Assessment of Green and Smart Electrical Installation Skills Required for Sustainable Building Practices among Electrical Installation and Maintenance Work Students in Technical Colleges in Rivers State

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ABSTRACT

The study examines the assessment of green and smart electrical installation skills required for sustainable building practices among electrical installation and maintenance work students in Technical Colleges in Rivers State. Three research questions were answered to guide the study. The study employed the descriptive research survey design and was carried out in Rivers State. The population of the study was 168 respondents comprised 13 Electrical Installation and Maintenance Work teachers in Technical Colleges and 155 electrical industry professionals. The sample for the study was 109 respondents consisting of 13 teachers and 96 training instructors that was purposively selected from 33 registered electrical industries in Rivers State. The sampling respondents were selected based on relevant qualifications and practical experience in electrical installation and sustainable building technologies. The instrument for data collection was researchers - developed questionnaire tagged "Green and Smart Electrical Installation Skills Questionnaire (GSEISQ)" design after Likert – 5-point rating scale of requirement. The instrument was subjected to face and content validation by three experts. The reliability of the instrument was established as 0.86, 0.89 and 0.84 for different sections of the instrument with an overall reliability coefficient of 0.86 through Cronbach Alpha. Data collected were analysed using Mean with Standard Deviation to answer the research questions while real limit of numbers were used for decision. The study found that green and smart electrical installation skills are *Highly Required (HR)* for sustainable building practices among Electrical Installation and Maintenance Work students in Technical Colleges in Rivers State. The study also found that strategies identified are *Highly Required (HR)* for integrating green and smart electrical installation skills into the Electrical Installation and Maintenance Work curriculum for sustainable building practices in Technical Colleges in Rivers State. Based on the findings of the study, it was recommended among others that National Board for Technical Education (NBTE) and curriculum development agencies should review the Electrical Installation and Maintenance Work curriculum to incorporate identified green electrical installation skills such as solar photovoltaic systems, battery energy storage systems, energy-efficient wiring, and electrical energy management. Technical College administrators and instructors should integrate practical training on smart electrical installation technologies - including smart meters, home automation systems, programmable logic controllers (PLC), Internet of Things (IoT)-enabled devices, and electric vehicle charging systems into workshop instruction to improve students' practical competencies.

Keywords: Green Electrical Installation Skills, Smart Electrical Installation Skills, Sustainable Building Practices, Electrical Installation and Maintenance Work, TVET.

INTRODUCTION

Concerns over climate change, environmental degradation, increasing energy demand and the steady depletion of natural resources have continued to place sustainable development at the centre of global discourse across several sectors of the economy, particularly the construction industry. The construction sector is widely recognized as one of the major contributors to high energy consumption, greenhouse gas emissions, material depletion and environmental pollution. In response to these challenges, sustainable building practices have become a practical approach for reducing the environmental impact of buildings while also promoting economic efficiency and social well-being. Such practices involve the planning, design, construction, operation and maintenance of buildings through the use of environmentally responsible materials, energy-efficient technologies, renewable energy systems and resource conservation measures across the building life cycle. However, the successful adoption of sustainable building practices does not depend on technology alone; it also requires a workforce with the appropriate green competencies and technical skills. Olaleye and Adetunji (2026) noted that the transition to sustainable construction in Nigeria has been constrained by inadequate green competencies among graduates of vocational and technical institutions, thereby limiting the adoption of sustainable building technologies.

The growing emphasis on sustainable buildings has also reshaped the competency demands placed on professionals and technicians involved in building construction and services. Electrical installation technicians occupy a significant position in this process because electrical systems determine, to a large extent, the energy performance, safety, automation and operational efficiency of modern buildings. Traditionally, Electrical Installation and Maintenance Works (EIMWs) as offered in Technical Colleges practice focused mainly on wiring, circuit protection, testing, fault diagnosis and the maintenance of electrical systems. Today, the emergence of renewable energy technologies, building automation, smart metering, intelligent lighting systems, home automation, Internet of Things (IoT) devices and energy management systems has expanded the scope of electrical installation and maintenance work. As a result, electrical installation and maintenance work technicians are now expected to possess competencies that support energy conservation, renewable energy integration, intelligent control systems and environmentally sustainable electrical practices. Arilesere and Jacob (2026) reported that competencies in solar photovoltaic installation, system configuration, maintenance, customer needs assessment and measurement techniques are essential for Technical and Vocational Education and Training (TVET) graduates who intend to participate effectively in sustainable green jobs in Nigeria.

This development has brought renewed attention to the relevance of green skills in Technical and Vocational Education and Training (TVET). Green skills are the knowledge, practical skills, attitudes, and values required to support environmentally sustainable economic activities and reduce harmful environmental effects. Within electrical installation and maintenance works, these skills include competencies in energy-efficient wiring systems, renewable energy technologies, waste minimization, environmental compliance, efficient use of electrical materials, energy auditing, and sustainable maintenance practices. They are not intended to replace conventional technical skills; rather, they extend and strengthen those skills by enabling technicians to perform electrical installation and maintenance work tasks in environmentally responsible ways. Hence, Cledumas, Kamin, Haruna and Mohammed (2019) assessed employers' perceptions of the green skills possessed by Electrical Installation and Maintenance Work graduates in Nigeria and found that although graduates demonstrated adequate competence in some industrial installation tasks but gaps were found to exists in key areas including preventive maintenance, equipment testing, interpretation of technical drawings and industrial electrical operations and so on. The authors concluded that continuous improvement in green competencies is necessary if graduates are to meet changing industry expectations.

Although green skills are important, they may not be sufficient on their own to meet the requirements of contemporary electrical installations. Technological advancement has introduced intelligent electrical systems that can monitor, control, and optimize building operations. This has created the need for smart electrical installation skills, which involve the ability to install, configure, operate, troubleshoot, and maintain intelligent electrical systems connected to digital communication technologies. Smart electrical installation covers smart

switches, programmable lighting systems, occupancy sensors, intelligent metering devices, building automation systems, renewable energy interfaces, battery storage systems, and IoT-enabled electrical devices. When these technologies are properly installed and integrated, they improve building energy efficiency, reduce operational costs, enhance occupant comfort, and support sustainable development objectives. For this reason, technical education institutions must prepare graduates who can function effectively in workplaces that are both digitally connected and environmentally sustainable.

The increasing application of green and smart technologies in the construction industry has important implications for Technical and Vocational Education and Training. Technical Colleges in Nigeria are established to produce craftsmen and technicians who can meet industry manpower needs through practical and competency-based training. In these institutions, Electrical Installation and Maintenance Work (EIMW) is designed to equip learners with competencies in electrical wiring, installation, maintenance, testing, and fault diagnosis for domestic and industrial applications. However, technological change often reshapes occupational standards more quickly than curriculum review processes can accommodate. Edevwie, Obi, and Okoye (2024) showed that innovative instructional approaches significantly improved students' practical skills in Electrical Installation and Maintenance Works, indicating that both curriculum content and teaching methods must be continually updated to reflect current industrial practices.

Similarly, Nwauzi, Ovundah, and Anah (2021) identified inadequate instructional facilities, obsolete workshop equipment, and limited exposure to contemporary industrial practices as major constraints to practical skills acquisition among Electrical Installation and Maintenance Work students in Rivers State. Their study recommended improved workshop facilities, stronger industry collaboration, and curriculum enhancement as strategies for strengthening students' practical competence. These observations suggest that graduates may struggle to adapt to emerging green and smart electrical technologies if instructional programmes continue to emphasize mainly conventional installation practices without adequate exposure to sustainable and intelligent electrical systems. Hence, it becomes necessary to assess the green and smart electrical installation skills required for sustainable building practices among Electrical Installation and Maintenance Work students in Technical Colleges in Rivers State.

Statement of the Problem

The shift towards sustainable construction has increased the demand for technicians who can apply green and smart electrical installation skills in energy-efficient buildings, renewable energy systems, intelligent building technologies, and environmentally responsible electrical practices. Consequently, Technical and Vocational Education and Training (TVET), especially Electrical Installation and Maintenance Work (EIMW) programmes in Technical Colleges, is expected to prepare students with competencies that match the emerging skill requirements of the green economy and the sustainable building industry. According to Deebom (2019), TVET is a programme that is used to train semi-skilled labour. It is an education program that is organized to orient people into skills acquisition, and as well teach them the attitude and knowledge necessary for the appropriate utilization of such skills (Deebom, 2019). Studies have shown that green competencies are now essential for improving workforce productivity, promoting environmental sustainability, and enhancing the employability of graduates in technical occupations (Cledumas et al., 2019; Arilesere & Jacob, 2026).

However, despite these expectations, available evidence indicates that many Technical Colleges in Nigeria still emphasize conventional electrical installation practices more than emerging green and smart electrical technologies. Previous studies have reported weaknesses in students' practical competencies, inadequate exposure to renewable energy systems, obsolete workshop facilities, and limited integration of sustainability-related skills into Electrical Installation and Maintenance Work programmes. These challenges tend to reduce the readiness of graduates for present industry demands (Nwauzi et al., 2021; Edevwie et al., 2024). As a result, graduates may experience difficulty securing relevant employment or participating effectively in sustainable building projects where competencies in smart electrical systems and green technologies are increasingly and highly required as perquisite for employment or service delivery.

Although existing studies have examined green skills, solar energy installation competencies, and practical skills acquisition among Technical College graduates, there is still limited empirical evidence on the specific green and smart electrical installation skills required for sustainable building practices among Electrical Installation and Maintenance Work students in Nigerian Technical Colleges. This gap creates uncertainty for curriculum developers, teachers, and policymakers in identifying the competencies that should be prioritized in preparing students for the changing demands of the construction and electrical industries. It is against this back drop that this study assesses green and smart electrical installation skills required for sustainable building practices among Electrical Installation and Maintenance Work students in Technical Colleges in Rivers State.

Purpose of the Study

The purpose of this study is to assess the green and smart electrical installation skills required for sustainable building practices among Electrical Installation and Maintenance Work students in Technical Colleges in Rivers State. Specifically, the study seeks to:

1. Determine the green electrical installation skills required for sustainable building practices among Electrical Installation and Maintenance Work students in Technical Colleges in Rivers State.

2. Determine the smart electrical installation skills required for sustainable building practices among Electrical Installation and Maintenance Work students in Technical Colleges in Rivers State.

3. Determine the strategies for integrating green and smart electrical installation skills into the Electrical Installation and Maintenance Work curriculum for sustainable building practices in Technical Colleges in Rivers State.

Research Questions

The following research questions guided the study:

1. What green electrical installation skills are required for sustainable building practices among Electrical Installation and Maintenance Work students in Technical Colleges in Rivers State?

2. What smart electrical installation skills are required for sustainable building practices among Electrical Installation and Maintenance Work students in Technical Colleges in Rivers State?

3. What the strategies for integrating green and smart electrical installation skills into the Electrical Installation and Maintenance Work curriculum for sustainable building practices in Technical Colleges in Rivers State?

THEORETICAL REVIEW

This study is anchored on Competency-Based Education (CBE) Theory, which offers a suitable foundation for identifying the competencies required to prepare Electrical Installation and Maintenance Work students for sustainable building practices. Competency-Based Education Theory was advanced by Benjamin S. Bloom (1971) and later developed further through competency-based training models by Richard A. Voorhees (2001). The central argument of the theory is that education should be organized around clearly defined competencies that learners are expected to demonstrate before they can be regarded as proficient. Competency-based education therefore places emphasis on measurable learning outcomes, practical performance, industry relevance, mastery of occupational skills, and continuous assessment. In contrast to the traditional approach, which often gives more attention to covering subject content, competency-based education focuses on ensuring that graduates acquire the knowledge, practical skills, attitudes, and professional behaviours needed for effective performance in the workplace.

The theory is especially relevant to Technical and Vocational Education and Training because TVET programmes are expected to produce graduates whose skills correspond directly with labour market and industry requirements. As electrical installation technologies increasingly shift towards renewable energy systems, smart buildings, intelligent electrical networks, and sustainable building practices, competency-based education provides a basis for Technical Colleges to identify, assess, and integrate emerging occupational competencies into their instructional programmes. In this study, the competency-based education theory is adopted as it serves as a framework for examining the green electrical installation skills, smart electrical installation skills, and curriculum integration strategies required for sustainable building practices among Electrical Installation and Maintenance Work students in Technical Colleges in Rivers State.

METHODOLOGY

This study adopted a descriptive survey research design. The design was considered appropriate because it enabled the researcher to obtain the opinions of respondents on green and smart electrical installation skills required for sustainable building practices among Electrical Installation and Maintenance Work (EIMW) students in Technical Colleges in Rivers State without manipulating any variables. The study was conducted in Technical Colleges in Rivers State that offers Electrical Installation and Maintenance Work programmes. The population of the study was 168 respondents comprised 13 Electrical Installation and Maintenance Work teachers in Technical Colleges and 155 electrical industry professionals that are involved in electrical installation, renewable energy systems, smart building technologies and electrical maintenance. These two groups were considered suitable because of their knowledge and experience regarding the competencies required for contemporary electrical installation practice. The sample for the study was 109 respondents consisting of 13 teachers based on census population and 96 training instructors that was purposively selected from 33 registered electrical industries in Rivers State. The sampling respondents were selected based on relevant qualifications and practical experience in electrical installation and sustainable building technologies that could provide valid information for the study.

The instrument for data collection was researchers - developed questionnaire tagged “Green and Smart Electrical Installation Skills Questionnaire (GSEISQ)” design in the pattern of Likert – 5 point rating scale of *Requirement*. The instrument consisted of four sections. Section A elicited respondents' demographic information. Section B contained items on green electrical installation skills, Section C contained items on smart electrical installation skills, while Section D contained items on strategies for integrating green and smart electrical installation skills into the Electrical Installation and Maintenance Work curriculum. The questionnaire was structured on a five-point modified Likert scale of Highly Required (5), Required (4), Moderately Required (3), Slightly Required (2), and Not Required (1).

The instrument was subjected to face and content validation by three experts: one expert in Electrical Engineering, one in Electrical/Electronic Technology Education, and one in Measurement and Evaluation, all from Rivers State University, Port Harcourt. Their observations and recommendations were used to improve the clarity, relevance, and adequacy of the instrument before administration. The reliability of the instrument was established through a pilot study involving 17 respondents drawn from Technical Colleges and electrical industries outside the study area but with similar characteristics to the study population. The data obtained were analysed using Cronbach's Alpha, which yielded reliability coefficients of 0.86 for green electrical installation skills, 0.89 for smart electrical installation skills, 0.84 for curriculum integration strategies, and an overall reliability coefficient of 0.86, indicating that the instrument was reliable for data collection.

Copies of the questionnaire were administered personally by the researchers with the assistance of two trained research assistants. Of the 109 copies administered, all were properly completed and returned, representing a 100% return rate. Data collected were analysed using Mean with Standard Deviation to answer the research questions. For research question, real limit of numbers was used for decision such that item with average mean of 4.50 – 5.00 was considered as Very Highly Required (VHR) while item between 3.50 – 4.49 was taken as Highly Required (HR), between 2.50 – 3.49 was taken as Moderately Required (MR) while item with mean

ranges between 1.50 – 2.49 was considered as Slightly Required (SR) and 1.00 – 1.49 was taken as Not Required (NR) respectively.

RESULTS

The results of the study were presented in Table 1 – 3 below.

Research Question 1: What green electrical installation skills are required for sustainable building practices among Electrical Installation and Maintenance Work students in Technical Colleges in Rivers State?

Table 1: Mean Ratings of Respondents on Green Electrical Installation Skills Required for Sustainable Building Practices

S/N	Green Electrical Installation Skills Required Include:	$\overline{X}_1$	SD	Rmk	$\overline{X}_2$	SD	Rmk
1	Ability to install energy-efficient electrical wiring systems.	3.64	0.83	**HR**	4.63	0.58	**NR**
2	Ability to install LED lighting systems for energy conservation.	3.80	1.01	**HR**	4.71	0.46	**HR**
3	Ability to install solar photovoltaic (PV) systems.	4.35	0.55	**HR**	4.83	0.39	**VHR**
4	Ability to install battery energy storage systems.	4.55	0.62	**VHR**	4.66	0.72	**VHR**
5	Ability to install energy-efficient electrical appliances.	4.49	0.68	**HR**	3.84	0.60	**HR**
6	Ability to select environmentally friendly electrical materials.	4.44	0.71	**HR**	4.03	1.01	**HR**
7	Ability to minimize electrical material waste during installation.	4.61	0.55	**VHR**	4.39	0.74	**HR**
8	Ability to conduct energy efficiency assessment of buildings.	4.52	0.59	**VHR**	3.68	0.61	**HR**
9	Ability to comply with environmental and energy regulations during installation.	4.66	0.48	**VHR**	4.05	1.01	**HR**
10	Ability to apply electrical safety practices that support environmental sustainability.	4.71	0.73	**VHR**	3.97	0.84	**HR**
	Average Mean	**4.38**	**0.68**	**HR**	**4.28**	**0.70**	**HR**

Source: Researchers' Field Result, 2026 $\overline{X}_1$ **-** Mean of Teachers, $\overline{X}_2$ - Mean of Instructors

The result from Table 1 reveals an average mean 4.38 and 4.28 for teachers and instructors which shows that all the items were *Highly Required (HR)* green electrical installation skills that are required for sustainable building practices among Electrical Installation and Maintenance Work students in Technical Colleges in Rivers State.

Research Question 2: What smart electrical installation skills are required for sustainable building practices among Electrical Installation and Maintenance Work students in Technical Colleges in Rivers State?

Table 2: Mean Ratings of Respondents on Smart Electrical Installation Skills Required for Sustainable Building Practices

S/N	Smart Electrical Installation Skills Required Include:	$\overline{X}_1$	SD	Rmk	$\overline{X}_2$	SD	Rmk
11	Ability to install smart lighting control systems.	4.68	0.52	**VHR**	4.58	0.60	**VHR**
12	Ability to install occupancy and motion sensors.	3.46	0.66	**MR**	4.42	0.71	**HR**
13	Ability to install smart switches and smart sockets.	4.68	0.63	**VHR**	3.47	0.64	**MR**
14	Ability to install smart energy meters.	3.76	0.41	**HR**	3.39	1.01	**MR**
15	Ability to install home automation systems.	4.69	0.49	**VHR**	4.57	0.56	**VHR**
16	Ability to integrate Internet of Things (IoT) devices into electrical installations.	4.67	0.73	**VHR**	3.84	0.71	**HR**

17	Ability to configure programmable electrical control systems.	4.73	0.47	**VHR**	4.23	0.65	**HR**
18	Ability to install electric vehicle charging systems.	3.94	0.66	**HR**	4.68	0.71	**VHR**
19	Ability to diagnose faults in smart electrical systems.	4.60	1.01	**HR**	3.35	1.01	**MR**
20	Ability to maintain intelligent electrical installations.	3.41	0.71	**MR**	4.73	0.57	**VHR**
	Average Mean	**4.26**	**0.63**	**HR**	**4.13**	**0.72**	**HR**

Source: Researchers' Field Result, 2026 $\bar{X}_1$ - Mean of Teachers, $\bar{X}_2$ - Mean of Instructors

Result from Table 2 shows that teachers from Technical Colleges has an average mean 4.26 while training instructors from registered electrical companies has an average mean of 4.13. This implies that both respondents (teachers and training instructors) agreed that all the listed items are *Highly Required (HR)* as smart electrical installation skills that are required for sustainable building practices among Electrical Installation and Maintenance Work students in Technical Colleges in Rivers State.

Research Question 3: What are the strategies for integrating green and smart electrical installation skills into the Electrical Installation and Maintenance Work curriculum for sustainable building practices in Technical Colleges in Rivers State?

Table 3: Mean Ratings of Respondents on Strategies Required for Integrating Smart and Green Electrical Installation Skills for Sustainable Building Practices

S/N	Strategies for Integrating Smart and Green Electrical Installation Skills Required Include:	$\bar{X}_1$	SD	Rmk	$\bar{X}_2$	SD	Rmk
21	Review the EIMW curriculum to include green electrical technologies.	4.58	0.62	**VHR**	4.62	0.55	**VHR**
22	Introduce practical training on solar photovoltaic installation.	3.64	0.74	**HR**	4.70	0.48	**VHR**
23	Provide training on battery energy storage systems.	4.38	1.02	**HR**	4.77	0.44	**VHR**
24	Include smart home automation in practical lessons.	3.78	0.43	**HR**	4.36	1.01	**HR**
25	Equip workshops with smart electrical installation facilities.	3.43	0.40	**MR**	3.94	0.84	**HR**
26	Strengthen industry-based training in sustainable electrical installation.	4.55	0.60	**VHR**	4.72	0.49	**VHR**
27	Provide regular in-service training for EIMW teachers on green technologies.	3.84	0.63	**HR**	3.30	0.37	**MR**
28	Collaborate with renewable energy companies during curriculum implementation.	4.61	0.54	**VHR**	3.75	0.46	**HR**
29	Adopt competency-based instructional strategies for teaching green and smart technologies.	4.35	1.01	**HR**	3.40	0.42	**HR**
30	Regularly review the curriculum to reflect emerging green and smart electrical technologies.	3.46	0.71	**MR**	4.67	0.73	**VHR**
	Average Mean	**4.06**	**0.67**	**HR**	**4.22**	**0.58**	**HR**

Source: Researchers' Field Result, 2026 $\bar{X}_1$ - Mean of Teachers, $\bar{X}_2$ - Mean of Instructors

Result from Table 3 shows that teachers from Technical Colleges has an average mean 4.06 while training instructors from registered electrical companies has an average mean of 4.22. This implies that both respondents (teachers and training instructors) agreed that all the listed items are *Highly Required (HR)* as strategies required

for integrating green and smart electrical installation skills into the Electrical Installation and Maintenance Work curriculum for sustainable building practices in Technical Colleges in Rivers State.

DISCUSSION OF FINDINGS

Results from Table 1 shows the green electrical installation skills that are required for sustainable building practices among Electrical Installation and Maintenance Work students in Technical Colleges in Rivers State. The result revealed that some of the identified and listed skills based on the findings of the study include ability to: install energy-efficient electrical wiring systems, install LED lighting systems, install solar photovoltaic systems, install battery energy storage systems, install energy-efficient electrical appliances, and the application of sustainable electrical safety practices and conduct building energy efficiency assessment among others. The high mean ratings obtained for these skills indicate that they are considered essential for preparing students to meet the demands of sustainable construction and the emerging green economy. This finding is in line with the study of Cledumas et al. (2019) who reported that employers considered green competencies essential for Electrical Installation and Maintenance Work graduates because they improve occupational performance and environmental sustainability. The authors observed that graduates require competencies that extend beyond traditional electrical installation to include environmentally responsible work practices and sustainable resource utilization. Similarly, the finding of the study also corroborates that of Arilesere and Jacob (2026) who found that competencies in solar photovoltaic installation, renewable energy systems, system testing, maintenance, and troubleshooting are indispensable for TVET graduates seeking employment and self-employment in the growing green economy.

Results from Table 2 shows the smart electrical installation skills that are required for sustainable building practices among Electrical Installation and Maintenance Work students in Technical Colleges in Rivers State. The result revealed that some of the identified and listed skills based on the findings of the study include ability to: install smart lighting control systems, install occupancy sensors, install smart switches and sockets, install smart energy meters, install home automation systems, electric vehicle charging systems, intelligent fault diagnosis, integrate IoT devices into electrical installations and configure programmable control systems among others. This finding reflects the rapid digital transformation occurring within the construction and electrical installation industries, where intelligent building technologies are increasingly replacing conventional electrical systems. The finding agrees with Legg-Jack and Ndebele (2022), who emphasized that graduates of electrical engineering trades require competencies that reflect current industrial technologies and should be developed through strong collaboration between technical institutions and industry to expose the students to contemporary industrial practices to improve workplace readiness. Also, the findings are in corroboration with Ogbuanya and Adebayo (2026) who demonstrated that innovative and practical instructional approaches significantly improve students' acquisition of contemporary electrical installation skills. These findings reinforce the need for Technical Colleges to integrate smart electrical technologies into Electrical Installation and Maintenance Work programmes to produce graduates who are competent in modern building technologies.

Results from Table 3 shows the strategies for integrating green and smart electrical installation skills into the Electrical Installation and Maintenance Work curriculum for sustainable building practices in Technical Colleges in Rivers State. The result revealed that some of the identified and listed strategies based on the findings of the study include review curriculum periodically, introduce solar PV practical training, provide battery storage training, include smart home automation, inclusion of renewable energy technologies and smart home automation in practical instruction, provision of modern workshop facilities, teacher capacity building, adoption of competency-based instructional approaches, stronger collaboration with electrical industries, equip workshops with smart technologies and train teachers on green technologies among others. These findings suggest that curriculum improvement requires a holistic approach involving instructional content, teaching methods, infrastructure, and stakeholder collaboration. This finding corroborates the study of Nwauzi et al. (2021), who identified inadequate workshop facilities, obsolete equipment, and insufficient exposure to industrial practices as major barriers to effective practical skills acquisition in Technical Colleges. Hence, Nwauzi et al. recommended the provision of modern instructional facilities and closer collaboration with

industry to improve students' practical competencies. Similarly, the finding of this study agrees with that of Olaleye and Adetunji (2026) as argued that integrating sustainable construction concepts into vocational education requires curriculum reforms, investment in modern technologies, and continuous professional development of teachers. The consistency between these findings and the present study demonstrates that curriculum transformation is fundamental to preparing graduates for sustainable building practices and the future world of work.

CONCLUSION

The study assessed the green and smart electrical installation skills required for sustainable building practices among Electrical Installation and Maintenance Work students in Technical Colleges in Rivers State. Based on the findings, green electrical installation skills, smart electrical technology skills, and strategies for curriculum integration are highly required for preparing students to meet the demands of sustainable construction and the modern electrical industry. The agreement between Technical College teachers and electrical industry professionals shows that these competencies are not only relevant within the school system but are also important in actual industry practice. Therefore, strengthening the acquisition of green and smart electrical installation skills in Technical Colleges will improve students' employability, support sustainable infrastructure development, and make Electrical Installation and Maintenance Work programmes more responsive to current and emerging industry needs.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are proposed:

1. The National Board for Technical Education (NBTE) and other relevant curriculum development agencies should review the Electrical Installation and Maintenance Work curriculum to adequately incorporate identified green electrical installation skills, including solar photovoltaic systems, battery energy storage systems, energy-efficient wiring, and electrical energy management.
2. Technical College administrators and instructors should incorporate practical training on smart electrical installation technologies, such as smart meters, home automation systems, programmable controllers, Internet of Things (IoT)-enabled devices, and electric vehicle charging systems, into workshop instruction to strengthen students' practical competencies.
3. Technical Colleges, the National Board for Technical Education (NBTE), and electrical industry stakeholders should establish sustainable partnerships aimed at equipping workshops with modern green and smart electrical technologies, supporting industry-based training for students, and providing continuous professional development for teachers in emerging sustainable electrical installation practices.

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