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Integrating Industry Based Electrical and Electronics Training into TVET Programmes for Entrepreneurial Skill Development and Sustainable Employment in Nigeria

Kingsley-chibuike susan Enoche*
Department of Technical Education
Faculty of Vocational and Technical Education, Ignatius Ajuru University of Education, Rumuolumeni Port Harcourt Rivers State, Nigeria

Abstract

Technical and Vocational Education and Training (TVET) plays a pivotal role in equipping individuals with the technical, practical, and entrepreneurial competencies necessary for economic development and employment generation. In Nigeria, the effectiveness of TVET in addressing youth unemployment and fostering entrepreneurship has been limited by weak industry collaboration, inadequate practical exposure, and outdated training infrastructure. This opinion paper contends that integrating industry-based electrical and electronics training into TVET programmes can significantly enhance graduates' entrepreneurial skills and promote sustainable employment. Drawing on recent scholarly literature, the paper underscores the importance of experiential learning, workplace attachments, and structured industry partnerships in bridging the gap between technical education and labour market requirements. It further illustrates how industry-integrated training strengthens technical competence, fosters innovation, and equips learners with the knowledge and skills necessary to establish viable technical enterprises. The paper concludes that strategic collaboration among government agencies, industries, and training institutions is essential to reposition electrical and electronics TVET as a catalyst for entrepreneurship, workforce readiness, and sustainable economic development in Nigeria.

Keywords: *Technical, Vocational Education Training, Industry, Electrical And Electronics Education, Entrepreneurship, Sustainable Employment.*

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***Corresponding Author:**
Kingsley-chibuike susan Enoche
Email: susan.kingsley@iaue.edu.ng

INTRODUCTION

The Indian digital landscape in 2026 is vastly Youth unemployment remains one of the most pressing socio economic challenges confronting Nigeria in the twenty first century (Fatokun, 2024). Despite the continuous expansion of higher education institutions and the increasing number of graduates produced annually, a significant proportion of young people remain unemployed or underemployed (Adeleye, 2023). This situation has raised serious concerns among

policymakers, educators, and development experts regarding the capacity of the education system to equip graduates with relevant skills required for the labor market. A major contributing factor to this problem is the mismatch between the competencies acquired through formal education and the practical skills demanded by employers in modern industries (Chiamogu & Chiamogu, 2015). In recent years, Technical and Vocational Education and Training has been increasingly recognized as a critical pathway for addressing this challenge. TVET focuses on equipping individuals with practical competencies, technical knowledge, and occupational skills that enable them to participate effectively in productive economic activities (Okon, 2019). Unlike conventional academic programs that emphasize theoretical knowledge, TVET emphasizes hands on training and skill acquisition that prepare learners for specific technical occupations and self-employment opportunities. Consequently, TVET has become an important mechanism for promoting workforce development, reducing unemployment, and encouraging entrepreneurial activities among young people (Adeleye, 2023). Globally, vocational education has been widely acknowledged as a strategic tool for enhancing national productivity and economic development (Fatokun, 2024). Countries with strong TVET systems often experience higher levels of industrial efficiency, innovation, and employment generation because their workforce possesses the technical expertise required to support technological advancement. The International Labor Organization emphasizes that well-structured TVET systems are essential for preparing workers with relevant competencies that align with the rapidly evolving demands of modern industries (International Labour Organization, 2021). In an era characterized by technological innovation, automation, and digital transformation, the need for skilled technical professionals has become more important than ever.

Within the Nigerian context, electrical and electronics trades constitute a particularly significant area within TVET programmes because of their relevance to modern infrastructure and technological systems. Electrical installation, renewable energy technologies, electronics maintenance, telecommunications support, and industrial automation are essential services that support economic development across various sectors. The demand for skilled electrical and electronics technicians continues to grow due to increased urbanization, expansion of digital technologies, and the need for sustainable energy solutions.

Despite the strategic importance of electrical and electronics training, many TVET institutions in Nigeria face considerable challenges in delivering effective technical education. Inadequate training facilities, obsolete workshop equipment, insufficient funding, and limited exposure of students to real industrial environments have hindered the development of practical competencies among learners (Udoudoh et al., 2015). These limitations reduce the ability of graduates to perform effectively in professional technical environments after completing their training.

Another significant challenge confronting TVET programmes in Nigeria is the weak collaboration between training institutions and industries (Okon, 2019). In many cases, educational programmes operate independently from the industrial sector, resulting in a gap between the skills taught in training institutions and the competencies required in the workplace. Research has indicated that many graduates of technical education programmes lack practical competencies due to inadequate exposure to real industrial operations during their training (Nwoye et al., 2020). As a consequence, many graduates encounter difficulties when attempting to secure employment or establish technical enterprises.

Strengthening collaboration between vocational training institutions and industries therefore represents an important strategy for improving the relevance and effectiveness of TVET programmes. Integrating industry based electrical and electronics training into TVET curricula can significantly enhance students' practical learning experiences by exposing them

to real workplace environments, modern technologies, and industry practices. Such integration allows learners to apply theoretical knowledge in practical contexts, develop problem solving abilities, and gain insights into the operational processes of technical enterprises (Agbo & Nnajiofor, 2023).

Furthermore, industry based training can play a crucial role in fostering entrepreneurial competence among learners (Fatokun, 2024). By interacting with professionals and observing how technical businesses operate, students gain knowledge about service delivery, equipment management, customer relations, and business organization. These experiences enable learners to recognize opportunities for self-employment and establish viable technical enterprises after graduation.

Against this background, this paper argues that effective integration of industry based electrical and electronics training into TVET programmes is essential for strengthening entrepreneurial skill development and promoting sustainable employment in Nigeria. By providing learners with opportunities to engage directly with industrial environments, industry based training enhances technical competence, encourages innovation, and prepares graduates to participate actively in economic development through entrepreneurship and skilled employment.

Conceptual Framework

The conceptual framework of this paper provides a theoretical explanation of the relationship between industry-based training, electrical and electronics skill acquisition, entrepreneurial competence, and sustainable employment outcomes within the context of Technical and Vocational Education and Training programmes. The framework is based on the understanding that effective vocational education requires a combination of institutional learning and practical workplace experience (Agbo & Nnajiofor, 2023).

TVET institutions play an important role in providing foundational knowledge and technical orientation to learners (Okon, 2019). Within these institutions, students acquire theoretical understanding of electrical and electronic systems, basic operational principles, safety procedures, and technical methodologies required for performing various tasks within the field. This foundational knowledge forms the basis upon which practical competencies are developed. However, theoretical instruction alone is often insufficient for preparing students to function effectively in complex industrial environments (Agbo & Nnajiofor, 2023). Without adequate exposure to real workplace settings, students may possess conceptual understanding of electrical and electronics systems but lack the practical competence required to apply this knowledge in solving real technological problems. This limitation underscores the importance of industry based experiential learning as a complementary component of vocational education. Industry based training therefore serves as a critical bridge between classroom instruction and real workplace practice. Through structured programmes such as industrial attachments, apprenticeships, cooperative education, and workplace training initiatives, students gain opportunities to interact with modern equipment, observe professional work processes, and participate in practical technical activities. During such experiences, learners engage directly in tasks such as installation of electrical systems, maintenance of electronic devices, troubleshooting of technical faults, and operation of specialized equipment (Aderinto et al., 2025). These experiential learning opportunities significantly enhance students' practical competence and confidence in performing technical tasks. In addition to technical skill acquisition, industry exposure also facilitates the development of professional attitudes such as teamwork, discipline, responsibility, and effective communication, which are essential for success in technical professions. Beyond technical competence, industry based learning also contributes to the development of entrepreneurial capacity among students. When learners observe the operations of electrical and electronics enterprises, they gain valuable insights into business management, service

delivery systems, customer engagement, and resource management. Such experiences help students understand how technical expertise can be transformed into viable business opportunities. Consequently, students who undergo industry integrated training are more likely to develop innovative thinking and entrepreneurial orientation. They become capable of identifying market opportunities, designing technical solutions, and establishing small scale enterprises that provide electrical and electronics services within their communities.

The conceptual framework therefore proposes that when electrical and electronics training provided within TVET institutions is effectively integrated with industry based experiential learning, it leads to improved technical competence, enhanced entrepreneurial skill development, and increased opportunities for sustainable employment among graduates.

Conceptually, the relationship can be represented as follows:

TVET Electrical and Electronics Training`
↓
Industry Based Practical Exposure
↓
Entrepreneurial Skill Development
↓
Sustainable Employment and Business Creation

This framework highlights the critical role of industry participation in strengthening the effectiveness of vocational education. By connecting classroom learning with real industrial practice, industry integrated training systems can significantly improve the capacity of TVET programmes to produce skilled, innovative, and entrepreneurial graduates capable of contributing to national development.

Role of TVET in Skill Development and Economic Growth

Technical and Vocational Education and Training (TVET) plays a pivotal role in national development by equipping individuals with the technical, professional, and entrepreneurial competencies required for productive participation in the economy (Fatokun, 2024). In developing countries like Nigeria, TVET systems not only contribute to workforce development but also act as engines for technological advancement, industrial growth, and employment generation. By producing skilled workers capable of meeting the demands of contemporary industries, TVET programmes serve as a bridge between education and the labour market, thereby addressing both unemployment and skills shortages (Udoudoh et al., 2015). One of the primary objectives of TVET is to foster the acquisition of practical skills that enable individuals to engage in economically productive activities. These competencies are especially critical in sectors that rely heavily on technical expertise, such as electrical installation, electronics maintenance, renewable energy technologies, and industrial automation. Studies have demonstrated that well-structured TVET programmes can stimulate entrepreneurship, support job creation, and enhance self-employment by equipping graduates with skills that are immediately applicable in business and industry contexts (Fatokun, 2024).

Beyond skill acquisition, TVET contributes to economic growth by supporting the creation of a technically competent workforce capable of adapting to technological innovations and industrial transformations (Njoku et al., 2015). In this regard, TVET functions not only as a mechanism for employment but also as a driver of innovation, as graduates often engage in problem solving, process improvement, and the development of technical solutions that enhance productivity. A skilled technical workforce also reduces the dependence of the economy on imported expertise, thereby supporting national self-reliance and industrial competitiveness (Njoku et al., 2015).

However, the effectiveness of TVET programmes depends largely on the relevance of their curricula to the current needs of the labour market (Nwoye et al., 2020). When training systems are disconnected from industrial realities, graduates often emerge with theoretical

knowledge but limited practical capabilities, making it difficult for them to integrate successfully into technical occupations. Scholars emphasize the importance of robust institutional collaboration with industries to ensure that training programmes are aligned with technological developments, industrial standards, and workplace expectations (Okon, 2019).

In Nigeria, strengthening the linkage between TVET institutions and industries is therefore crucial for ensuring that vocational education contributes meaningfully to economic development. Collaborative partnerships can enable access to modern equipment, internships, mentorship, and applied learning opportunities, which collectively enhance the employability and entrepreneurial potential of TVET graduates. Such collaboration ensures that TVET does not only prepare learners for wage employment but also equips them with the skills necessary to establish small and medium scale enterprises in technical and industrial sectors.

Electrical and Electronics Training within Nigerian TVET Programmes

Electrical and electronics training represents a cornerstone of technical education in Nigeria, forming a critical pathway for producing skilled manpower capable of supporting both industrial and technological advancement (Aderinto et al., 2025). These programmes are specifically designed to equip learners with comprehensive competencies in areas such as electrical installations, maintenance and troubleshooting of power systems, renewable energy technologies, electronics repair, and industrial automation. Graduates are expected to possess not only theoretical knowledge but also practical problem-solving abilities, technical proficiency, and entrepreneurial skills necessary to contribute effectively to modern industrial and service sectors (Njoku et al., 2015).

The significance of electrical and electronics training extends beyond individual skill acquisition; it is essential for the functioning and growth of contemporary economies. Electricity and electronic technologies are the backbone of nearly all industrial operations, communication systems, transportation networks, healthcare services, and domestic utilities (Adeleye, 2023). Technicians trained in these fields play a vital role in installing and maintaining power systems, repairing electronic devices, implementing renewable energy solutions, and supporting automation processes within industries (Aderinto et al., 2025). Their contributions not only support economic productivity but also enhance infrastructure development, improve service delivery, and expand access to energy and technology in underserved and rural communities, thereby promoting inclusive and sustainable development.

Despite the strategic importance of these skills, the delivery of electrical and electronics training within Nigerian TVET institutions faces significant challenges. Many technical institutions lack adequate workshop facilities and modern laboratories equipped with current technologies used in industrial practice (Adeleye, 2023). Outdated training equipment, coupled with limited exposure to contemporary industrial systems, constrains students' ability to develop the practical competencies required for professional effectiveness. Consequently, graduates often leave training programmes with theoretical knowledge but insufficient hands-on experience, reducing their employability and limiting their capacity to establish technically competent enterprises (Nwoye et al., 2020).

Another major challenge is the weak linkage between TVET institutions and industry. In the absence of structured partnerships, students graduate with minimal exposure to actual workplace environments, which hampers their readiness to meet industrial standards and operational expectations (Aderinto et al., 2025). Industrial attachments, apprenticeship programmes, and mentorship from experienced professionals are essential components of high-quality technical education, providing learners with practical insight into the day-to-day operations of technical enterprises. Such experiences also expose students to problem-solving in real contexts, enabling them to adapt technical knowledge to evolving industrial needs

and technological innovations (Chiamogu & Chiamogu, 2015).

The integration of industry-based training into electrical and electronics curricula offers a practical solution to these challenges. By participating in workplace-based learning, students can engage directly with modern technologies, interact with professionals, and gain exposure to contemporary industrial processes. This experiential learning fosters not only technical competence but also entrepreneurial skills, as learners observe how technical expertise can be transformed into viable business opportunities. Students develop competencies in client engagement, resource management, and service delivery, preparing them to establish and manage small-scale enterprises within the electrical and electronics sector (Njoku et al., 2015).

Furthermore, industry-based training strengthens critical thinking, innovation capacity, and adaptability among graduates, equipping them to respond effectively to technological disruptions and emerging market opportunities. When electrical and electronics TVET programmes are aligned with industrial realities, students gain a holistic understanding of both technical operations and business processes, positioning them to contribute meaningfully to employment generation, enterprise development, and broader economic growth. Strengthening institutional collaboration with industries, investing in modern training infrastructure, and promoting hands-on experiential learning are therefore essential strategies for ensuring that electrical and electronics training in Nigeria achieves its potential as a driver of sustainable development and entrepreneurship.

Role of TVET in Skill Development and Economic Growth

Technical and Vocational Education and Training (TVET) serves as a cornerstone for national development by equipping individuals with the technical, professional, and entrepreneurial competencies required for productive participation in the economy (Udoudoh et al., 2015). In developing countries such as Nigeria, TVET systems not only facilitate workforce development but also act as key drivers of industrial growth, technological advancement, and employment creation. By producing skilled workers capable of meeting the demands of contemporary industries, TVET programmes bridge the gap between formal education and the labour market, addressing both unemployment and the skills mismatch that hampers economic development.

A primary objective of TVET is to foster the acquisition of practical skills that allow individuals to engage in productive economic activities and contribute meaningfully to societal development (Udoudoh et al., 2015). These competencies are particularly critical in sectors that rely heavily on technical expertise, including electrical installation, electronics maintenance, renewable energy technologies, and industrial automation. Empirical studies suggest that well-structured TVET programmes can stimulate entrepreneurship, enhance self-employment opportunities, and facilitate job creation by equipping graduates with skills immediately applicable in both business and industrial contexts (Fatokun, 2024). Beyond facilitating skill acquisition, TVET contributes significantly to economic growth by generating a technically competent workforce capable of adapting to technological innovations and evolving industrial practices (Njoku et al., 2015). In this respect, TVET functions not only as a mechanism for employment but also as a platform for innovation, as graduates often engage in problem solving, process optimization, and the development of practical technical solutions that enhance organizational and industrial productivity. By cultivating a workforce with practical competencies, TVET also reduces reliance on foreign expertise, thereby promoting national self-reliance, strengthening industrial competitiveness, and fostering sustainable economic development.

However, the effectiveness of TVET programmes depends largely on the relevance of their curricula to current labour market needs (Chiamogu & Chiamogu, 2015). When training

systems operate in isolation from industrial realities, graduates often possess theoretical knowledge but lack practical capabilities, which limits their ability to perform effectively in technical occupations. Scholars underscore the necessity of robust institutional collaboration with industries to ensure that TVET curricula are aligned with technological advancements, industrial standards, and workplace requirements (Okon, 2019).

In Nigeria, establishing strong linkages between TVET institutions and industries is therefore essential to ensure that vocational education makes tangible contributions to economic development. Collaborative partnerships can provide students with access to modern equipment, internships, mentorship opportunities, and hands-on learning experiences, which collectively enhance employability and entrepreneurial competence. Such collaboration ensures that TVET does not merely prepare learners for wage employment but also equips them with the skills necessary to establish small and medium scale technical enterprises that support sustainable economic growth and community development.

Policy Implications

The effective integration of industry-based training into TVET programmes requires the development of comprehensive policies and institutional frameworks that actively promote collaboration between educational institutions and industries. For TVET to achieve its objectives of producing technically competent and entrepreneurial graduates, government agencies and regulatory bodies must establish enabling conditions that encourage industries to participate meaningfully in vocational education and training.

Government policies should prioritize mechanisms such as industrial attachments, apprenticeships, cooperative training programmes, and structured workplace learning. These initiatives create opportunities for students to gain practical experience and enhance their problem-solving abilities, preparing them to meet the demands of contemporary industrial environments. Regulatory frameworks should also incentivize industries to contribute resources, mentorship, and technical expertise to vocational institutions, ensuring alignment between curricula and current industry standards. Investment in modern training infrastructure is another critical policy requirement. Workshops and laboratories within TVET institutions should be equipped with contemporary technologies, including renewable energy systems, industrial automation tools, and digital diagnostic equipment. Such infrastructure ensures that students are trained on the same technologies and operational procedures they will encounter in real industrial settings, bridging the gap between theoretical knowledge and practical application. In addition, industry participation in curriculum design should be formalized, allowing technical institutions to develop programmes that reflect evolving technological trends and labour market needs. When curricula are co-developed with industry input, graduates are more likely to acquire both technical competencies and entrepreneurial skills necessary for establishing and managing small and medium-scale enterprises. Effective policy frameworks should therefore focus on fostering partnerships between government agencies, industries, and educational institutions to create sustainable, industry-aligned TVET systems.

Conclusion

Technical and Vocational Education and Training remains a critical pathway for equipping individuals with the practical skills and competencies required for productive participation in modern economies. In Nigeria, the need to strengthen TVET has become increasingly urgent due to rising youth unemployment and the growing demand for skilled technical professionals across multiple sectors.

Electrical and electronics training represents a particularly strategic component of TVET because of its relevance to energy systems, industrial technologies, telecommunications infrastructure, and electronic services. Yet, the

effectiveness of training in these fields has been constrained by inadequate practical facilities, outdated equipment, limited industrial exposure, and insufficient collaboration between training institutions and industries. These gaps have limited graduates' employability and reduced the potential for entrepreneurial enterprise development in the sector.

This paper has argued that integrating industry-based electrical and electronics training into TVET programmes can significantly enhance entrepreneurial skill acquisition and promote sustainable employment among Nigerian youths. By exposing students to real industrial environments, industry-based training enables learners to apply theoretical knowledge, develop technical proficiency, and understand the operational dynamics of electrical and electronics enterprises.

Furthermore, industry involvement in training delivery strengthens students' capacity for innovation, problem solving, and business development. Graduates equipped with both technical competence and entrepreneurial knowledge are better positioned to identify market opportunities, establish viable technical enterprises, and contribute meaningfully to national economic development. Strengthening collaboration among government institutions, industries, and vocational training providers is therefore essential for improving the relevance and quality of TVET, enhancing employment outcomes, and fostering sustainable entrepreneurial development in Nigeria.

Suggestions

1. **Strengthen Institutional Collaboration:** Government should establish policies and frameworks that encourage active collaboration between TVET institutions and industries involved in electrical and electronics services.
2. **Structured Industrial Experience:** Technical institutions should implement well-structured apprenticeship, industrial attachment, and cooperative training programmes that provide students with extensive workplace experience.
3. **Upgrade Training Infrastructure:** Electrical and electronics workshops and laboratories should be equipped with modern tools, digital diagnostic equipment, renewable energy technologies, and automation systems that reflect contemporary industrial practices.
4. **Integrate Entrepreneurship Education:** Entrepreneurship education should be embedded into electrical and electronics training programmes to equip graduates with business management, financial planning, and enterprise development skills.
5. **Continuous Professional Development:** TVET instructors should undergo regular professional development to stay updated on emerging technologies, industrial innovations, and modern teaching methodologies.
6. **Active Private Sector Participation:** Private sector organizations should participate in curriculum design, mentorship programmes, training delivery, and provision of real-world technical exposure for students.
7. **Policy Monitoring and Evaluation:** Regulatory agencies should periodically assess the effectiveness of industry-based training policies to ensure that graduates acquire both technical competence and entrepreneurial skills that promote sustainable employment.

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