in Nigeria's TVET system requires comprehensive strategies that address both

accessibility and inclusivity. Accessibility involves ensuring that digital learning resources are available to all students, regardless of their geographical location or socio-economic status. Inclusivity demands that these resources cater to diverse learning needs, including those of students with disabilities.

Research has shown that accessible and inclusive education can significantly enhance learning outcomes and contribute to national development by fostering a skilled and empowered workforce (UNESCO, 2018). Yet, in Nigeria, the adoption of digital learning in TVET is hampered by systemic issues such as inadequate funding, limited internet connectivity, and a lack of trained educators proficient in digital pedagogy (Oviawe, Uwameiye, &Uddin, 2017). Addressing these issues is critical to leveraging digital learning environments for the enhancement of TVET. It is based on these scenarios that this study examines effective strategies that can transform Nigeria's TVET system through accessible and inclusive digital learning environments as these strategies could drive national development by equipping the workforce with the necessary skills for the modern economy.

Purpose of the Study

The purpose of the study is to examine strategies for enhancing Technical Vocational Education and Training (TVET) through accessible and inclusive digital learning environment as pathways to national development in Nigeria. Specifically, the study seeks to find out how the use of;

1. Adaptive technologies as a strategy for enhancing TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria.
2. Universal design principles as a strategy for enhancing TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria.
3. Inclusive Teaching practices as a strategy for enhancing TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria inclusive teaching.

Research Questions

The following questions were answered to guide the study.

1. How does adaptive technologies as a strategy enhance TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria?
2. How does universal design principles as a strategy enhance TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria?
3. How does inclusive teaching practices as a strategy for enhance TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria inclusive teaching?

Hypotheses

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

1. There is no significant difference in the mean response of teachers and students on how the use of adaptive technologies as a strategy enhance TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria.
2. There is no significant difference in the mean response of teachers and students on how the use of universal design principles as a strategy enhance TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria.
3. There is no significant difference in the mean response of teachers and students on how the use of inclusive teaching practices as a strategy enhance TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria.

Methodology

The study was carried out in Rivers State universities offering Technical and Vocational Education and Training (TVET). These universities are Rivers State University (RSU), Port Harcourt and Ignatius Ajuru University of Education, Rumulumeni. The study employed descriptive research survey design. The population of the study was all 31 lecturers and 458 students of Industrial /Technology Education. Due to small population size of lecturers, it was a census study while stratified random sampling technique was use to select 86 final year students. Hence, the sample for the study was 117 respondents (Lecturers = 31; Students = 86). The instrument for data collection was a self-structured questionnaire tagged “Strategies for Enhancing Technical Vocational Education and Training Digital Learning Questionnaire (SETVETDLQ)”. The instrument was design in the pattern of Modified rating scale of

agreement of Strongly Agree (SA), Agree (A), Disagree (D) and Strongly Disagree (SD) with numerical values of 4, 3, 2 and 1 respectively. The instrument was validated by three experts; two in Industrial /Technology Education from Rivers State University, Port Harcourt and one in Measurement and Evaluation from University of Port Harcourt. For reliability of the instrument, the instrument was piloted on 6 lecturers and 16 students selected through simpler random sampling technique that were not part of the study. The reliability coefficient of the instrument was established using and Pearson Product Moment Correlation. The instrument was collected and computed which yielded a reliability index of 0.83. Out of 31 and 86 copies of the instrument that were distributed to lecturers and students, only 106 copies (Lecturers = 31 and Students = 75) were completely filled and successfully retrieved and was used for analysis. This represents 91 percent Rate of Return (RoR). Data were analysed using descriptive statistics of mean for research questions while hypotheses were tested using z-test. Any item with a mean value that is equal to 2.50 and above was regarded as *Agree*(A) while item with mean value below 2.50 was regarded as *Disagree*(D). For the null hypotheses, the decision was that if the calculated value of z (z_{crit}) is equal to or greater than the critical value of z (z_{cal}), the null hypotheses was rejected but if the calculated value of z (z_{cal}) is less than the critical value of z (z_{crit}), the null hypotheses was accepted.

Results

The result of the study was presented as follows.

Research Question 1: How does adaptive technologies as a strategy enhance TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria?

Table 1: Mean Response of Respondents on How Adaptive Technologies Enhance TVET through Accessible and Inclusive Digital Learning Environments

S/N	Item Statement	X	SD	RMK	X	SD	RMK
1	Adaptive technologies provide equal learning opportunities for all learners.	3.21	0.68	A	3.61	0.70	SA
2	Adaptive technologies improve the accessibility of TVET programs for students with disabilities.	3.69	1.01	SA	3.04	0.62	A
3	The use of adaptive technologies in TVET	3.77	0.63	SA	3.73	0.57	SA

	enhances the engagement and participation of all students.						
4	Adaptive technologies help to customize learning experiences to meet individual student needs in TVET.	2.98	0.80	A	2.72	0.62	A
5	The integration of adaptive technologies in TVET facilitates better retention and understanding of technical concepts.	3.01	0.71	A	3.09	1.01	A
6	Adaptive technologies support flexible learning schedules and formats, making TVET more accessible.	3.10	0.83	A	3.83	0.66	SA
7	Adaptive technologies enhance the inclusivity of TVET by addressing diverse learning styles.	3.89	0.59	SA	3.01	0.76	A
	Average Mean	3.38	0.75	A	3.29	0.71	A

Source: *Researchers' Field Result, 2024*

Table 1 shows how adaptive technologies as a strategy for enhancing TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria. The result from Table 1 revealed that adaptive technologies as a strategy enhanced TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria through the inclusivity of TVET by addressing diverse learning styles, help to customize learning experiences to meet individual student needs in TVET, facilitates better retention and understanding of technical concepts, enhances the engagement and participation of all students and provide equal learning opportunities for all learners among others. This was shown in the response of teachers and students with an average mean of 3.38 and 3.29 which are higher than the cut-off mark of 2.50.

Research Question 2:How does universal design principles as a strategy enhance TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria?

Table 2: Mean Response of Respondents on How Universal Design Principles Enhance TVET through Accessible and Inclusive Digital Learning Environments

S/N	Item Statement	X	SD	RMK	X	SD	RMK
8	The use of universal design principles in TVET reduces barriers to education for students in rural and underserved areas.	3.30	0.86	A	3.11	0.70	SA

9	Universal design principles provide real-time feedback and assessments, improving learning outcomes in TVET.	3.61	0.60	SA	3.01	0.65	A
10	The implementation of universal design principles in TVET provides various learning styles and preferences, making learning more inclusive and interactive workforce in Nigeria.	3.08	0.77	A	3.80	1.01	SA
11	Universal design principles in TVET promote lifelong learning and continuous skill development.	2.90	0.82	A	3.59	0.71	SA
12	These principles allow educators to create adaptable content that meets the individual needs of students, supporting differentiated instruction and self-paced learning.	3.77	0.76	SA	2.73	0.83	A
13	The use of universal design principles in TVET supports collaborative learning and peer interaction.	3.16	1.01	A	3.09	0.71	A
14	Universally designed environments reduce barriers and enhance learning opportunities for students with diverse needs.	3.74	0.63	SA	3.41	0.50	A
	Average Mean	3.37	0.78	A	3.25	0.73	A

Source: *Researchers' Field Result, 2024*

Table 2 shows how the use of universal design principles as a strategy for enhancing TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria. The result from Table 2 revealed that universal design principles as a strategy enhanced TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria as universal design principles in TVET; reduces barriers to education for students in rural and underserved areas, reduce barriers and enhance learning opportunities for students with diverse needs, allow educators to create adaptable content that meets the individual needs of students, supporting differentiated instruction and self-paced learning and provides various learning styles and preferences, making learning more inclusive and interactive workforce in Nigeria among others. This was shown in the response of teachers and students with an average mean of 3.37 and 3.25 which are higher than the cut-off mark of 2.50.

Research Question 3: Inclusive teaching practices as a strategy for enhance TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria inclusive teaching?

Table 3: Mean Response of Respondents on How Teaching Practice Enhance TVET through Accessible and Inclusive Digital Learning Environments

S/N	Item Statement	X	SD	RMK	X	SD	RMK
15	The integration of inclusive teaching practicesin TVET foster greater student involvement and motivation, leading to improved educational outcomes.	3.64	0.84	SA	3.09	0.73	SA
16	Inclusive teaching practicesin TVET facilitate the acquisition of industry-relevant skills and competencies.	3.02	0.70	A	3.71	0.51	SA
17	Inclusive teaching practicesin TVET help to attract and retain students from diverse backgrounds.	3.33	0.61	A	3.80	0.60	SA
18	Digital learning platforms designed with inclusive practices ensure that content is accessible to all students, regardless of location.	3.28	0.58	A	3.51	1.01	SA
19	Inclusive teaching practicesin TVET encourage self-paced and independent learning among students.	3.81	0.81	SA	3.22	0.77	A
20	The use of inclusive teaching practicesfacilitates personalized and flexible learning experiences in TVET.	3.05	0.74	A	3.03	0.62	A
	Average Mean	3.36	0.70	A	3.39	0.72	A

Source: *Researchers' Field Result, 2024*

Table 3 shows how the use of inclusive teaching practices as a strategy for enhancing TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria. The result from Table 3 revealed that inclusive teaching practices as a strategy enhanced TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria as inclusive teaching practicesin TVET foster greater student involvement and motivation, leading to improved educational outcomes, facilitate the acquisition of industry-relevant skills and competencies, ensure that content is accessible to all students, regardless of location and facilitates personalized and flexible learning experiences

in TVET among others. This was shown in the response of teachers and students with an average mean of 3.36 and 3.39 which are higher than the cut-off mark of 2.50.

Statistical Test of Hypotheses

The following hypotheses were tested at 0.05 level of significance;

Hypothesis 1: There is no significant difference in the mean response of teachers and students on how the use of adaptive technologies as a strategy enhance TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria.

Table 4: z-Test Analysis on How the Use of Adaptive Technologies Enhance TVET Accessibility and Inclusivity of Digital Learning Environment

Categories	$\bar{X}$	SD	N	df	α	zcal	zcrit	Remark
Teachers	3.38	0.75	31	104	0.05	0.56	1.96	Accepted
Students	3.29	0.71	75					

Source: *Researcher's Field Result; 2024* Accept H_0 if $z_{cal} \leq z_{crit}$, Otherwise Reject H_0 .

Since the calculated value of z ($z_{cal}=0.56$) is less than the critical value of z ($z_{crit}=1.96$) at 0.05 level of significance, the null hypothesis was accepted. This implies that there is no significant difference in the mean response of teachers and students on how the use of adaptive technologies as a strategy enhance TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria.

Hypothesis 2: There is no significant difference in the mean response of teachers and students on how the use of universal design principles as a strategy enhance TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria.

Table 5: z-Test Analysis on How the Use of Universal Design Principles Enhance TVET Accessibility and Inclusivity of Digital Learning Environment

Categories	$\bar{X}$	SD	N	df	α	zcal	zcrit	Remark
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Teachers	3.37	0.78	31					
				104	0.05	0.72	1.96	Accepted
Students	3.25	0.73	75					

Source: *Researcher's Field Result; 2024* Accept Ho if $z_{cal} \leq z_{crit}$, Otherwise Reject Ho.

Since the calculated value of $z(z_{cal}=0.72)$ is less than the critical value of $z(z_{crit}=1.96)$ at 0.05 level of significance, the null hypothesis was accepted. This implies that there is no significant difference in the mean response of teachers and students on how the use of universal design principles as a strategy enhance TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria.

Hypothesis 3: There is no significant difference in the mean response of teachers and students on how the use of inclusive teaching practices as a strategy enhance TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria.

Table 6: z-Test Analysis on How the Use of Inclusive Teaching Practices Enhance TVET Accessibility and Inclusivity of Digital Learning Environment

Categories	$\bar{X}$	SD	N	df	α	z_{cal}	z_{crit}	Remark
Teachers	3.36	0.70	31					
				104	0.05	-0.20	1.96	Accepted
Students	3.99	0.72	75					

Source: *Researcher's Field Result; 2024* Accept Ho if $z_{cal} \leq z_{crit}$, Otherwise Reject Ho.

Since the calculated value of $z(z_{cal}=-0.20)$ is less than the critical value of $z(z_{crit}=1.96)$ at 0.05 level of significance, the null hypothesis was accepted. This implies that there is no significant difference in the mean response of teachers and students on how the use of inclusive teaching practices as a strategy enhance TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria.

Discussion of Findings

Result from Table 1 revealed that adaptive technologies as a strategy enhanced TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria through the inclusivity of TVET by addressing diverse learning styles, help to customize learning experiences to meet individual student needs in TVET, facilitates better retention and understanding of technical concepts, enhances the engagement and participation of all students and provide equal learning opportunities for all learners among others. This was shown in the response of teachers and students with an average mean of 3.38 and 3.29 which are higher than the cut-off mark of 2.50. The finding of this study is in line with Mayer (2009) as asserted that adaptive technologies such as multimedia learning enhance understanding and retention of complex concepts, which is particularly beneficial in vocational education.

Result from Table 2 revealed that universal design principles as a strategy enhanced TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria as universal design principles in TVET; reduces barriers to education for students in rural and underserved areas, reduce barriers and enhance learning opportunities for students with diverse needs, allow educators to create adaptable content that meets the individual needs of students, supporting differentiated instruction and self-paced learning and provides various learning styles and preferences, making learning more inclusive and interactive workforce in Nigeria among others. This was shown in the response of teachers and students with an average mean of 3.37 and 3.25 which are higher than the cut-off mark of 2.50. The finding of this study corroborates with CAST (2018) and Meyer, Rose and Gordon (2014) who found that universally designed environments reduce barriers and enhance learning opportunities for students with diverse needs.

Table 3 shows how the use of inclusive teaching practices as a strategy for enhancing TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria. The result from Table 3 revealed that inclusive teaching practices as a strategy enhanced TVET through accessible and inclusive digital learning environments as pathways for national development in Nigeria as inclusive teaching practices in TVET foster greater student involvement and motivation, leading to improved educational outcomes, facilitate the acquisition of industry-relevant skills and competencies, ensure that content is accessible to

all students, regardless of location and facilitates personalized and flexible learning experiences in TVET among others. This was shown in the response of teachers and students with an average mean of 3.36 and 3.39 which are higher than the cut-off mark of 2.50. The finding of this study is in corroboration with Tobin and Behling (2018) as stressed that inclusive teaching practices foster greater student involvement and motivation, leading to improved educational outcomes. The finding is also in consistent with that of Ally and Samaka (2013) and UNESCO (2018) whose research highlights the role of digital inclusion in bridging educational gaps and promoting equity.

Conclusion

The study concludes that adoption of various strategies enhanced Technical Vocational Education and Training (TVET) through accessible and inclusive digital learning environment as pathways to national development in Nigeria. The findings of this study shows that adoption of adaptive technologies, use of universal design principles and the use of inclusive teaching practices in as strategies enhanced TVET through accessible and inclusive digital learning environments and hence a pathway to national development in Nigeria.

Recommendations

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

1. Encouraging collaborations between government, private sector, and international organizations to invest in building robust digital infrastructure and provide resources, funding, and technical support for adoption of adaptive technologies initiatives in TVET.
2. Government should formulate and implement policies that promote digital learning environment and ensure the provision of facilities for universal design principles for all teachers and learners of TVET programs.
3. Government and stakeholders of TVET should ensure proper implementation of comprehensive professional development programs to enhance the digital literacy and pedagogical skills of TVET educators.

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