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# Sustainable Construction Skills in TVET: Balancing Economic Growth, Environmental Protection, and Security in Nigeria

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**Abstract:** *Technical Vocational Education and Training (TVET) play a critical role in developing industry-relevant skills required for sustainable development in the construction sector. However, in Nigeria, the contribution of TVET to sustainable construction remains limited due to skills mismatch, outdated curricula, inadequate resources, and insufficient integration of sustainability and safety principles. This study examined sustainable construction skills in TVET as a means of balancing economic growth, environmental protection, and security in Nigeria. A mixed-methods research design was adopted, combining quantitative and qualitative approaches. Primary data were collected through a structured questionnaire administered to TVET educators, TVET students, and construction industry professionals, with 285 valid responses analysed. Descriptive statistics (frequencies, percentages, mean, and standard deviation) were used to analyse quantitative data using IBM SPSS Statistics 26, while qualitative responses were thematically analysed with NVivo 12. The findings revealed strong consensus that sustainable construction skills, such as energy-efficient construction techniques, sustainable materials usage, waste management, environmental impact assessment, and safety-oriented practices, are essential components of TVET programmes. The study further established that these skills significantly enhance employability, productivity, entrepreneurship, environmental sustainability, workplace safety, and community security. The study concludes that effective integration of sustainable construction skills into TVET curricula is critical for achieving sustainable economic development, environmental stewardship, and national security in Nigeria, and recommends*

*curriculum reform, instructor capacity building, industry collaboration, and increased investment in TVET infrastructure.*

**Keywords:** technical vocational education and training, sustainable construction skills, curriculum development, employability, environmental sustainability.

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## INTRODUCTION

Technical Vocational Education and Training (TVET) has been recognised globally as a strategic tool for equipping individuals with practical skills that promote employment, self-reliance, and socio-economic development (Auta & Onwusuru, 2022). In Nigeria, TVET's role is particularly important given the country's high youth unemployment, persistent skills gaps in key sectors like construction, and urgent need for sustainable economic growth (Muoghalu & Ahmad, 2023). Sustainable construction skills are a subset of technical competencies that integrate economic, environmental, and social considerations into building and infrastructure practices to improve performance, reduce ecological impact, and support resilient communities.

Sustainable construction focuses on reducing environmental degradation, optimising resource usage, and enhancing occupational safety while contributing to economic advancement (Unegbu & Yawas, 2025). Nigeria's construction sector is a significant contributor to GDP and employment; yet, without a skilled workforce conversant with sustainable practices, the industry struggles with inefficiencies, waste, and environmental damage. Therefore, integrating sustainable construction skills within TVET curricula offers a pathway to strengthen the construction workforce and address national development goals through sustainable practice (Unegbu et al., 2025). Moreover, green process skills, such as energy-efficient building methods, waste reduction techniques, and environmental assessment competencies, are vital for transitioning the sector to a greener economy (Hamza et al., 2025).

TVET can also act as a catalyst for environmental protection and climate change mitigation. Greening TVET involves training students to understand and apply skills that reduce carbon emissions, promote renewable energy solutions, and support environmental conservation, key pillars of sustainable development goals (Ayuba et al, 2024). Through this lens, sustainable construction skills become critical tools for balancing economic growth with environmental protection, ensuring that future professionals are not only technically competent but also environmentally conscious.

Despite the acknowledged importance of TVET for economic development in Nigeria, several challenges undermine the contribution of TVET to sustainable construction. Firstly, there is a mismatch between skills taught in TVET institutions and the evolving needs of the construction

industry, especially with respect to sustainability and green practices (Auta & Onwusuru, 2022). Secondly, inadequate funding, outdated curricula, and limited access to modern tools and technologies hinder effective delivery of sustainable skills (Ime et al., 2025). Thirdly, environmental and safety concerns inherent in construction practices remain high due to insufficient integration of sustainability principles into training programs. Hence this research seeks to explore the role of sustainable construction skills in TVET and how they can balance economic growth, environmental protection, and security in Nigeria. While the specific objectives are to: (1) Identify the key sustainable construction skills required in TVET programmes. (2) Assess the contribution of sustainable construction skills to economic growth in Nigeria. (3) Examine how sustainable construction skills support environmental protection. (4) Investigate the link between sustainable construction skills and safety/security outcomes in the construction sector.

## **Literature Review**

### **Concept of Sustainable Construction**

Sustainable construction refers to building practices that minimise environmental impact, maximise economic efficiency, and enhance social quality throughout the life cycle of infrastructure projects. This encompasses responsible resource use, waste reduction, energy efficiency, and the adoption of green technologies (Unegbu, et al., 2025). In the Nigerian context, sustainable construction remains inconsistently practiced due to weak policies, limited awareness, and low adoption of green methods, though there is growing acknowledgement of its importance for environmental protection and economic performance (Unegbu et al., 2025).

### **Technical Vocational Education and Training (TVET) in Nigeria**

Technical Vocational Education and Training (TVET) is an integral component of Nigeria's education system aimed at equipping learners with practical skills for employment and self-reliance. Scholars argue that TVET must be continuously reformed to meet future skill needs, particularly as Nigeria seeks to develop a green economy and combat climate change (Offiong et al., 2022). TVET has been identified as a strategic education pathway that can address unemployment and enhance skills development if adequately supported through policy, funding, and institutional reforms (Ime et al., 2025; Muogahlu & Ahmad, 2025). However, current literature highlights constraints such as outdated curricula, limited funding, and weak alignment with industry needs (Ime et al., 2025; Offiong et al., 2022).

### **Sustainable Construction Skills and Competency Requirements**

Sustainable construction skills go beyond basic technical know-how: they include competencies in energy-efficient methods, green materials, environmental assessment, project resource planning, and safety management. Globally and locally, construction practitioners require a blend of technical and soft skills to meet sustainability goals, including communication, critical thinking, and problem-solving (Auta & Onwusuru, 2022; Unegbu et al., 2025). Research indicates that TVET trainees in construction programmes can achieve high readiness in critical knowledge and soft skills for green project management when curricula incorporate sustainability principles and industry-aligned competencies (Mohamad et al., 2023).

### **Economic Growth and the Construction Sector in Nigeria**

The construction sector is a significant contributor to economic development through job creation, capital investment, and infrastructure expansion. Sustainable construction practices have the potential to improve productivity, reduce lifecycle costs, and stimulate economic growth by adopting efficient and resource-saving technologies (Unegbu et al., 2025). TVET plays a critical role in producing skilled workers capable of engaging in such practices, thus enhancing labour market outcomes and economic diversification (Muogahlu & Ahmad, 2025). However, the efficiency of this linkage depends on how well TVET curricula capture emerging industry needs and sustainability demands.

### **Environmental Protection and Sustainable Building Practices**

Nigeria faces significant environmental challenges tied to rapid urbanisation, resource depletion, and climate change. Research emphasises that greening TVET, integrating environmental education and skills that reduce carbon emissions, is vital for achieving sustainable development goals (Ayuba et al., 2024). These skills include waste management, renewable energy utilisation, and environmentally-sound construction techniques. Greening TVET is seen as an agent for climate change mitigation and environmental stewardship, equipping learners with competencies to reduce ecological impacts in their professional roles (Ayuba et al., 2024).

### **Construction Industry, Safety, and National Security Concerns**

Safety and security within the construction sector relate both to occupational safety and broader human security. Studies show that skilled training in safety and best practices can reduce accidents and workplace risks, supporting healthier working conditions and community wellbeing. Moreover, literature on TVET's role in tackling unemployment suggests that deploying TVET strategically can reduce insecurity by engaging youth in productive work and reducing socio-economic vulnerabilities (Chukwu, 2023). This implies that sustainable construction skills, when linked to security-related competencies, can support safer workplaces and contribute to national stability.

## **Integration of Sustainability Principles into TVET Curriculum**

Integrating sustainability principles into TVET curricula requires systematic curriculum reforms aligned with environmental, economic, and social factors. Although there is growing research advocating green skills integration, practical implementation challenges persist, including teacher capacity, institutional readiness, and industry collaborations. Effective integration factors include curriculum restructuring, stakeholder participation in curriculum design, and industry-TVET linkage to align skill delivery with labour market needs (Nwoye et al., 2020; Offiong et al., 2022). Such linkages facilitate knowledge exchange and ensure that TVET graduates possess relevant sustainable construction competencies.

### **Review of Empirical Studies**

Empirical research on TVET and sustainable practices in Nigeria underscores both the potential and limitations of current systems. For example, studies on TVET funding reveal that inadequate resources diminish the quality and sustainability of skill training, thus weakening the link between TVET and human capital development (Ime et al., 2025). Other research indicates that TVET programmes, if redesigned to meet 21st-century workforce demands, can address unemployment and improve economic resilience (Muogahlu & Ahmad, 2025). Furthermore, current literature on sustainable construction highlights moderate adoption levels, pointing to gaps in knowledge and practice among industry actors (Unegbu et al., 2025).

### **Research Gap Identified from Literature**

While existing literature highlights the importance of TVET in sustainable development and economic growth, there is a notable gap in empirical research that specifically examines how sustainable construction skills in TVET balance economic, environmental, and security outcomes in Nigeria. Additionally, studies often focus on general TVET reform or sustainability independently, lacking an integrated analysis that connects TVET curricula, construction skills, environmental protection, and human security. This research aims to fill that gap by examining sustainable construction skills within TVET and their role in advancing balanced development objectives.

### **Methodology**

This study adopted a mixed-methods research design, integrating both quantitative and qualitative approaches to obtain a comprehensive understanding of sustainable construction skills in Technical Vocational Education and Training (TVET) and their role in balancing economic growth, environmental protection, and security in Nigeria. Mixed-methods design was considered appropriate because it allows researchers to combine the strengths of quantitative data with qualitative insights to provide a more holistic interpretation of research problems (Creswell &

Creswell, 2018). The study was conducted in Nigeria with emphasis on TVET institutions offering construction-related programmes such as building technology, construction technology, and related trades. These institutions included selected technical colleges, polytechnics, colleges of education (technical), and universities that provide TVET-oriented construction programmes. The population of the study comprised TVET lecturers teaching construction-related courses, TVET students enrolled in construction programmes, and construction industry professionals involved in training, supervision, or employment of TVET graduates. These categories were selected because they play key roles in skill development, curriculum implementation, and practical application of sustainable construction practices. A multi-stage sampling technique was employed in selecting respondents. First, purposive sampling was used to identify TVET institutions offering construction-related programmes, while simple random sampling was applied to select participants from the identified respondent groups to ensure fairness and representativeness (Etikan, Musa, & Alkassim, 2016). Data were collected primarily through a structured questionnaire administered online, yielding 285 valid responses out of 300 that was targeted, representing a 95% response rate, which is considered highly acceptable for statistical analysis (Dillman, Smyth, & Christian, 2014). The research instrument was a structured questionnaire developed based on an extensive review of literature on sustainable construction skills, TVET, economic development, environmental sustainability, and safety practices in construction. The instrument was validated through content and face validity by experts in TVET, construction education, and educational measurement to ensure that the items adequately represented the research objectives. Reliability of the instrument was established through a pilot study involving 30 respondents, and Cronbach's Alpha reliability coefficients indicated good internal consistency across the sections of the questionnaire, with values ranging from 0.82 to 0.87 and an overall reliability coefficient of 0.84, exceeding the acceptable threshold of 0.70 (Taber, 2018). Primary data were collected through the online administration of the questionnaire, while secondary data were obtained from academic journals, institutional reports, and industry publications to provide contextual support for the study. Ethical research principles were strictly followed, including obtaining informed consent from participants, ensuring voluntary participation, and maintaining the confidentiality and anonymity of all responses. Quantitative data were analysed using descriptive statistical methods, including frequencies, percentages, mean, and standard deviation, with the aid of IBM SPSS Statistics version 26 to ensure accuracy and reliability of statistical outputs (IBM Corp., 2019), while qualitative responses from the open-ended question were analysed thematically using NVivo 12 following established qualitative analysis procedures (Braun & Clarke, 2006).

**Table 1. Respondents profile**

Demographics	Distributions	Frequency/Percentage
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Gender	Male	180 (63.2%)
	Female	105 (36.8%)
Role	TVET Educator	80 (28.1%)
	TVET Student	160 (56.1%)
	Construction Industry Professional	45 (15.8%)
	Technical College	60 (21.1%)
	Polytechnic	75 (26.3%)
Institution/Organization	College of Education (Technical)	55 (19.3%)
	University	65 (22.8%)
	Construction Firm	30 (10.5%)
Years of Experience/Study	Less than 5 years	135 (47.4%)
	5–10 years	95 (33.3%)
	Above 10 years	55 (19.3%)
<b>Total Number of Respondents = 285</b>		

The demographic distribution of the 285 respondents presented in table 1 provides important context for understanding the study's findings on sustainable construction skills in TVET in Nigeria. The gender composition shows a higher proportion of male respondents (63.2%) compared to female respondents (36.8%), reflecting the male-dominated nature of the construction and technical education sectors in Nigeria. In terms of role, the majority of respondents were TVET students (56.1%), followed by TVET educators (28.1%) and construction industry professionals (15.8%), indicating that the data largely capture perspectives from both trainees and trainers, with complementary input from industry practitioners. The institutional distribution reveals broad representation across key TVET and construction-related institutions, with respondents drawn from polytechnics (26.3%), universities (22.8%), technical colleges (21.1%), colleges of education (technical) (19.3%), and construction firms (10.5%), suggesting a balanced spread across educational and industry settings. Regarding experience and level of study, nearly half of the

respondents had less than five years of experience or study (47.4%), while 33.3% reported 5–10 years, and 19.3% had over ten years, indicating that the sample includes both early-career participants and more experienced stakeholders. Overall, the demographic profile suggests that the study draws on a diverse and relevant group of respondents whose backgrounds enhance the credibility and representativeness of the findings on sustainable construction skills in Nigeria.

## Presentation Of Findings

### Quantitative Data Findings

**Table 2. Sustainable Construction Skills Required in TVET Programmes. (Objective 1) n = 285.**

Item	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)	Mean	Standard Deviation
TVET programmes should include training on energy-efficient construction techniques.	125 (43.9%)	95 (33.3%)	30 (10.5%)	20 (7.0%)	15 (5.3%)	4.03	1.01
Knowledge of sustainable building materials is essential for construction trainees.	135 (47.4%)	90 (31.6%)	25 (8.8%)	20 (7.0%)	15 (5.3%)	4.09	0.99
Waste management and recycling skills are necessary for modern construction practice.	140 (49.1%)	85 (29.8%)	30 (10.5%)	20 (7.0%)	10 (3.5%)	4.14	0.96
Environmental impact assessment skills should be taught in TVET construction programmes.	120 (42.1%)	100 (35.1%)	35 (12.3%)	20 (7.0%)	10 (3.5%)	4.05	0.98

Item	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)	Mean	Standard Deviation
Safety-oriented construction skills are part of sustainable construction competence.	150 (52.6%)	90 (31.6%)	25 (8.8%)	10 (3.5%)	10 (3.5%)	4.26	0.89

### Interpretation

Table 2 presents respondents' perceptions of the sustainable construction skills required in TVET programmes in Nigeria and shows a strong consensus in favour of integrating such skills into TVET curricula. Across all five items, the mean scores are above the criterion mean of 3.00, ranging from 4.03 to 4.26, indicating overall agreement. A substantial majority of respondents either strongly agreed or agreed that TVET programmes should include training on energy-efficient construction techniques (77.2%), possess knowledge of sustainable building materials (79.0%), and emphasize waste management and recycling skills (78.9%), underscoring the perceived importance of environmental sustainability competencies in modern construction practice. Similarly, over three-quarters of the respondents supported the inclusion of environmental impact assessment skills (77.2%), reflecting awareness of the need to address environmental consequences of construction activities. Notably, safety-oriented construction skills recorded the highest level of agreement, with 84.2% of respondents strongly agreeing or agreeing and the highest mean score ( $M = 4.26$ ,  $SD = 0.89$ ), highlighting safety as a core component of sustainable construction competence. The relatively low standard deviations across items suggest consistency in respondents' views. Overall, the findings indicate that stakeholders strongly recognize energy efficiency, sustainable materials, waste management, environmental assessment, and safety skills as essential sustainable construction competencies that TVET programmes must prioritize to meet contemporary industry and sustainability demands in Nigeria.

**Table 3. Sustainable Construction Skills and Economic Growth. (Objective 2) n = 285**

Item	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)	Mean	Standard Deviation
Sustainable construction skills increase	145 (50.9%)	90 (31.6%)	25 (8.8%)	15 (5.3%)	10 (3.5%)	4.21	0.91

Item	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)	Mean	Standard Deviation
employability of TVET graduates.							
TVET graduates with sustainable skills contribute more to economic productivity.	135 (47.4%)	95 (33.3%)	30 (10.5%)	15 (5.3%)	10 (3.5%)	4.15	0.94
Adoption of sustainable construction practices reduces project costs in the long term.	120 (42.1%)	100 (35.1%)	35 (12.3%)	20 (7.0%)	10 (3.5%)	4.02	0.98
Sustainable construction skills support the growth of Nigeria's construction industry.	140 (49.1%)	90 (31.6%)	30 (10.5%)	15 (5.3%)	10 (3.5%)	4.17	0.93
TVET-based sustainable skills promote entrepreneurship in the construction sector.	130 (45.6%)	95 (33.3%)	35 (12.3%)	15 (5.3%)	10 (3.5%)	4.12	0.95

### Interpretation

Table 3 illustrates respondents' perceptions of the contribution of sustainable construction skills to economic growth in Nigeria and reveals a consistently high level of agreement across all items. The mean scores for the five statements range from 4.02 to 4.21, all exceeding the benchmark mean of 3.00, which indicates strong positive perceptions regarding the economic relevance of sustainable construction skills acquired through TVET. A clear majority of respondents agreed or strongly agreed that sustainable construction skills increase the employability of TVET graduates (82.5%), with this item recording the highest mean score ( $M = 4.21$ ,  $SD = 0.91$ ), suggesting that employability is viewed as the most immediate economic benefit. Similarly, substantial

proportions of respondents affirmed that TVET graduates with sustainable skills contribute more to economic productivity (80.7%) and that such skills support the overall growth of Nigeria's construction industry (80.7%), reflecting confidence in the sector-wide economic impact of sustainability-oriented competencies. Although slightly lower, strong agreement was also observed for the long-term cost reduction benefits of adopting sustainable construction practices (77.2%) and the role of TVET-based sustainable skills in promoting entrepreneurship within the construction sector (78.9%). The relatively low standard deviations across all items indicate minimal variation in respondents' views. Overall, the findings suggest that sustainable construction skills are widely perceived as critical drivers of employability, productivity, industrial growth, cost efficiency, and entrepreneurship, thereby reinforcing their importance in fostering sustainable economic growth in Nigeria through TVET programmes.

**Table 4. Sustainable Construction Skills and Environmental Protection. (Objective 3). n = 285.**

Item	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)	Mean	Standard Deviation
Sustainable construction skills help reduce environmental pollution.	150 (52.6%)	90 (31.6%)	25 (8.8%)	10 (3.5%)	10 (3.5%)	4.26	0.89
TVET training can promote environmentally responsible construction practices.	145 (50.9%)	95 (33.3%)	25 (8.8%)	10 (3.5%)	10 (3.5%)	4.25	0.88
Knowledge of green construction reduces excessive use of natural resources.	140 (49.1%)	90 (31.6%)	35 (12.3%)	10 (3.5%)	10 (3.5%)	4.19	0.92

Item	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)	Mean	Standard Deviation
Sustainable construction practices help mitigate climate change effects.	130 (45.6%)	100 (35.1%)	35 (12.3%)	10 (3.5%)	10 (3.5%)	4.14	0.93
TVET graduates should be trained to comply with environmental regulations.	155 (54.4%)	85 (29.8%)	25 (8.8%)	10 (3.5%)	10 (3.5%)	4.28	0.87

### Interpretation

Table 4 shows respondents' perceptions of how sustainable construction skills support environmental protection in Nigeria and indicate a strong consensus in favour of integrating such skills into TVET programmes. All items recorded high mean scores ranging from 4.14 to 4.28, well above the criterion mean of 3.00, demonstrating widespread agreement among respondents. A substantial majority of participants either strongly agreed or agreed that sustainable construction skills help reduce environmental pollution (84.2%) and that TVET training promotes environmentally responsible construction practices (84.2%), underscoring the perceived role of TVET in fostering environmental stewardship within the construction sector. Similarly, respondents acknowledged that knowledge of green construction reduces excessive use of natural resources (80.7%) and that sustainable construction practices contribute to mitigating climate change effects (80.7%), reflecting awareness of the environmental benefits of sustainability-oriented competencies. Notably, the statement that TVET graduates should be trained to comply with environmental regulations recorded the highest level of agreement (84.2%) and the highest mean score ( $M = 4.28$ ,  $SD = 0.87$ ), highlighting the importance placed on regulatory compliance in achieving environmental protection. The relatively low standard deviations across all items indicate consistency in respondents' views. Overall, the findings suggest that sustainable construction skills acquired through TVET are widely perceived as critical tools for reducing pollution, conserving natural resources, mitigating climate change, and ensuring compliance with environmental regulations in Nigeria.

**Table 5. Sustainable Construction Skills, Safety, and Security. (Objective 4). n = 285.**

Item	Strongly Agree (5)	Agree (4)	Neutral (3)	Disagree (2)	Strongly Disagree (1)	Mean	Standard. Deviation
Sustainable construction skills reduce workplace accidents.	145 (50.9%)	95 (33.3%)	25 (8.8%)	10 (3.5%)	10 (3.5%)	4.24	0.89
Safety training in TVET improves construction site security.	150 (52.6%)	90 (31.6%)	25 (8.8%)	10 (3.5%)	10 (3.5%)	4.26	0.88
Proper construction skills reduce risks of building collapse.	155 (54.4%)	85 (29.8%)	25 (8.8%)	10 (3.5%)	10 (3.5%)	4.28	0.87
TVET skill development can help reduce youth unemployment and insecurity.	140 (49.1%)	95 (33.3%)	30 (10.5%)	10 (3.5%)	10 (3.5%)	4.21	0.90
Sustainable construction skills contribute to safer communities.	150 (52.6%)	90 (31.6%)	25 (8.8%)	10 (3.5%)	10 (3.5%)	4.26	0.88

### Interpretation

Table 5 presents respondents' views on the relationship between sustainable construction skills, safety, and security in Nigeria and demonstrates a very strong level of agreement across all items. All five statements recorded high mean scores, ranging from 4.21 to 4.28, which are well above the criterion mean of 3.00, indicating that respondents strongly perceive sustainable construction skills as crucial to improving safety and security outcomes. A large majority of respondents either

agreed or strongly agreed that sustainable construction skills reduce workplace accidents (84.2%) and that safety training in TVET improves construction site security (84.2%), highlighting the importance of structured safety education in construction training programmes. The highest level of agreement was observed for the statement that proper construction skills reduce the risks of building collapse, with 84.2% agreement and the highest mean score ( $M = 4.28$ ,  $SD = 0.87$ ), underscoring concerns about structural failures and the role of skilled workmanship in mitigating such risks. In addition, most respondents affirmed that TVET skill development can help reduce youth unemployment and insecurity (82.5%), suggesting broader social and security benefits beyond the construction sector. Similarly, strong agreement was recorded for the view that sustainable construction skills contribute to safer communities (84.2%). The low standard deviations across all items indicate a high level of consistency in respondents' opinions. Overall, the findings suggest that sustainable construction skills acquired through TVET programmes are widely regarded as essential not only for enhancing construction safety but also for promoting social security and community safety in Nigeria.

### **Qualitative Data Findings**

#### **Open-Ended Question (Item 21):**

In your opinion, how can TVET institutions improve the teaching of sustainable construction skills in Nigeria?

#### **Theme 1: Practical-Oriented Training**

This was the most dominant theme identified. Respondents emphasized the need for TVET institutions to focus more on hands-on training, practical workshops, and real-life construction site experiences. Many participants noted that sustainable construction skills are best learned through practice rather than theory alone.

*Extracts from participants' responses:*

- “Students should spend more time on construction sites.”
- “TVET should focus more on practical skills than classroom teaching.”

#### **Theme 2: Curriculum Review and Integration of Sustainability**

Respondents highlighted the importance of updating TVET curricula to explicitly include sustainable and green construction concepts, such as energy efficiency, waste management, and

environmentally friendly materials. This theme reflects the need to align TVET programmes with global sustainability goals.

*Extracts from participants' responses:*

- “Green building and sustainability should be part of the curriculum.”
- “The curriculum needs to reflect current environmental challenges.”

### **Theme 3: Use of Modern Technology and Equipment**

Participants emphasized the adoption of modern construction technologies, including digital tools, simulations, and contemporary equipment. They argued that exposure to current industry technologies would enhance students' competence and employability.

*Extracts from participants' responses:*

- “TVET schools should use modern machines and tools.”
- “Technology like BIM should be introduced in construction training.”

### **Theme 4: Instructor Capacity Building**

This theme reflects concerns about the competence of instructors. Respondents suggested regular training, retraining, and certification of TVET teachers to ensure they are up to date with sustainable construction practices and industry standards.

*Extracts from participants' responses:*

- “Teachers need to be trained on sustainable construction methods.”
- “Instructors should be exposed to new construction techniques.”

### **Theme 5: Industry Collaboration and Partnerships**

Some respondents stressed the need for stronger collaboration between TVET institutions and the construction industry, including internships, industrial attachments, and guest lectures by industry professionals.

*Extracts from participants' responses:*

- “TVET institutions should partner with construction companies.”
- “Industry experts should be involved in training students.”

### **Summary of Qualitative Findings**

The thematic analysis reveals that respondents believe improving the teaching of sustainable construction skills in TVET institutions requires a multidimensional approach. Emphasis on practical training, curriculum reform, technological integration, instructor development, and industry collaboration emerged as key strategies. These themes collectively highlight the need to reposition TVET institutions as practice-driven, industry-aligned, and sustainability-focused centres for skill development in Nigeria.

### **Discussion of Findings**

The findings of this study demonstrate a strong consensus among respondents that sustainable construction skills are essential within TVET programmes for balancing economic growth, environmental protection, and security in Nigeria. The high agreement on the inclusion of energy-efficient construction techniques, sustainable materials, waste management, environmental impact assessment, and safety-oriented skills confirms earlier studies which argue that sustainable construction competencies are critical for modern construction practice and workforce readiness (Auta & Onwusuru, 2022; Unegbu et al., 2025), suggesting strong convergence between industry expectations and educational priorities. The finding that sustainable construction skills significantly enhance employability, productivity, entrepreneurship, and industry growth also agrees with prior research, which identifies TVET as a strategic driver of economic development when curricula are aligned with sustainability and labour market demands (Muoghalu & Ahmad, 2025; Mohamad et al., 2023); this alignment reflects Nigeria's growing need for a skilled green workforce within its construction sector. Furthermore, respondents' strong perception that sustainable construction skills support environmental protection through pollution reduction, resource conservation, climate change mitigation, and regulatory compliance is consistent with studies on greening TVET, which emphasise the role of technical vocational education in promoting environmental stewardship and achieving sustainable development goals (Ayuba et al., 2024; Hamza et al., 2025). The results linking sustainable construction skills with improved safety outcomes, reduced building collapse risks, lower workplace accidents, and enhanced community security equally support existing evidence, which indicates that structured skills training and safety education reduce occupational hazards and contribute to broader social stability (Chukwu, 2023; Unegbu et al., 2025). The qualitative findings further reinforce these quantitative results, with respondents advocating for practical-oriented training, curriculum reform, technology integration, instructor capacity building, and industry collaboration, recommendations that closely mirror earlier studies highlighting weak industry–TVET linkages, outdated curricula, and instructor skill gaps as major constraints to effective TVET delivery in Nigeria (Ime et al., 2025; Offiong et al., 2022; Nwoye et al., 2020). The findings extend prior research by empirically demonstrating that sustainable construction skills within TVET simultaneously address economic, environmental, and

security dimensions, thereby filling a critical gap in Nigerian TVET and construction education literature.

### **Implications of the Study**

This study offers important theoretical and practical implications for the understanding and implementation of sustainable construction skills within Technical Vocational Education and Training (TVET) in Nigeria. Theoretically, the findings strengthen the linkage between human capital theory and sustainable development by demonstrating that TVET-based skill acquisition in sustainable construction extends beyond employability outcomes to include broader economic, environmental, and security benefits. The evidence supports the view that TVET functions as a multidimensional development framework capable of addressing labour market demands, environmental sustainability, and societal safety challenges simultaneously. By empirically integrating economic growth, environmental protection, and security considerations into a single analytical framework, the study advances existing TVET and sustainability theories and provides context-specific insights from a developing economy perspective.

Practically, the study underscores the need for deliberate curriculum reforms that embed sustainable construction competencies, such as energy-efficient construction techniques, use of sustainable materials, waste management, environmental compliance, and safety practices, into TVET programmes. The strong positive perceptions reported by educators, students, and industry professionals indicate that aligning TVET curricula with sustainability principles can enhance graduate employability, support entrepreneurship, improve workplace safety, and contribute to industry growth. The findings also highlight the importance of strengthening industry–TVET collaboration, expanding work-integrated learning opportunities, and investing in continuous professional development for TVET instructors to ensure effective delivery of sustainable skills. For policymakers and regulatory agencies, the results provide empirical justification for increased investment in TVET as a strategic tool for promoting sustainable economic development, environmental protection, and social stability in Nigeria.

### **Conclusion**

This study examined the role of sustainable construction skills in Technical Vocational Education and Training (TVET) as a mechanism for balancing economic growth, environmental protection, and security in Nigeria, and the findings provide strong empirical evidence of their multidimensional importance. The results reveal a broad consensus among TVET educators, students, and construction industry professionals that sustainable construction competencies, particularly energy efficiency, sustainable materials, waste management, environmental impact assessment, and safety-oriented skills, are essential components that should be systematically

integrated into TVET curricula. The study further establishes that the acquisition of these skills significantly enhances graduate employability, productivity, entrepreneurship, and long-term cost efficiency within the construction sector, thereby reinforcing TVET's strategic role in promoting sustainable economic growth. In addition, the findings demonstrate that sustainable construction skills contribute meaningfully to environmental protection by reducing pollution, conserving natural resources, mitigating climate change effects, and ensuring compliance with environmental regulations, underscoring the relevance of greening TVET in addressing Nigeria's environmental challenges. Importantly, the study also highlights the strong relationship between sustainable construction skills, safety, and security, showing that improved training reduces workplace accidents, lowers the risk of building collapse, enhances construction site security, and contributes to broader social stability by addressing youth unemployment and community safety concerns. The qualitative findings further complement the quantitative results by emphasizing the need for practical-oriented training, curriculum reform, modern technology adoption, instructor capacity building, and stronger industry collaboration as critical pathways for improving the delivery of sustainable construction skills in TVET institutions. Overall, the study concludes that integrating sustainable construction skills into TVET is not only vital for producing competent and employable graduates but also serves as a powerful policy and educational tool for advancing sustainable development, environmental stewardship, and national security in Nigeria.

### **Limitations**

The scope of this research was constrained by time and resource limitations, which may affect the depth and breadth of data collection and analysis.

### **Recommendations**

Based on the findings of this study, the following recommendations are proposed to enhance the effectiveness of sustainable construction skills development within TVET programmes in Nigeria.

#### **1. Curriculum Reform and Integration of Sustainability**

TVET regulatory bodies and curriculum developers should comprehensively review and update construction-related curricula to embed sustainable construction competencies, including energy-efficient construction techniques, sustainable building materials, waste management, environmental impact assessment, and safety practices, in line with industry standards and sustainability goals.

#### **2. Strengthening Practical and Work-Integrated Learning**

TVET institutions should place greater emphasis on practical-oriented training by expanding workshops, laboratory sessions, and supervised industrial attachments to enable students to acquire hands-on experience in sustainable construction practices.

### **3. Capacity Building for TVET Instructors**

Regular training, retraining, and industry exposure programmes should be organized for TVET instructors to enhance their technical competence in sustainable construction methods, emerging technologies, and safety management practices.

### **4. Enhanced Industry–TVET Collaboration**

Stronger partnerships should be established between TVET institutions and construction firms to facilitate internships, apprenticeship programmes, guest lectures, and joint curriculum development, ensuring that training remains relevant to labour market needs.

### **5. Investment in Modern Facilities and Technologies**

Government and institutional management should increase funding for TVET institutions to procure modern construction tools, equipment, and digital technologies such as Building Information Modelling (BIM) and simulation tools that support sustainable construction training.

### **6. Policy Support and Regulatory Enforcement**

Policymakers and regulatory agencies should develop and enforce policies that promote sustainability in construction education and practice, including incentives for institutions and firms that adopt sustainable construction standards.

### **7. Promotion of TVET as a Tool for Employment and Security**

Government and development agencies should leverage TVET as a strategic intervention for reducing youth unemployment and insecurity by expanding access to construction-related TVET programmes and supporting graduate entrepreneurship through grants and incubation schemes.

### **Future Research Directions**

Future studies could build on this research in several ways. Longitudinal research designs are recommended to examine the long-term impacts of sustainable construction skills acquisition on graduates' employability, career progression, and workplace safety outcomes. Further research could also adopt experimental or quasi-experimental approaches to assess the effectiveness of specific sustainable construction training interventions within TVET programmes. Additionally, qualitative case studies involving employers, policymakers, and regulatory agencies could provide deeper insights into institutional and policy barriers to integrating sustainability into TVET

curricula. Comparative studies across different regions, countries, or construction sub-sectors would further enrich understanding of contextual differences and best practices, while future research could also explore the role of emerging digital technologies, such as Building Information Modelling (BIM), simulation tools, and virtual reality, in enhancing sustainable construction skills training in TVET institutions.

## References

- Auta, M. A., & Onwusuru, I. M. (2022). TVET Graduates Employability for Construction Industry: A Mixed-Method Study. *Online Journal for TVET Practitioners*, 7(1), 85-94.
- Ayuba, Z. G., Datol, I. G., & Aluwong, E. B. (2024). Greening Technical Vocational Education and Training (TVET) for combating climate change and promoting sustainable development in Nigeria. *BW Academic Journal*, 1(3), 43–49.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Chukwu, D. U. (2023). The role of Technical Vocational Education and Training (TVET) in tackling unemployment and insecurity in Nigeria: A review. *Industrial Technology Education Research Journal*, 6(1), 15–24.
- Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches* (5th ed.). Sage Publications.
- Dillman, D. A., Smyth, J. D., & Christian, L. M. (2014). *Internet, phone, mail, and mixed-mode surveys: The tailored design method* (4th ed.). Wiley.
- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1–4. <https://doi.org/10.11648/j.ajtas.20160501.11>
- Hamza, S., Chedi, J.M., & Angulu, H. (2025). Integrating Green Process Skills into Construction Technology: Nigeria’s Roadmap to Sustainable Economic Growth and Development. *In: TVET@Asia*, 24, 1-17. [https://tvvet-online.asia/wp-content/uploads/2025/03/TVET@Asia-Issue-24\\_Hamza-et-al.\\_proofread-formattiert-2.pdf](https://tvvet-online.asia/wp-content/uploads/2025/03/TVET@Asia-Issue-24_Hamza-et-al._proofread-formattiert-2.pdf)
- IBM Corp. (2019). *IBM SPSS Statistics for Windows* (Version 26.0). IBM Corp.
- Ime, E. O., Udoudo, N. J., Ekong, E. A., & Udom, U. G. (2025). Sustainability of Technical Vocational Education and Training funding for human capital development in Nigeria. *Journal of Community & Communication Research*. 10(1), 38-46.
- Mohamad, M. M., Ruslan, R. F. I., Fatin Najwa Mohd Nusa, & Ahmad, A. (2023). The

- knowledge and skill readiness of TVET trainee in construction program for green construction project management. *Online Journal for TVET Practitioners*, 8(1), 43-51
- Muogahlu, N., & Ahmad, A. B. (2025). Redesigning Technical Vocational Education and Training for sustainable economic development in Nigeria. *Journal of Vocational Education Studies*.6(1), 96-110.
- Nwoye, E. G., Ndubuisi, B. N., Omale, B. A. & Nengak, I. S. (2020). Strategies for enhancing TVET-industrial linkage for skill training and sustainable national development. *Journal of Association of Vocational and Technical Educators of Nigeria*, 26(1), 52-62
- Offiong, M. A., Utuk, I., & Essien, E. (2022). Technical Vocational Education and Training (TVET): A response to future skill need and job creation for a green economy in Nigeria. *Journal of Association of Vocational and Technical Educators of Nigeria*. 28(1), 94-104.
- Taber, K. S. (2018). The use of Cronbach's alpha when developing and reporting research instruments in science education. *Research in Science Education*, 48(6), 1273–1296.  
<https://doi.org/10.1007/s11165-016-9602-2>
- Unegbu, H.C.O., Yawas, D. S., Dan-Asabe, B. & Alabi, A.A. (2025). *Sustainable construction in Nigeria: A comprehensive socioeconomic impact assessment*. *IEM Journal*, 86(1), 21-32.