EXPLORING THE CONTRIBUTIONS OF INSTITUTIONAL-BASED TVET IN ACQUISITION OF ELECTRICAL/ ELECTRONICS SKILL FOR SUSTAINABLE DEVELOPMENT IN NIGERIA

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Abstract
Institutional-based Technical and Vocational Education and Training (TVET) is crucial in providing individuals with practical skills in various technical field including electrical and electronics technology, which are required for Nigeria's Sustainable development success. Besides, the demand for competent skilled professionals in the electrical/electronics field is increasing due to advancement in technology. Hence, this paper explores the contributions of institutional-based technical and vocational education in acquisition of electrical/electronics skill for sustainable development in Nigeria. The paper argues that TVET programs provide hands-on training, industry-relevant curricula, and sophisticated laboratory facilities to help students improve their electrical installation, automation, and electronic system maintenance skills. These skills help to drive economic growth by lowering unemployment, encouraging entrepreneurship, and ensuring the availability of a trained workforce for national development. Despite its importance, TVET in Nigeria confronts obstacles such as insufficient funding, outdated equipment, minimal industrial collaboration among others. To sustain TVET impacts, the study concluded and recommended that funding, collaboration with private-sector and improved infrastructure can help increase skill acquisition and sustainability. Also, TVET curriculum should regularly be updated to correspond with industry demands and worldwide best practices alongside with regular professional development for instructors to stay up-to-date on instructional techniques and technology

Keywords: Institutional-Based (TVET), Electrical/Electronics, Sustainable Development

Introduction

Technical and Vocational Education and Training (TVET) institutes plays an important role in providing individuals with essential electrical and electronics skills, thereby fostering sustainable development in Nigeria. By providing practical and industry-relevant training, these institutes help to meet the critical need for competent workers in electrical and electronics sectors, which are important to the country's economic growth and technical improvement. TVET's ability to improve human capital emphasizes its importance in achieving sustainable development. Edwin and Stella (2016), pointed out that advancing TVET promotes human capital development, which is necessary for national progress. Similarly, Igberaharha (2021) in a study reported that enhancing the quality of TVET is vital for long-term growth since it assures that the workforce is knowledgeable and capable of satisfying business demands. Furthermore, Udoka and Owodiong (2024) emphasize the importance of developing renewable energy abilities among electrical/electronic engineering

students in order to shift to a sustainable green economy.

In Nigeria, where there is a pressing need for sustainable industrialization, improving electrical/electronics skill development among students is imperative. Njoku and Ewe (2024) contend that providing students with practical skills in this field is essential for long-term industrial development. Furthermore, Osuyi and Mochi (2023) explore the function of TVET as a tool for productivity and sustainable development, emphasizing its value in job creation and poverty reduction. Thus, exploring the contributions of institutional-based TVET in the acquisition of electrical/electronics skills is crucial for understanding its impact on sustainable development in Nigeria.

Overview of Technical and Vocational Education and Training (TVET)

TVET encompasses formal, non-formal, and informal learning that prepares people for specialized trades, crafts, and professions at various educational levels. According to UNESCO (2019), TVET is an important driver of economic growth since it addresses skill gaps, expands employment prospects, and encourages entrepreneurship. Many developing countries, like Nigeria, sees TVET as a critical tool for industrialization, economic diversification, and poverty alleviation. It teaches practical skills that promote self-sufficiency, employment development, and technical growth (Okolie & Asfa, 2017). Despite its relevance, TVET is facing several challenges among which are insufficient finance, obsolete curricula, and a lack of industry participation, which limit its effectiveness.

According to the International Labour Organization (ILO, 2021), TVET is essential for improving workforce adaptability and productivity, particularly in areas that require specialized skills. Countries like Germany, Finland, and South Korea have shown that a strong TVET system leads to a trained work force, decreased unemployment rates, and increased economic production (OECD, 2022). However, in Nigeria, the TVET sector has suffered from underfunding, societal stigma, and little industry participation (UNESCO-UNEVOC, 2013). Addressing these difficulties would necessitate broad policy changes, increased investment, and improved collaboration between educational institutions and companies. According to the European Commission (2021), countries with a strong TVET framework, such as Switzerland and Australia, have higher productivity rates due to a focus on practical, skills-based education.

Additionally, TVET is critical in lowering youth unemployment, which remains a major concern in many African nations (Michael, Florence, & Damon 2022). Expanding TVET accessibility, upgrading training infrastructure, and incorporating digital literacy into TVET courses are crucial to maximize its impact on economic development.

Concept of Institutional-Based Technical and Vocational Education

Institutional-based TVET is defined as structured technical education given by formal educational institutions such as technical colleges, polytechnics, and universities. These institutions are in charge of training skilled workers for a variety of industries through curriculum-based learning that combines theoretical knowledge and practical practice (Ogunode, Niyi,

Abigeal & Lydia, 2020). Institutional-based TVET varies from informal and apprenticeship-based learning in that it adheres to nationally accepted standards and provides formal certificates such as National Diplomas (ND) and Higher National Diplomas (HND). The effectiveness of institutional-based TVET is determined by the quality of curriculum delivery, the availability of current training equipment, and industry partnerships for real-world experience. Countries with strong TVET systems, such as Germany and South Korea, have effective institutional-based training models that are industry-driven and competency-based.

Ibrahim, Jacob, and Aina (2023) found that effective institutional-based TVET requires a framework that connects curricular material with growing industry norms. This entails incorporating digital technologies, environmental practices, and new trends like artificial intelligence and robotics into technical education. Also, studies show that combining competency-based learning and work-integrated training improves students' employability and productivity in the job market (Michael, Florence, & Damon 2022). Moreover, current institutional-based TVET uses blended learning methodologies such as e-learning platforms, virtual laboratories, and simulation-based training to improve technical skill development (Mohammed, 2022). Furthermore, some literatures have revealed that nations with dual training systems in which students mix classroom instruction with practical industrial training experience lower skill mismatches and higher labor readiness. To strengthen Nigeria's institutional TVET, policies supporting digital inclusiveness, investment in contemporary facilities, and increased industry-academic collaboration are required.

The Role of Electrical/Electronics Skills in Sustainable Development

Electrical and electronic skills are essential in many industries, including energy, telecommunications, automation, and manufacturing. These abilities help to ensure economic sustainability by encouraging technological innovation, efficient electricity consumption, and industrial expansion (Mohammed, 2022). In terms of sustainable development, electrical/ electronics training is important for advancing renewable energy technologies, smart grids, and energy-efficient systems. For example, the increasing demand for solar and wind energy solutions need a workforce specialized in electrical/electronics engineering to install, maintain, and repair these devices (Tawalbeh, Murtaza, Al-Othman, Alami, Singh, & Olabi, 2022).

Furthermore, competent electrical and electronics workers are required for the Fourth Industrial Revolution (4IR), which is largely based on automation, robots, and Internet of Things (IoT) applications. Developing expertise in these sectors boosts national competitiveness, lowers dependency on foreign technologies, and offers high-value job opportunities. A research by the World Bank (2020) underlines the relevance of technical skills in reaching the United Nations Sustainable Development Goals (SDGs), particularly in energy efficiency, green technology adoption, and industrial innovation. Nigeria's shift to a knowledge-based economy involves improving TVET programs to generate highly trained electrical/electronics professionals

capable of solving contemporary technology issues.

Furthermore, electrical/electronics TVET is critical for sustainable infrastructure development because it ensures efficient power distribution networks, smart city technologies, and eco-friendly industrial systems. Government and the corporate sector should work together to develop specialized TVET programs focused on growing electrical/electronics fields including energy storage technology and automation engineering.

Curriculum and Training Standards in Electrical/Electronics TVET

The curriculum and training standards of Electrical/Electronics under the umbrella of Technical and Vocational Education and Training (TVET) are pivotal in educating students to meet industry demands. According to Aniedi and Caleb (2017), a good TVET curriculum must be competency-based, incorporating both theoretical knowledge and practical skills. Curriculum standards in Nigeria are regulated by the National Board for Technical Education (NBTE), which ensures alignment with worldwide benchmarks (NBTE 2016).

A typical electrical/electronics TVET curriculum covers the:

- fundamentals of electricity and electronics, including circuit theory, Ohm's law, and electronic components.
- Power Systems and Energy Management: Research on electrical power generation, distribution, and alternative energy sources.
- automation and control systems, including Knowledge of programmable logic controllers (PLCs), industrial automation, and smart technologies.
- Telecommunications and Networking training such as fiber optics, wireless communication, and network security.
- Embedded Systems and IoT: Using microcontrollers and IoT technology in current industries.
- Safety and Maintenance Procedures among which are adherence to occupational health and safety regulations in electrical work environments.

However, there are gaps in the implementation due to obsolete syllabi and insufficient instructional materials (Oladejo 2019). Furthermore, research show that matching the curriculum with changing technology breakthroughs is necessary for being relevant in the current workforce (Kennedy, Ekong, & Okorie, 2022). Regular curriculum changes and the incorporation of industry comments improve the applicability of TVET programs (Omar & Kamaruzaman, 2024). Practical components, internships, and cooperation with technology firms must be prioritized to ensure that students obtain hands-on experience, which will improve their employability (Oviawe, (2017).

Institutional Facilities and Their Impact on Skill Acquisition

The quality of training facilities at TVET institutions has a direct impact on skill acquisition and competency development. Adequate facilities, such as well-equipped laboratories, workshops, and current instructional materials, are required for efficient skill acquisition in TVET institutions (Kennedy, Ekong & Okorie, 2022). According to Rufai, Umar and Idris, (2013), institutions with

updated training facilities produce graduates who are more employable. Some of the important institutional amenities that influence skill learning are:

- Electrical/Electronics laboratories equipped with oscilloscopes, functioning generators, circuit boards, and microcontrollers for practical experiments.
- Simulation software including use of Proteus, and AutoCAD Electrical for design and testing.
- Workshops for fabrication and maintenance, including soldering, circuit prototyping, and equipment repair, MATLAB among others.
- Renewable Energy Training Centers that offer hands-on training in solar, wind, and hybrid energy technologies.

Conversely, institutions that lack infrastructure has high tendency of having poor performing students and skill disparities. Many TVET centers in Nigeria confront issues such as outmoded equipment, insufficient training kits, and overcrowded workshops, which affects learning of practical (Akomolafe, & Adesua (2016). The use of current technical equipment, such as simulation tools and digital learning platforms, has the potential to greatly increase training quality and student outcomes (Akinola, Eze, Ali, Alfred & Attah 2020). Furthermore, investing in infrastructure expansion and routine maintenance of current facilities will improve the overall learning experience (Oviawe, 2017). Collaborations with international training institutes can also provide access to more resources and creative teaching methods (Omar & Kamaruzaman, 2024). Invariably, this will assist institutions that provide TVET programmes in meeting industrial demands.

Collaboration between Institutions and Industry for Skill Development

Industry participation is an essential component of a successful TVET program. According to Omar and Kamaruzaman, (2024), collaborations between institutions and companies broaden students' exposure to real-world applications. Internship programs, industry attachments, and apprenticeship schemes have all been shown to effectively bridge the gap between theory and practice (Oviawe, 2017). However, weak links and insufficient industry involvement in Nigeria prevent these benefits from being fully realized (Akinola, Eze, Ali, Alfred & Attah 2020). Improving these linkages through legislative incentives and industry-sponsored training programs can dramatically increase skill development (Akomolafe, & Adesua (2016). Furthermore, mentorship programs organized by industry experts provide vital insights and exposure to emerging trends in the electrical/electronics industry (Adebayo & Usman, 2019). Joint research initiatives involving TVET universities and industry partners can foster innovation and guarantee that training remains relevant to current technical breakthroughs (Rufai, Umar, & Idris, 2013).

Challenges facing Institutional-Based TVET in Nigeria

Nigeria's TVET institutions encounter several issues that have an impact on educational quality and skill acquisition. Inadequate funding, a shortage of skilled instructors, and obsolete curricula are among the major concerns (Akomolafe, & Adesua (2016).

Also, public perceptions of TVET as inferior to traditional university education deter enrollment (Rufai, Umar, & Idris, 2013). In the same vein, Akinola, et al (2020) stated that inadequate policy implementation and a lack of ongoing professional development for educators exacerbate these issues. Other obstacles include restricted access to new technical tools, limited government and corporate sector support, and an immature framework for monitoring and assessing the effectiveness of TVET programs (NBTE, 2016). Addressing these systemic difficulties requires a multi-stakeholder approach that includes government involvement, corporate sector participation, and academic institutions (Aniedi & Caleb 2017). Furthermore, regional disparities in TVET accessibility result in an unequal distribution of trained workers, which undermines national development efforts (Rufai, Umar, & Idris, 2013).

Strategies to enhancing TVET in Electrical/Electronics Skills Acquisition

Several initiatives can be used to improve TVET in Nigeria, including curriculum improvements, investments in contemporary training facilities, and greater industrial relationships. The use of competency-based training and digital learning tools can improve instructional effectiveness (Kennedy, Ekong, & Okorie. 2022). Also, Government policies should prioritize funding, fostering vocational education awareness, and provide incentives for industry collaborations (Omar & Kamaruzaman, (2024). Instructor training and retraining should also be priority to guarantee that they keep up with technology advances (Oviawe, 2017). Furthermore, including entrepreneurship education into TVET courses can promote self-employment among graduates, reducing reliance on official employment (Akinola, Eze, Ali, Alfred & Attah (2020). Expanding TVET programs to rural areas and ensuring inclusion in enrollment policies would help to create a more diverse and skilled workforce (Oladejo 2019). Finally, utilizing international cooperation and exchange programs can expose students and instructors to best practices in global vocational education (Aniedi & Caleb 2017).

Conclusion

TVET in Electrical/Electronics is an important driver of economic growth and workforce development in Nigeria. However, the sector has considerable obstacles, such as insufficient facilities, weak industry links, and outdated curriculums. Addressing these difficulties through improved policies, funding, and curriculum will result in a more effective TVET system. Greater investment in human capital development, industry-academic cooperation, and technological breakthroughs are required to overcome the present skill gaps and enhance graduates' employability.

Recommendations

Based on the study, the following recommendations are put forward for possible considerations by the stakeholders in the field of electrical/ electronics technology.

1. TVET curriculum should regularly be updated to correspond with industry demands and worldwide best practices.
2. Government should prioritize infrastructure development by investing in contemporary training facilities, equipment, and technology to increase learning.

3. TVET Institutions should ensure that there is collaboration with industries through apprenticeship and internship programs.
4. TVET based Institutions should ensure that instructors receive ongoing professional development to stay up-to-date on instructional techniques and technology.
5. There should be an integration of emerging technologies, such as AI, robots, and digital manufacturing, into TVET curriculum.
6. Public-private partnerships and innovative funding sources should be established to support TVET growth.

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