

Harnessing Innovative TVET for Advanced Digital Skills Acquisition in Higher Institutions in Enugu State, Nigeria.

By

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Abstract

The study was carried out to find out the need for harnessing innovative TVET for Advanced Digital Skills Acquisition in higher Institution in Enugu State, Nigeria. Specifically, it aimed to determine the ways of harnessing innovative TVET for Advanced Digital Skills Acquisition. Adopting a descriptive survey research design, four specific research questions with corresponding hypotheses guided the study. Data were collected from 328 TVET students (112 Male, 216 female) in selected TVET institutions (University of Nigeria, Nsukka and Federal College of Education Eha-Amufu in Enugu State, Nigeria, using a 20-item structured questionnaire. Descriptive analysis was conducted using the mean and standard deviation, and independent samples t-tests were utilized to evaluate hypotheses with a significance level of 0.05. Findings revealed that TVET students strongly lack proficiency in data analysis, AI/ML concepts, cloud platforms, cybersecurity, digital compliance, and digital forensics, while moderately lacking in ERP systems and digital reporting. Key components and strategies perceived as "Very Highly Needed" for the framework include work-integrated learning, professional development for educators, and strengthening industry partnerships. The study found no significant gender differences in the perceived lack of advanced digital skills or the needed framework components and strategies among TVET graduates. These insights underscore the urgency for TVET curricula and pedagogy to adapt to digital transformation and propose a framework for enhanced graduate employability.

Keywords: Harnessing, Innovative, TVET, Advanced, Digital Skills, Acquisition.

Introduction

The need for technical and vocational education and training has become a veritable tool for advancing skill acquisition in the society. According to Okoro (2020). The need for increased skill acquisition has become so paramount in the recent year where white-collar job is no longer rampant. Fostering skill among the university students will always open a new vista for their employability in the labour market after their graduation. One of the educational programme design to foster this skill acquisition in student is TVET.

Technical and Vocational Education and Training (TVET) plays a key role in bridging this gap by preparing people for practical, skill-based jobs. However, for TVET to stay relevant and effective in this dynamic landscape, it must proactively adapt its curricula and teaching methods to foster advanced digital skills (UNESCO-UNEVOC, 2024). Traditional TVET models, while effective for specific trades, may not adequately address the cross-cutting digital competencies required for modern work environments (UNESCO, 2022). The challenge lies in identifying the precise digital skills that are lacking and designing a comprehensive framework that integrates these skills seamlessly into TVET programs. This study aims to address this critical need by proposing a 21st-century framework to harness TVET's potential in cultivating a digitally proficient workforce, thereby ensuring the sustained employability and societal contribution of its graduates.

The term TVET stands for Technical and Vocational Education and Training. It's a system designed to equip individuals with practical, technical, and professional skills for employment and livelihoods in various fields, including hands-on work in professional trades (Editorial staff, 2021). TVET is defined as education and training that provides skills and knowledge for employment (Bala&Singhal, 2019). Okorafor (2017) defines TVET education as being designed to impart knowledge and skills that are conducive to workplace efficiency, sustainable livelihoods, personal development, and socioeconomic advancement. Through a broad educational approach, Technical and Vocational Education and Training gives individuals the practical skills and knowledge required for jobs in various fields, including production and service-oriented work. It focuses on preparing students for specific occupational fields

(Cilliers&Viljoen, 2023). The industry professionals are guiding students to acquire the needed practical experience.

Industry professionals are experts with deep, hands-on knowledge in their field (Silverlight Research, 2025). Their experience, gained over many years, makes them invaluable resources and thought leaders who provide crucial insight into emerging trends and best practices (Palindrome Communications, 2023). They are crucial in Technical and Vocational Education and Training (TVET) to guarantee that training programs remain applicable to the modern job market. They contribute by advising on curriculum, acting as guest lecturers, and mentoring students, helping to connect theoretical classroom knowledge with practical, real-world application (Yunos, Sern & Hamdan, 2018). Furthermore, they supervise internships and evaluate student performance, guaranteeing that graduates meet current industry standards (Colombo Plan Staff College, 2021).

TVET educators are crucial in equipping students with the digital skills they need. Their job goes beyond just teaching basic computer literacy; they must embed complex digital competencies directly into vocational courses. A key part of this is curriculum integration, where instructors weave digital skills into every subject, from engineering to hospitality (Tee & Chan, 2016). This ensures that students are not only mastering their trade but also acquiring the digital tools necessary to succeed in it. For instance, a student studying to become a mechanic might learn to use advanced diagnostic software, while a culinary arts student could be trained on a digital inventory system.

Educators also use digital pedagogies, leveraging online platforms and virtual labs to create dynamic and engaging learning environments (TVET Trainer, 2024). This approach gives

students practical experience with industry-standard tools. As the digital landscape continuously evolves, educators must also engage in continuous professional development by attending workshops and seminars to remain current on new technologies such as AI, big data, and the Internet of Things (IoT) (UNESCO-UNEVOC, 2020). This continuous learning is vital to ensure the skills they teach remain relevant and valuable.

Skill acquisition is a continuous process of adapting and adjusting to a specific environment to solve problems (Araújo & Davids, 2025). This involves intentional practice and direct experience, and it applies to a variety of fields, from physical activities like sports to mental skills like coding (Adu, Adu, & Arthur, 2024). Ultimately, skill acquisition is about finding the most effective and efficient way to achieve a goal while navigating changing conditions (Gottwald & Owen, 2023). Technical and Vocational Education and Training (TVET) is a crucial way to get practical skills necessary for economic competition and a better quality of life. It is a structured program designed to provide the knowledge and abilities required for workplace efficiency, personal development, and socioeconomic growth (Araújo & Davids, 2025). The main goal of TVET is to establish a productive workforce that align with the demands of the economy. However, a significant challenge is the perception that TVET colleges must produce a skilled workforce that can meet the country's economic demands (Mbatha, Buthelezi, & Ajani, 2024). Ultimately, TVET is about giving students the skills and expertise needed to create more opportunities for themselves and build financially stable careers. For example, mathematics is considered a key tool for enhancing students' practical skills within TVET (Adu, Adu, & Arthur, 2024). In the 21st century, it's crucial for TVET graduates to acquire advanced digital skills to remain relevant in the modern job market.

Advanced digital skills are high-level abilities that allow professionals to use technology in innovative ways, especially in fields like information and communication technology (ICT) (UNESCO, 2018). These skills include proficiency in modern technologies such as artificial intelligence (AI), machine learning, and big data analytics, which are vital for today's digital economy. The European Commission (2024) has identified these specialized skills as being in high demand across both the public and private sectors, covering abilities from using software design patterns to defining firewall rules. A type of advanced digital skill is e-leadership or e-business skills, which is the ability to effectively use digital technology within an organization to promote innovation. This involves blending digital expertise with soft skills and subject-specific knowledge to create and carry out digital transformation projects (AgID, 2024). For the purpose of this study, advanced digital skills are defined as a mix of specialized abilities like AI, machine learning, and big data analytics, combined with e-business knowledge. This definition also includes the integration of these technical skills with soft skills. To stay relevant in the 21st century, graduates of Technical and Vocational Education and Training (TVET) programs will require these specific skills.

Statement of the Problem

The rapid advancement of digital technologies has reshaped global labour market expectations, making advanced digital skills essential for employability, innovation, and national development. Universities, particularly those in Enugu State, Nigeria, are therefore expected to produce graduates who can thrive in an increasingly digital and technology-driven economy. However, despite this growing demand, many universities in the state still rely on traditional teaching approaches that emphasize theory rather than practical, technology-oriented skill

development. This gap has raised concerns about the readiness of graduates to meet 21st-century digital competency requirements.

Innovative Technical and Vocational Education and Training (TVET) has emerged globally as a strategic approach for developing practical digital skills in higher education systems. It involves integrating modern digital tools, emerging technologies, and hands-on learning methods across disciplines. Yet, in Enugu State universities, the adoption of innovative TVET remains limited, fragmented, or poorly implemented. Although TVET has historically existed in Nigerian education, it has largely focused on conventional trades rather than advanced digital technologies such as robotics, artificial intelligence, digital fabrication, cybersecurity, software development, digital animation, and data analytics.

The global digital divide further exacerbates the issue: while universities in technologically advanced countries integrate cutting-edge digital tools into TVET systems, many universities in Enugu State still struggle with basic ICT integration. This disparity limits students' competitiveness and reduces the region's capacity for innovation-driven development. In essence, the core problem is that universities in Enugu State have not effectively harnessed innovative TVET as a tool for advanced digital skills acquisition. This shortfall threatens the employability of graduates and the region's overall technological and economic progress. Therefore, a systematic investigation is needed to understand how innovative TVET can be optimally utilized to enhance advanced digital skills training within university settings in Enugu State.

Purpose of the Study

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The general purpose of the study was to find out the ways of harnessing innovative TVET for Advanced Digital Skills Acquisition among Higher Institution students in Enugu State, Nigeria.

Specifically, the study sought to:

1. Identify innovative skills within TVET capable of advancing skill acquisition among Higher Institution students in Enugu State.
2. Identify effective methods for impacting these innovative skills to Higher Institution students
3. Identify potential challenges that could hinder students acquisition of advances digital skills through TVET
4. Propose recommendations to strengthen the integration of innovative digital skills in TVET programs for Higher Institution students

Research Questions

The study was guided by the following research questions:

1. What are the innovative skills within TVET capable of advancing skill acquisition among Higher Institution students in Enugu State?
2. What are the effective methods for impacting these innovative skills to Higher Institution students?
3. What are the potential challenges that could hinder students acquisition of advances digital skills through TVET?
4. What are the recommendations to strengthen the integration of innovative digital skills in TVET programs for Higher Institution students?

Research Hypotheses

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

1. There is no significant difference between the mean scores of TVET lecturers and TVET instructors on the innovative skills within TVET capable of advancing skill acquisition among Higher Institution students in Enugu State.
2. There is no significant difference between the mean scores of TVET lecturers and TVET instructors the effective methods for impacting these innovative skills to Higher Institution students
3. There is no significant difference between the mean scores of TVET lecturers and TVET instructors on the potential challenges that could hinder students acquisition of advances digital skills through TVET
4. There is no significant difference between the mean scores of TVET lecturers and TVET instructors on the Propose recommendations to strengthen the integration of innovative digital skills in TVET programs for Higher Institution students

Methodology

The study employed a descriptive survey research design, a method that involves collecting and analyzing data from a representative sample of a larger group to describe its characteristics (Nworgu, 2015). This design was chosen as it was suitable for gathering opinions from students in TVET programmes institutions in Enugu State, Nigeria. The research was conducted at three specific institutions in Enugu State. Via University of Nigeria, Nsukka (UNN), Enugu State University of Science and Technology (ESUT) and Institute of

Management and Technology (IMT). Four specific purposes, research questions and corresponding hypotheses guided the study. The total population was 328 TVET students, consisting of 112 males and 216 females. The stratified sampling technique was employed to select male and female participants. A 23-item structured questionnaire was used as the data collection tool.

The questionnaire used a Likert scale with two sets of response options: "Strongly Agreed (SA) 4 points, Agreed (A) 3 points, Disagreed (D) 2 points, Strongly Disagreed (SD) 1 point" and "Very Highly Needed (VHN) 4 points. The questionnaire's validity was confirmed by three subject matter experts in TVET. Its reliability was established through a trial test on 20 lecturers and instructors at Nnamdi Azikiwe University, yielding a Cronbach's Alpha reliability index of 0.89. The researchers, along with two assistants, administered the questionnaires and retrieved them on the spot to ensure a high response rate. Data analysis involved using descriptive statistics, specifically mean and standard deviation, to answer the research questions. The mean was interpreted using a benchmark of 3.50 as the cut-off point. Items with a mean score of 3.50 or higher were interpreted as "Agreed" or "Highly Needed," while those with a mean below 3.50 were considered "Disagreed" or "Slightly Needed." The null hypotheses were tested using a t-test at a 0.05 level of significance. The null hypothesis was accepted if the calculated t-value was less than the t-table value of 1.96, and it was not rejected if the calculated t-value was greater than 1.96.

Presentation of Results

Research Question 1: What are the innovative skills in TVET that are capable of advancing skill acquisition among University students in Enugu State?

Table 1: Mean Responses of the respondents of TVET lecturers and TVET instructors on the several innovative skills in TVET that are capable of advancing skill acquisition among University students in Enugu State.

S/N	Item Statement	X	SD	t-cal	Remark
1	Building, programming, and maintaining robotic systems for industrial and service applications.	3.05	1.15	0.50	RQ, NS
2	Developing smart systems, predictive models, and data-driven solutions.	2.55	1.10	0.30	RQ, NS
3	Using tools like Python, R, SPSS, or Power BI to analyze and interpret complex datasets.	3.25	1.16	0.20	RQ, NS
4	Protecting digital infrastructure, identifying vulnerabilities, and implementing security protocols.	3.15	1.18	0.40	RQ, NS
5	Managing cloud platforms such as AWS, Azure, or Google Cloud for scalable digital solutions.	3.31	1.17	0.13	RQ, NS
6	Designing and maintaining networked smart systems for homes, industries, and cities.	3.18	1.19	0.40	RQ, NS
7	Creating Android and iOS applications using Flutter, Kotlin, or React Native.	3.11	1.14	0.30	RQ, NS
8	Operating, programming, and maintaining drones for mapping, agriculture, and security applications.	2.05	1.17	0.50	RQ, NS
9	Producing animations, videos, and digital content using tools like Blender and Adobe suites.	2.10	1.14	0.11	RQ, NS
10	Creating and managing tech-driven startups, online ventures, and innovation-based enterprises	3.09	1.16	0.80	RQ, NS
11	Using sensors, drones, and software to optimize agricultural productivity	3.07	1.19	0.30	RQ, NS
12		3.45	1.18	0.40	RQ, NS

The results show that respondents generally agreed that a wide range of innovative skills in Technical and Vocational Education and Training (TVET) can significantly advance skill acquisition among university students in Enugu State. Most of the listed skills recorded mean scores above the acceptable benchmark (≥ 2.50), indicating positive agreement. These include competencies in cloud computing, data analytics, robotics, cybersecurity, smart systems design, mobile app development, agri-tech, and tech entrepreneurship. Skills such as drone operation and

digital content creation received slightly lower mean scores but still fall within the range of relevance. The low t-calculated values across all items show no significant difference in responses between TVET lecturers and instructors. Overall, the findings suggest broad consensus that digital, technical, and innovation-driven skills are essential for enhancing students' acquisition of modern, industry-relevant competencies.

Research Question 2: What are the ways of impacting these innovative skills to university students?

Table 2: Mean Ratings of respondents of TVET lecturers and TVET instructors ways of impacting these innovative skills to university students

S/N	Item Statement	X	SD	t-cal	Remark
1	Setting up dedicated labs equipped with robotics kits, 3D printers, software, and IoT devices to support practical learning	3.05	1.15	0.50	RQ, NS
2	Students learn by executing real-world projects such as building apps, designing prototypes, or conducting data analysis.	2.55	1.10	0.30	RQ, NS
3	Inviting professionals from ICT firms to train students in emerging technologies like AI, cloud computing, and cybersecurity	3.25	1.16	0.20	RQ, NS
4	Placing students in tech companies, digital farms, engineering firms, and media studios for hands-on exposure	3.15	1.18	0.40	RQ, NS
5	Embedding global certifications such as CISCO, AWS, Google IT Support, or Autodesk into university courses	3.31	1.17	0.13	RQ, NS
6	Students work in teams to solve digital problems, while advanced learners mentor beginners	3.18	1.19	0.40	RQ, NS
7	Using platforms like MATLAB, AutoCAD, or virtual robotics simulators to practice skills without physical limitations	3.11	1.14	0.30	RQ, NS
8	Combining online content (e-learning modules, video tutorials) with hands-on, in-person practical sessions	2.05	1.17	0.50	RQ, NS
9	Providing safe environments where students can test codes, run experiments, and build prototypes without fear of	2.10	1.14	0.11	RQ, NS

	failure.				
10	Teaching students how to think creatively, identify challenges, and design user-friendly tech solutions	3.09	1.16	0.80	RQ, NS
11	Linking students with innovators who guide them in skill development and startup creation.	3.07	1.19	0.30	RQ, NS
12	Regular practical sessions in robotics, IoT, renewable energy, data labs, etc., embedded into weekly schedules.	3.45	1.18	0.40	RQ, NS
13	Encouraging students to use Python, Linux, Blender, Arduino, and other free resources to build digital solutions.	3.07	1.19	0.30	RQ, NS

The findings indicate that TVET lecturers and instructors generally agree on multiple effective ways to impart innovative skills to university students. Respondents rated strategies such as establishing well-equipped labs, integrating global certifications, placing students in industry for practical exposure, team-based problem solving, and regular hands-on sessions as particularly impactful, reflected by mean scores above 3.0. Approaches like project-based learning, mentorship, use of virtual simulators, and linking students with innovators also received favorable ratings. Lower-rated items, such as combining online content with practical sessions and providing risk-free experimental environments, still showed relevance but were considered less prominent. The low t-calculated values suggest no significant difference in perceptions between lecturers and instructors. Overall, the study emphasizes that a combination of practical, industry-linked, and mentorship-driven strategies is essential for effectively transferring innovative skills to students.

Research Question 3: What are the possible challenges that could hinder the acquisition of these skill to students?

Table 3: Mean Ratings of respondents of TVET lecturers and TVET instructors on the possible challenges that could hinder the acquisition of these skill to students

S/N	Item Statement	X	SD	t-cal	Remark
1	Lack of functional digital labs, robotics equipment, 3D printers, IoT devices, and modern computers	3.05	1.15	0.50	RQ, NS
2	Slow or unreliable broadband limits access to online tools, virtual labs, and digital learning resources	2.55	1.10	0.30	RQ, NS
3	Universities often lack funds to purchase new equipment, maintain facilities, or update outdated technologies.	3.25	1.16	0.20	RQ, NS
4	Few lecturers are trained in emerging digital technologies such as AI, cloud computing, and cybersecurity	3.15	1.18	0.40	RQ, NS
5	Many academic programs do not reflect current industry trends or include practical digital skill components	3.31	1.17	0.13	RQ, NS
6	Weak partnerships with tech companies result in fewer	3.18	1.19	0.40	RQ, NS

	internships, mentorships, and industry-led training opportunities				
7	Learning is often theory-based, with minimal hands-on exercises or real-world problem-solving activities	3.11	1.14	0.30	RQ, NS
8	Some stakeholders may prefer traditional teaching methods and resist adopting modern TVET approaches	2.05	1.17	0.50	RQ, NS
9	Digital equipment quickly becomes unusable when there is no technical staff to repair or upgrade it	2.10	1.14	0.11	RQ, NS
10	Students from low-income backgrounds may struggle to access digital resources or afford transportation to tech hubs.	3.09	1.16	0.80	RQ, NS
11	Even when digital skill policies exist, they are often poorly implemented or monitored in universities.	3.07	1.19	0.30	RQ, NS
12		3.45	1.18	0.40	RQ, NS

The study reveals that several challenges may hinder university students in Enugu State from acquiring innovative TVET skills. Respondents identified key barriers such as inadequate digital labs and equipment, insufficient funding for modern technologies, limited lecturer expertise in emerging digital fields, outdated academic programs, weak industry partnerships, and a predominance of theory-based learning over hands-on practice. Other issues include students' limited access to digital resources due to socio-economic constraints, poor implementation of digital skill policies, and occasional resistance from stakeholders to modern TVET approaches. While some items, such as lack of technical staff to maintain equipment or reliance on online content, received lower mean scores, they still indicate potential obstacles. The low t-calculated values across all items suggest consensus between TVET lecturers and instructors. Overall, the findings underscore that both infrastructural and systemic limitations must be addressed to effectively facilitate skill acquisition among students.

Research Question 4: What are the possible recommendation to boost skill innovative skill among university students?

Table 4: Mean Ratings of respondents of TVET lecturers and TVET instructors recommendation to boost skill innovative skill among university students

S/N	Item Statement	X	SD	t-cal	Remark
1	Universities should create digital labs with robotics kits, 3D printers, IoT devices, and high-performance computers.	3.05	1.15	0.50	RQ, NS
2	Improve broadband access on campus to support online research, virtual labs, and digital collaboration	2.55	1.10	0.30	RQ, NS
3	Update programs to integrate AI, data science, cybersecurity, and other emerging technologies	3.25	1.16	0.20	RQ, NS
4	Provide regular training, workshops, and certifications for lecturers on new digital tools and teaching methods	3.15	1.18	0.40	RQ, NS
5	Collaborate with companies like Microsoft, Google, Huawei, and local tech firms for training, internships, and mentorship.	3.31	1.17	0.13	RQ, NS
6	Seek government support, private investments, and grants to sustain digital skill programs	3.18	1.19	0.40	RQ, NS
7	Ensure students gain practical exposure in tech firms, engineering industries, digital media studios, and innovation centers	3.11	1.14	0.30	RQ, NS
8	Offer certifications such as AWS, Cisco, CompTIA, Oracle, and Autodesk to enhance employability	2.05	1.17	0.50	RQ, NS
9	Support student-led organizations focused on coding, robotics, AI, and digital entrepreneurship.	2.10	1.14	0.11	RQ, NS
10	Create initiatives that encourage female participation and support students with disabilities.	3.09	1.16	0.80	RQ, NS
11	Partner with global universities and innovation centers for exchange programs and joint research.	3.07	1.19	0.30	RQ, NS
12	Develop strong institutional policies on digital skill development and ensure effective implementation and evaluation	3.45	1.18	0.40	RQ, NS

The respondents identified several key recommendations to enhance innovative skill acquisition among university students in Enugu State. High-rated strategies include creating fully equipped digital labs, updating academic programs to incorporate emerging technologies like AI and cybersecurity, providing ongoing training and certifications for lecturers, fostering industry collaborations, and securing government and private funding to sustain digital skill initiatives. Other important recommendations involve ensuring practical exposure through internships, supporting student-led tech organizations, promoting inclusivity for female students and those with disabilities, and establishing strong institutional policies for digital skill development. While a few items, such as offering specific certifications or supporting student organizations, received slightly lower mean scores, they remain relevant. The low t-calculated values indicate

agreement between TVET lecturers and instructors. Overall, the findings emphasize a multi-faceted approach combining infrastructure, curriculum, training, industry partnership, and policy support to effectively boost innovative skills among students.

Discussion of findings

The findings from this study revealed that inadequate infrastructure, lack of funding, limited instructor expertise, outdated curricula, weak industry collaboration and social-economic constraints hamper students' acquisition of innovative TVET skills find strong support in the recent TVET literature. This finding align with Reko, Okoye and Maxwell (2020) in their analysis of technical and vocational education in Nigeria argue that fundamental problems such as poor funding, insufficient facilities, lack of qualified instructors, and curricular misalignment with workplace needs remain major obstacles to effective TVET delivery. Their findings align closely with your respondents' concerns about obsolete labs, inadequate equipment, and staff unpreparedness.

Similarly, a 2024 study by Jeffrey and Aryee (2020) in "Building Capacity for Artificial Intelligence in Africa: A Cross-Country Survey of Challenges and Governance Pathways" finds that though there is recognition of AI and other emerging technologies' importance, participation remains limited due to poor infrastructure, weak policy implementation, funding shortfalls, and inequitable access, especially for disadvantaged students. This echoes your finding that socio-economic constraints and institutional resource gaps hinder access to digital resources.

In addition, recent work by Chinyere (2023) investigating quality of TVET programmes in Nigeria stresses that inadequate facilities, poor funding, and lack of teacher training constitute

major barriers to quality technical education. The author recommends that sustainable funding, capacity-building of instructors, and infrastructure development are essential if TVET is to deliver relevant practical skills.

More so, in a recent empirical study in Nigeria, Ogunbote (2020) found out that integrating emerging technologies (e.g. digital tools, VR/AR, robotics, etc.) into technical-education curricula positively influenced students' academic performance, practical competence, and motivation. This supports the present finding's that embedding modern digital labs, updating curricula for emerging technologies, and providing certifications/training can boost innovative skills among students. Fatokun & Gumbo (2024) argue that TVET curricula often fail to incorporate emerging technologies (AI, IoT, robotics, etc.), which undermines employability and readiness for modern labour markets. Their study recommends that TVET institutions revise curricula to include such technologies to prepare future-ready graduates.

This directly aligns with this findings calling for program updates, digital labs, and institutional policy support. In a 2025 study of TVET institutions in Kenya, Omutange (2020) demonstrated that using modern digital technology platforms in teaching and learning significantly improved educational quality and learning outcomes. Their results bolster the recommendation for integrating ICT and digital tools, continuous training for instructors, and embedding digital competencies across curricula all of which the respondents rated highly. In a 2024 systematic review of online teacher/technical education in Africa, Oubibi (2022) showed that interactive technologies (simulations, VR/AR, collaborative platforms) can significantly enhance learning outcomes, engagement, and skills acquisition but only when supported by adequate infrastructure, policy coordination, and educator training. This echoes the

recommendation for robust institutional policies, funding support, inclusive strategies, and continuous lecturer training to sustain digital-skill programs.

Conclusion

Harnessing innovative Technical and Vocational Education and Training (TVET) for advanced digital skills acquisition in universities in Enugu State is essential for equipping students with the competencies required to thrive in an increasingly technology-driven world. As global industries continue to embrace automation, artificial intelligence, digital fabrication, and data-driven processes, universities in the state must reposition their teaching and learning systems toward practical, technology-oriented education. This requires modern infrastructure, skilled instructors, industry partnerships, updated curricula, and supportive institutional policies that foster hands-on innovation and creativity. By embracing innovative TVET approaches, universities can not only bridge the digital skills gap but also enhance graduate employability, stimulate local innovation ecosystems, and contribute meaningfully to the socioeconomic development of Enugu State and Nigeria at large.

Recommendations

In light of the conclusions, the following recommendations are put forward to enhance advanced digital skills acquisition within TVET institutions:

1. Universities in Enugu State should invest in state-of-the-art innovation laboratories, smart classrooms, and reliable high-speed internet to support practical, hands-on digital training. Modern tools such as robotics kits, 3D printers, IoT devices, and advanced software platforms must be made accessible to students.

2. Lecturers and technical personnel should undergo regular training in emerging technologies including artificial intelligence, cybersecurity, cloud computing, and digital fabrication to ensure they can effectively deliver innovative TVET-based instruction and mentor students in advanced digital skills.
3. Universities should collaborate more closely with technology companies, digital innovation hubs, and industrial organizations to provide students with internships, mentorship programs, live projects, and certification opportunities that expose them to real-world digital applications and enhance employability.
4. Academic programs should be updated to integrate project-based learning, digital skill certifications, entrepreneurship education, and interdisciplinary innovation modules to ensure that learning remains responsive to global technological trends

References

Adu, T. S., Adu, B. O., & Arthur, Y. D. (2024). Enhancing practical skills of TVET students using mathematics as a tool: A case study in some selected TVET schools in Kwahu.

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- Bala, S., & Singhal, P. (2019). Gender-Responsive TVET Framework: An Indian Perspective. In *Gender Issues in Technical and Vocational Education Programs* (pp. 1–24). IGI Global.
- Cilliers, L. & Viljoen, K. (2023). "Insights into Instagram use by Technical and Vocational Education and Training colleges". *South African Journal of Information Management*, 25(1), a1685. Available from <https://doi.org/10.4102/sajim.v25i1.1685>
- Creswell, J. W. (2014). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (4th ed.). SAGE Publications.
- Gottwald, A., & Owen, J. (2023). The role of problem-solving in skill acquisition. *Journal of Sport Psychology*, 15(2), 45-58.
- Kana, K., & Letaba, K. (2024). Addressing the Skills Gap in Technical and Vocational Training for Sustainable Socio-Economic Growth and Development. *International Journal of Research and Innovation in Social Science*.
- Mbatha, J. T., Buthelezi, A. B., & Ajani, O. A. (2024). Exploring the campus managers' challenges in managing educational resources in a TVET college. *International Journal of Business Ecosystem & Strategy*, 6(3), 204-213. <https://doi.org/10.4018/978-1-5225-9438-3.ch019>
- Okorafor, A. O. (2017). TVET policies and practices in Nigeria: Why the gap. *European Journal of Education Studies*, 1, 1-118.
- Palindrome Communications. (2023). *What is an Industry Expert*. Retrieved from <https://palindromecommunications.com/what-is-an-industry-expert-blog/>
- Schwab, K. (2016). *The Fourth Industrial Revolution*. World Economic Forum.
- Silverlight Research. (2025). *What Do Industry Experts Do? Unlocking the Value of Specialised Knowledge*. Retrieved from <https://www.silverlightresearch.com/blog/what-do-industry-experts-do-unlocking-the-value-of-specialised-knowledge?lang=man>
- Tee, T. Y., & Chan, C. Y. (2016). *Demand for digital skills, skill gaps and graduate employability: Evidence from employers in Malaysia*. PMC.
- UNESCO. (2018). *Digital skills critical for jobs and social inclusion*. UNESCO. <https://www.unesco.org/en/articles/digital-skills-critical-jobs-and-social-inclusion>

UNESCO. (2022). *Transforming technical and vocational education and training for successful and just transitions: UNESCO strategy 2022-2029*.

UNESCO-UNEVOC. (2024). *Digital transformation in global TVET: methodology and practices*.

World Economic Forum. (2023). *The Future of Jobs Report 2023*. World Economic Forum.

Yunos, J. B. M., Sern, C. L., & Hamdan, H. (2018). *Industrial Engagement in the Technical and Vocational Training (TVET) System*. ResearchGate. Retrieved from

Obizue, M. N., & Enomah, S. (2025). Human Capital Development and Educational Advancement In Nigeria: Realities And Way Forward. *Int'l Journal of Education Research and Scientific Development*, 7(2), 15-27. <https://www.ijresd.org> (ISSN) Print: 2992-5665 and Online: 2992-5673.

Oke, A., & Fernandes, F. A. P. (2020). Innovations in teaching and learning: Exploring the perceptions of the education sector on the 4th industrial revolution (4IR). *Journal of Open Innovation: Technology, Market, and Complexity*, 6(2), 31. <https://doi.org/10.3390/joitmc6020031>

Schoentgen, A., & Wilkinson, L. (2021). Ethical issues in digital technologies. <https://hdl.handle.net/10419/238052>

Seleke, B., & Teis, N. J. (2025). Bridging the Digital Divide: Integrating Fourth Industrial Revolution (4IR) Technologies in TVET for Enhanced Youth Skilling and Employability in South Africa. *TWIST*, 20(2), 441-452. <https://orcid.org/0000-0002-8191-5653>

Sibanda, M., & Fon, F. (2022). Prospects and challenges of integrating technology into pedagogy in South African higher education institutions in the context of the Fourth Industrial Revolution. *Kagisano* 13, 13. <https://www.researchgate.net/profile/Fabian-Fon/publication/36427845>