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Assessment of Maintenance Skills Improvement Needs of Electrical Installation and Maintenance Work Teachers in Science and Technical Colleges in North East, Nigeria

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ABSTRACT

This study assessed the maintenance skills improvement needs of Electrical Installation and Maintenance Work (EIMW) teachers in Science and Technical Colleges in North East, Nigeria. The study specifically sought to ascertain the current level of maintenance skills possessed by EIMW teachers and determine the areas where maintenance skills improvement was required. The study was anchored on Experiential Learning Theory developed by Kolb (1984). A descriptive survey research design was adopted for the study. The study was conducted in the North-East geopolitical zone of Nigeria comprising Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe States. The population of the study consisted of 146 EIMW teachers in Science and Technical Colleges, including professionally qualified and non-professionally qualified teachers. Since the population size was manageable, the entire population was used without sampling. Data were collected using a structured questionnaire titled "Technical College Skills Improvement Needs (TCSIN)" developed by the researcher. The instrument was validated by experts in Electrical Technology Education and Measurement and Evaluation, while reliability was established using Cronbach's Alpha with an overall reliability coefficient of 0.976. Out of 146 copies of the questionnaire administered, 135 were retrieved and analyzed using mean, standard deviation, and t-test statistics at 0.05 level of significance. The findings revealed that both qualified and non-qualified EIMW teachers possessed low maintenance skills and identified similar areas requiring improvement, particularly in technical operations, troubleshooting, and safety practices. The study concluded that EIMW teachers require continuous professional development and practical exposure to modern electrical maintenance technologies. The study recommended periodic workshops, refresher training, and specialized maintenance skill development programmes for EIMW teachers

Introduction

Electrical Installation and Maintenance Work (EIMW) is an important component of vocational and technical education that contributes significantly to industrial growth, technological advancement, and workforce development. In Nigeria, technical colleges are expected to equip learners with practical and employable skills that align with industrial standards and national development goals. The rapid advancement in electrical technologies and the increasing complexity of electrical systems have placed greater demands on technical education, especially in the area of electrical installation and maintenance work. Consequently, teachers of EIMW are expected to possess adequate maintenance skills that will enable them to prepare students for modern industrial practices and workplace realities (FRN, 2018). The effectiveness of technical education therefore depends largely on the competency level of teachers responsible for practical instruction and maintenance of workshop facilities.

In North East, Nigeria, the delivery of technical education has continued to face serious challenges arising from inadequate infrastructure, obsolete equipment, insecurity, and limited opportunities for teachers' professional development. According to UNICEF (2021), these conditions have negatively affected educational delivery and reduced teachers' exposure to modern technological practices. As a result, many teachers experience difficulties in adapting to emerging technologies such as automation systems, smart electrical installations, predictive maintenance, and modern safety procedures. Ogbuanya and Owodunni (2015) observed that teachers in electrical installation and maintenance work must continuously update their knowledge and practical skills in order to cope with the dynamic demands of the electrical industry. This suggests that teachers who lack current maintenance competencies may not effectively deliver practical instruction to students.

The National Board for Technical Education (NBTE, 2020) emphasized that technical teachers should be competent in both traditional and emerging electrical maintenance technologies. However, Ogbuanya (2018) noted that many technical teachers in Nigeria, particularly those in under-resourced regions such as the North East, have limited access to regular in-service training, technical workshops, and industrial exposure needed for skills improvement. This situation creates a gap between teachers' existing competencies and industry expectations. The EIMW programme itself comprises practical areas such as domestic installation, industrial installation, battery charging and repairs, cable jointing, and winding of electrical machines (NBTE, 2015). Effective teaching of these areas requires teachers to possess strong maintenance skills for handling tools, equipment, and machines used in workshop practice.

Maintenance remains an essential aspect of technical education because tools, equipment, and machines are liable to wear, breakdown, and malfunction. Ogbuanya (2015) defined maintenance as actions taken to restore or keep equipment in good working condition, while Ezeji (2016) stressed that proper maintenance improves equipment reliability and reduces machine downtime. Therefore, assessing the current maintenance skills possessed by EIMW teachers and identifying areas where improvement is required became necessary for improving technical education delivery in North East, Nigeria.

Statement of the Problem

The effectiveness of technical education in electrical installation and maintenance work depends largely on the competence and maintenance skills of teachers responsible for implementing the curriculum in technical colleges. However, many EIMW teachers in North East, Nigeria appear to possess inadequate and outdated practical maintenance skills due to limited professional development opportunities and poor access to modern industrial technologies. Ogbuanya (2018) observed that many technical teachers in Nigerian technical colleges lack current practical competencies required for maintaining and operating modern electrical systems. This problem is more severe in North East, Nigeria where insecurity, infrastructural decay, and socio-economic challenges have disrupted educational activities and restricted access to training resources (UNICEF, 2021).

In addition, curriculum reforms introduced by the National Board for Technical Education (NBTE, 2020) aimed at aligning technical education with industry demands have not been adequately supported with sufficient teacher retraining programmes. Consequently, many teachers still rely on obsolete maintenance techniques and traditional instructional practices that do not reflect current technological realities. This gap affects the quality of practical instruction given to students and may produce graduates who lack the competencies required in modern industries (Mbata, 2016). Furthermore, poor maintenance skills among teachers contribute to frequent breakdown of workshop equipment, thereby limiting students' opportunities for effective practical learning (Owo, 2017). Despite the importance of maintenance skills in technical education, there is inadequate empirical evidence on the specific maintenance skill gaps and improvement needs of EIMW teachers in North East, Nigeria. Therefore, this study became necessary to assess the current level of maintenance skills possessed by EIMW teachers and identify the specific maintenance skill areas where improvement is required.

Purpose of the Study

The main purpose of this study was to identify and analyse the maintenance skills improvement needs of Electrical installation and maintenance work (EIMW) teachers in Science and technical colleges across North East, Nigeria. Specifically, the study sought to:

1. Ascertain the current level of maintenance skills possessed by EIMW teachers in science and technical colleges in North East, Nigeria.
2. Determine the areas of maintenance skills where EIMW teachers in science and technical colleges in North East, Nigeria require improvement.

Research Questions

Based on the research objectives, here were matching research questions:

1. What is the current level of maintenance skills possessed by EIMW teachers in science and technical colleges in North East, Nigeria?
2. In which areas of maintenance skills do EIMW teachers in science and technical colleges in North East, Nigeria require improvement?

Hypotheses

Based on the purposes of this study, the following research hypotheses were formulated and tested at 0.05 level of significance:

Ho$_1$: There is no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on the current level of maintenance skills possessed by EIMW teachers in Science and technical colleges in North East, Nigeria.

Ho$_2$: There is no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on the areas of maintenance skills where EIMW teachers in Science and technical colleges in North East, Nigeria require improvement.

2. Literature Review

Current State of Maintenance Techniques in Nigeria

Maintenance is a technique, which has been neglected in Nigeria. This behavior has eaten deep most especially in some of our tertiary institutions, technical colleges and some manufacturing industries that are blessed and equipped with facilities/equipment and infrastructure. Akpan (2016) lamented that one of the adverse effects of our poor maintenance technique was the graduation of students with low practical knowledge and skills despite the well-developed practical curriculum and manpower. He further asserted that in the case of industries, most of them produce below their installed capacity thereby causing scarcity of goods and services. Also, that in some cases, this may lead to the closure of the firms despite the high demand for the products and availability of the input resources such as raw materials, manpower, capital e.t.c. This was one of the reasons why the country was full with foreign goods to satisfy the yearnings of the consumers, thus killing the morale of the local producers. This has made us a consumer nation instead of producer that would have put us on sound footings in the eyes of other countries (Okwa, 2017). According to Akpan (2016), Nigeria, like some other developing countries did not see maintenance technique as one of the valuable tools needed to improve the economic activities and the standard of living. He further opined that, despite the advantages associated with good maintenance in our nation's set up, most maintenance staff have been found to lack the basic techniques in maintenance activities. Clifford (2018) pointed out that lack of maintenance techniques in our nation's set up is attributed to the following reasons among others;

i. Ineffective organization’s structure for maintenance

ii. Non-availability of spare parts and where available the supplies are inadequate

iii. Lack of knowledge of the concept of maintenance and the benefits derived from it

iv. Lack of management and techniques in maintenance operations

v. Non-recognition of maintenance by management as a vital activity which must be carried out in the organization

vi. Absence of support for maintenance by management with a clear policy

vii. Sheer incompetence or limited knowledge of the plants on the part of the maintenance staff and

viii. Inadequate budget provisions for maintenance works.

Skills in Electrical Installation and Maintenance Work Trade

Skill can be described as human capability to perform technical work very well. Ability that comes from knowledge, practice and attitude to be able to do something. EIMW program provides graduates with the technical skills for careers in their chosen discipline. Akpan (2016) stressed that skills is the expertness in practical ability with dexterity and fact. Ibrahim and Nathan (2016) defined skill as the ability and capacity acquired through deliberate systematic and sustained efforts to smoothly and adaptively carryout complex activities or job functions involving ideas (cognitive skills), things (technical skills). So, to possess a skill is to demonstrate the habit of acting, thinking and behaving in a specific activity in such a way that the process becomes natural to the individual through repetitions or practices.

Types of Skill in Electrical installations and maintenance work trade

Akpan (2016), Ibrahim and Nathan (2016) and Ogbuaya (2017), on types of skills, variously maintained that there are four main types of skills. They include;

i. Perceptual - interpretation of presented information

ii. Perceptual motor - involve the thought, interpretation and movement skills

iii. Cognitive - or intellectual skills that require thought processes

iv. Motor - movement and muscle control

Maintenance Techniques

In maintenance techniques, it is important to be able to identify problems through their symptoms. Experience matters a lot in this respect. For effective maintenance techniques, it is important to keep detailed record of all faults and failures of plants and equipment. According to (Nelson, 2015), in order that valuable time is not spent in analyzing faults, which recurs or is common to a type of machine or equipment, he emphasized that this requires the development of fault findings or trouble-shooting chart algorithms. There are many ways by which maintenance techniques can be carried out and each depends on experience, the type of equipment, facilities and the available fault detecting devices etc. Hunt (2015), Ibrahim and Nathan (2016) and Ikoro (2016), in their various studies maintained that the followings are the maintenance techniques that are required;

i. Fault Analysis: In maintenance techniques, problems lead to symptoms and the knowledge of the symptoms lead to tracing the problems. It is important that the real problems are solved and not just correcting the symptoms. For example, if an electrical equipment fails due to blown fuse, the problem that led to the fuse blown off must first of all be established and solved in addition to replacing the fuse. For effective fault analysis, detailed records of all faults and failures of plants, equipment and trouble-shooting charts are necessary in order to minimize the valuable time spent in the analysis.

ii. Fault Diagnosis: It is expected that maintenance engineers or mechanics should have diagnostic skills capable of identifying faults which arise in plants, equipment or machines.

In diagnosing the faults, it is better to start with the simplest and most probable cause and continue through less probable causes until the faults are discovered and solved. This will not only minimize the valuable time spent in diagnostic analysis but will also help to reduce the tendency of generating problems in problem free areas. The mechanical or electrical symptoms and their probable causes will also assist in this direction.

iii. Dismantling Techniques: In maintenance practices, it may be necessary to dismantle a machine in order to gain access to some machine components requiring repairs and/or maintenances. If such machine had not been handled before for such maintenance, it is very important to plan the dismantling operations. The machine should only be dismantled to the point where faulty components can be identified and repaired. Individual's initiatives and skills matters a lot here. However, it is very important to note and commit into memory the sequences in which the parts are removed and their relative positions in the machine especially where no exploded or assembly drawings exist for easy reassembling.

iv. Repairing and Replacing: Having dismantled the machine to the point where faulty components are identified, it is the duty of the maintenance personnel to repair it if the need arises. To replace the defective, damaged, or worn-out parts, there are some instances when the costs of repairing are substantial and unforeseen. It will then be rational to consider whether it is economical to replace the machine rather than to repair it.

They further opined that one simple method whereby the decision between repairing and replacing problem is not overlooked or solved by default to set a repair limit. The value set for the repair limit is a function of age, availability of replacement items, cost of installations, among others. If the estimated cost of the repairs exceeds the repair limit, the machine would be considered as an active candidate for replacement and hence are repcaced

The important role maintenance techniques plays in our economy through technical and vocational education and training programme especially now that Nigeria and the entire world is facing rapid technological advancement cannot be overemphasized. Technical and Vocational Education and Training (TVET) institutions in Nigeria lack effective maintenance techniques. These, according to their positions has resulted in production of graduates who are incompetent in maintenance abilities, thereby affecting the ever-growing teaching in Nigeria. This then resulted in an urgent study for an effective and robust maintenance strategies for the improvement of TVET programs in general and electrical installation and maintenance work in particular in Nigeria.

Preventive Maintenance in Technical College Laboratory Tools, Equipment and Machines

Preventive maintenance (PM) is a systematic and proactive approach to equipment upkeep that involves regular inspections, servicing, and minor repairs to mitigate potential failures before they occur. This maintenance strategy aims to ensure the longevity, reliability, and efficiency of machines and laboratory equipment by addressing wears and tears before it escalates into significant malfunctions. Unlike corrective maintenance which addresses failures after they happen, preventive maintenance is performed even when machines appear to be functioning normally to minimize unexpected downtimes and costly repairs.

Umahi (2018) identified the following as the objectives of preventive maintenance:

1. Enhancing Efficiency and Longevity: Preventive maintenance helps maintain optimal working conditions, reducing deteriorations and ensuring that laboratory tools, equipment and machines function at their best for extended periods.

2. Reducing Unexpected Equipment Failures: By addressing minor issues before they escalate, preventive maintenance minimizes the likelihood of sudden breakdowns that could disrupt academic activities.

3. Ensuring Safety in the Laboratory Environment: Regular inspections and maintenance reduces the risks of accidents caused by faulty tools, equipment and machines, while also ensuring compliance with safety standards and protecting students, instructors and teachers.

4. Minimizing Downtime and Interruptions in Learning Processes: Well-maintained equipment reduces the frequency of interruptions during practical sessions, ensuring that students maximize their learning time.

5. Maintaining Optimal Working Conditions: Regular servicing, calibrations, and component replacements ensure that machines and equipment operate efficiently, delivering accurate and reliable performances.

Corrective Maintenance in Technical College Laboratory Tools, Equipment and Machines

Corrective maintenance (CM) is a reactive approach to equipment maintenance that involves identifying and rectifying faults in laboratory tools, equipment and machines after they have malfunctioned or shown signs of failures. This process includes minor repairs, part replacements and in some cases, full overhauls to restore the equipment's full operational capability. Unlike preventive maintenance which aims to prevent failures before they occur, corrective maintenance addresses existing issues to ensure machines continuous functioning as intended.

Uzo (2016), and Ukpabio (2018) pointed the following objectives, types and examples of corrective maintenances in technical colleges:

1. Restoring the functionality of malfunctioning equipment: The primary goal is to bring faulty machines back to working order so as to maintain continuous laboratory operations.

2. Addressing minor issues before they escalate into major failures: Timely corrective maintenance prevents minor issues from worsening into extensive damages that require more costly and time-consuming repairs.

3. Improving the efficiency of machines after failure: Once a machine is repaired, corrective maintenance ensures that it functions at optimal performance, sometimes even improving efficiency through better-calibrated or newly installed parts.

4. Ensuring continuous operations in the laboratory: Technical college laboratories rely on well-functioning tools, equipment and machines for training students, and corrective maintenance helps minimize downtime by promptly addressing faults.

5. Extending the lifespan of laboratory/workshop tools, equipment and machines: When

faults are identified and repaired in a timely manner, the overall longevity of tools, equipment and machines increases, reducing the frequency of replacements.

6. Enhancing safety in the laboratory environment: Malfunctioning equipment and machines can pose hazards to students and teachers; corrective maintenance ensures that such risks are mitigated by repairing electrical faults, mechanical failures, or leaks.

Reliability-Centered Maintenance in Technical College Laboratory/Workshop Tools, Equipment and Machines

According to Ogbuanya (2018), reliability-Centered Maintenance (RCM) is an advanced, structured approach that aims to ensure the operational reliability of tools, equipment and machines by identifying the most critical assets and applying appropriate maintenance strategies. This approach focuses on maximizing the reliability of technical college laboratory tools, equipment and machines through combinations of preventive, predictive, and corrective maintenance methods. RCM emphasizes proactive measures that can prevent breakdowns, optimize machine performance, and minimize unnecessary repairs or downtime. RCM is a holistic process that not only addresses the mechanical aspects of machines but also considers the operational environment, the frequency of use, and the potential impact of machine failures. This makes RCM an ideal strategy for technical college workshops/laboratories where equipment reliability is essential for uninterrupted learnings, experimentations and researches. Ogbuanya (2017) and Grace (2018) variously explained the objectives and steps in implementations and examples of RCM in technical college laboratories and workshops.

Objectives of Reliability-Centered Maintenance

The Core Objectives of Reliability-Centered Maintenance in Technical College Workshops/Laboratories are:

1. Enhancing Equipment Reliability: By identifying the most critical machinery and implementing a tailored maintenance approach, RCM ensures that laboratory/workshop equipment operates reliably over an extended period.

2. Minimizing Maintenance Costs: RCM uses a data-driven approach to focus on the equipment that matters most, allowing for more efficient resource allocations and reducing the need for costly repairs or unplanned downtime.

3. Ensuring Safe Operations: Consistent monitoring and maintenance of critical equipment reduces the likelihood of sudden failures, thereby safeguarding both equipment and personnel in the laboratory/workshop environments.

4. Extending Equipment Lifespan: By maintaining machines in peak working conditions and addressing potential issues early, RCM maximizes the useful life of laboratory/workshop tools, equipment and machines, delaying costly replacements.

Predictive Maintenance in Technical College Workshop/Laboratory Tools, Equipment and Machines

Predictive maintenance (PDM) is a proactive maintenance strategy that uses real-time data and advanced analytics to predict equipment failures before they occur (Ogbuanya, 2017). By continuously monitoring the conditions of machines and utilizing diagnostic tools, predictive maintenance allows for maintenance actions to be taken based on the actual state of the equipment, rather than on fixed schedules. This data-driven approach helps predict potential issues, enabling technicians to intervene only when necessary. Ibrahim and Nathaniel (2016) asserts that predictive maintenance plays a critical role in ensuring that workshops/laboratories equipment operates smoothly and efficiently, reducing downtime and extending the useful life of machinery. Ibrahim and Nathaniel (2016) also explained the following key features of predictive maintenance.

1. Data-Driven Decision Making: Predictive maintenance relies heavily on real-time data collected from equipment sensors, such as temperature, vibration, pressure, and acoustics. This data is analyzed to predict future failures.

2. Condition Monitoring: By using various diagnostic tools like thermography, vibration, and oil analysis, predictive maintenance monitors the health of laboratory equipment. These tools help detect subtle changes in equipment behavior that could indicate an impending failure.

3. Trend Analysis: Predictive maintenance involves the collection of historical and real-time data, which is then analyzed for patterns or trends that could signal potential issues. This analysis helps forecast when maintenance should be performed.

4. Minimized Downtime: Since predictive maintenance anticipates failures before they happen, it allows for maintenance to be scheduled during non-peak hours or when the equipment is least critical, reducing downtime in the laboratory.

Importance of Electrical Installation and Maintenance Work in Technical Education

Electrical installation and maintenance work is one of the most significant components of technical education. It provides the foundation upon which industrial, commercial, and domestic electrical systems are designed, sustained, and improved. The importance of this area of training in technical colleges goes beyond the acquisition of routine craft skills. It encompasses the development of a workforce that is capable of meeting the complex demands of energy supply, technological change, and industrial growth. In the context of technical education, electrical installation and maintenance work equips learners with applied competencies that are both directly transferable to the labour market and essential for national development. This makes the teaching of the trade central to the goals of vocational and technical institutions that seek to prepare graduates who can contribute meaningfully to the economy.

One of the key roles of electrical installation and maintenance work in technical education according to Adebayo (2019) is its ability to bridge the gap between theoretical science and practical applications. He further opined that learners in technical colleges are not only taught the scientific principles of electricity but are also exposed to practical problem-solving through wirings, machine maintenances, and system repairs. He emphased that technical college education programmes that are strongly practice-oriented yield better employability outcomes because they prepare learners to handle real-world challenges. In this sense, electrical installation and maintenance training ensures that students develop confidence in using their knowledge in diverse work settings, from domestic wirings to industrial plant maintenances, which in turn enhances their readiness for employment.

Another dimension of importance lies in the contributions of electrical installation and maintenance to technological advancement and sustainability. As economies across the globe transition to more energy-efficient and technologically sophisticated systems, the demand for competent electricians and maintenance specialists continues to grow. This is particularly relevant in countries like Nigeria where energy distributions, equipment servicing and system safety are pressing issues. In agreement with the above, Okafor (2020) held that technical education that emphasizes electrical skills provides a pool of manpower capable of maintaining reliable energy systems, thus reducing dependence on external expertise. He further explained that nations that prioritise electrical training within vocational education are better positioned to sustain industrial growth, as reliable energy systems are the backbone of production and service delivery.

In his own contributions, Nwachukwu (2018) had opined that electrical installation and maintenance is critical in fostering self-reliance and entrepreneurship among graduates of technical colleges. He claimed that training provides learners with competencies that allow them to set up small businesses, handle domestic and commercial contracts, and provide essential services in both rural and urban communities. This entrepreneurial potential helps to reduce unemployment, which remains a major socio-economic challenge in Nigeria. Adeyemi (2021) noted that one of the strengths of technical education is its dual function of producing wage employees for industry and equipping individuals for self-employment. Within this framework, electrical installation and maintenance stands out as one of the trades with the highest potential for self-sustaining careers, since electricity is indispensable in modern life. In addition, electrical installation and maintenance work is significant for safety and quality assurance in society. Training in this area teaches future technicians not only how to install systems but also how to maintain them to prevent hazards such as fire outbreaks, electrocution, and equipment failures. Chukwu (2017) had earlier highlight that inadequate training of electricians often results in poor handling of electrical systems, which contributes to accidents and infrastructural losses.

Professional Development of Technical Education

Professional development within the field of technical education has increasingly been recognised as a central pillar in ensuring the relevance and effectiveness of vocational and technical training in the 21st century. With the rapid advancement of technology, the evolving labour market, and the emergence of new pedagogical strategies, the role of professional development is no longer viewed as optional but rather as an essential requirement for technical educators to remain competent and effective in their roles. Technical education is unique in its dual responsibility of providing both academic knowledge and occupational competencies, making the preparation and continuous growth of teachers a critical factor in sustaining quality learning outcomes for students (Gotze, 2019). One of the fundamental arguments for professional development in technical education according Jamie (2021) is its role in aligning instructional practices with labour market needs. Continuing Jamie stated that technical education unlike traditional education that often prioritises theoretical learning, technical education depends heavily on its ability to prepare learners for workplace readiness and employability. Neube (2018) pointed out that professional development equips technical educators with the capacity to integrate current industry practices into classroom instructions, ensuring that students receive training relevant to present-day realities. He added that the alignment of education and work is particularly vital in technical education, where outdated teaching practices or obsolete industry knowledge can significantly hinder the employability prospects of graduates.

Professional development is also essential for building the pedagogical expertise of instructors who often enter technical education with strong industry backgrounds but limited teaching experiences. While content mastery is indispensable, educators must also be capable of designing learner-centred instructions, integrating project-based learning, and applying assessment strategies that measure both academic and technical competencies. Anderson (2017) in his submission opined that this balance between practical expertise and instructional competence requires continuous training, workshops, mentoring, and reflective practices to fully equip teachers for the challenges of modern classrooms. Lewis (2020) also added that the role of such training becomes even more critical when considering that many technical education instructors enter the profession mid-career from industry sectors, often lacking formal pedagogical training.

Technological change presents another challenge that reinforces the demand for continuous professional development. Martinez (2019) in his work asserts that with the integration of digital tools, simulation technologies, and automation into the workplace, technical educators must constantly update their own knowledge to remain effective facilitators of learning. He further opined that professional development initiatives that emphasise digital literacy, instructional technologies, and the use of virtual learning environments allow teachers to not only deliver technical content but also prepare students for the digitalised workplaces they will encounter. This adaptation therefore is crucial as industries increasingly demand workers with hybrid skills that combine technical expertise with digital competencies. Furthermore, Williams (2021) was of the view that the importance of professional development is also tied to the changing expectations of students in technical education. He stated that learners today operate in a knowledge-driven economy and often expect interactive, flexible, and innovative approaches to learning. In his own study, Kang'ethe (2020) claimed that professional development provides instructors with the ability to create engaging classroom environments through problem-based and experiential methods that integrate theory with practical which are provided by technical education. Such approaches not only improve knowledge retention but also foster creativity, teamwork, and problem-solving abilities and skills that are indispensable in contemporary industries (Morales, 2022).

Theoretical Framework: Experiential Learning Theory (Kolb, 1984)

The Experiential Learning Theory was propounded by David A. Kolb in 1984, and it continues to be one of the most influential frameworks for understanding how individuals acquire, refine, and apply practical knowledge. Kolb conceptualised learning as a cyclical process that integrates experience, reflection, conceptualisation, and experimentation. Rather than positioning learners as passive recipients of knowledge, the theory emphasises that true understanding and skill mastery come when individuals actively engage with tasks, reflect on outcomes, derive principles, and reapply them in new situations. This perspective is particularly relevant to the development of teachers in technical and vocational education. Electrical installation and maintenance is a discipline where theory alone is insufficient. Effectiveness depends on the ability to translate knowledge into practice, troubleshoot real problems, and model these competencies for students.

Kolb's cycle offers a natural framework for skill improvement among teachers because it not only supports technical knowledge acquisitions but also ensures that teachers engage in continuous reflective practice that sharpens their professional expertise.

Gotze (2019) observed that experiential approaches are especially crucial in technical training because they expose educators and learners to real-world contexts that demand adaptability and creativity. In line with this observations, electrical installation and maintenance teachers in North East, Nigeria require regular opportunities to update their skills through authentic, hands-on experiences that mirror industrial practices. Without such engagement, their teaching risks becoming outdated, leaving students underprepared for the labour market. Similarly, Jamie (2021) argued that experiential learning enhances professional identity formation among teachers by fostering confidence in their capacity to perform tasks, adapt to technological changes, and mentor learners effectively. This aligns directly with the study, as teachers whose maintenance skills are constantly reinforced through experience and reflection are better able to transfer those competencies to their students.

Expanding further, Wallace (2020) had explained that experiential learning is not only about skill repetition but also about critical reflection on gaps between current practices and industry standards. This reinforces the need for continuous professional development for teachers in electrical installation as the field is dynamic, with new technologies and safety standards emerging rapidly. By linking this to the study, it becomes evident that the assessment of maintenance skills improvement needs should not be a one-time exercise but a continuous process embedded within teacher training programmes. Smith (2018) earlier opined that when educators participate in experiential learning cycles, they become more adept at identifying skill deficiencies, which makes such assessments more accurate and actionable.

Hence, Kolb's theory justifies why teachers of electrical installation and maintenance must be provided with avenues to practise, reflect, conceptualise and experiment with evolving maintenance techniques. The theory fits into the present study as it highlights the importance of identifying where teachers' experiential cycles are incomplete such as insufficient hands-on training, lack of reflective opportunities or inadequate exposure to new technologies so that targeted interventions can be designed to improve their skills. By embedding Kolb's model into teacher development, science and technical colleges can ensure that their workforce remains competent, reflective and aligned with industrial demands.

Review of Related Empirical Studies

The following empirical studies are directly related to the assessment of maintenance skills and skills improvement needs of EIMW teachers:

In a study by Bala, Ezugu, and Zakari (2019), on "Technical skills improvement needs of electrical installation and maintenance work trade teachers for effective teaching in technical colleges in Kano State", two research questions and two null hypotheses were formulated that guided the study. A descriptive survey research design was used for the study. The population for the study was 48 respondents comprised of graduate teachers and non-graduate teachers of electrical installation and maintenance work trade of government technical colleges in Kano State. The entire population was used in the study as the population was relatively small. Mean and standard deviations were used to analyze the data relating to the research questions and t-test was used to test the hypotheses at 0.05 level of significance. The findings revealed that the electrical installation and maintenance work trade teachers needed all the 34 items of technical and pedagogical skills which included among others; possession of solar, photovoltaic cells installation skills, working drawings, ability to diagnose electrical system on malfunctions or failures among others. The reviewed study was similar to the concluded study because methodology and statistical tools employed were similar and also involved skill improvement needs of electrical/installation and maintenance work teachers in technical colleges. The only difference was that the reviewed study focused on technical improvement as against maintenance skills improvement. The study was also conducted in Kano state while the concluded work was in North-East, Nigeria. The 34 items were not presented in two clusters to justify the use of only two research questions.

Benson, Oke and Oluwaitayo (2022) in another study on skills improvement needs of electrical installation teachers for productive skills development in Ondo State technical colleges, three research questions were used and the researchers adopted survey research design. The population was 89, which comprised of all the teachers teaching electrical installation in all technical colleges in Ondo State. There was no sampling as the population was relatively small The instrument used for the data collection was a questionnaire tagged Electrical Installation Skills Questionnaire (EISQ). The instrument was face validated by three lecturers who were experts in technology and vocational education in Ekiti State University, Ado-Ekiti. The reliability of the instrument was established using Cronbach Alpha reliability techniques which yielded the reliability coefficient of 0.86. This was considered a high reliability index. After the data collection, the mean and standard deviations were employed to analyze the data. The findings of the study revealed that electrical installation trade teachers training background lack quality in terms of technical skills. Students of electrical installation trade in technical colleges in Ondo State of Nigeria generally had low skills in EIMW. The authors who studied all EIMW teachers in Ondo State would have carried out hypotheses test to validate and generalize the results. In the present study, the researcher employed mean, standard deviation and hypotheses in analysing the collected data. In the reviewed study, the specific number of respondents that made up the population was not mentioned and generally did not follow the guiding principle for such studies.

Also, Okedawuayo and Toyin (2022) in their study carried out an investigation on maintenance skill improvement needs of electrical installation teachers for productive skill development in Ondo State technical colleges. A descriptive research survey was adopted for this study. Research questionnaire was formulated. The population for the study comprised of teachers teaching electrical installation in technical colleges in Ondo State. There was no sample as the researchers were able to manage the entire population. The instrument used for the data collection was a questionnaire tagged Electrical Installation Skills Questionnaire (EISQ) developed by the researchers. The instrument was face validated by three lecturers who were experts in Technology and Vocational Education in Ekiti State University, Ado-Ekiti. The reliability of the instrument was established using Cronbach Alpha reliability techniques which yielded the reliability coefficient of 0.86. This was considered a high reliability. Data was collected, the mean, standard deviation and hypotheses at 0.05 level of significance were employed to analyze the data. The findings of the study revealed that electrical installation trade teachers lack quality in terms of maintenance skills required of them. In this study, the researchers during validation exercise carried out only face validity. It could have covered the content so as to obtain valid result that will lead to improvement needs. This study also would have reported findings of the study corresponding with the research questions.

Ali, Bala, Ezugu and Isah (2023) in their study investigated the pedagogical skills improvement needs of electrical installation and maintenance work trade teachers in technical colleges in Kano State. A descriptive survey research design was used for the study. The population of the study was made up of 48 electrical installation and maintenance work trade teachers in all the six technical colleges in Kano State. Three research questions and three null hypotheses were formulated that guided the study. The entire population was used in the study. The instrument used for the data collection was structured questionnaire containing 80 items and titled "Pedagogical Skills Improvement Needs of Electrical Installation and Maintenance Work Trade Questionnaire (PSINEIMWTQ)" that was developed by the researchers and used to collect the data. The questionnaire had a four-point rating scale. Three experts validated the questionnaire and its reliability coefficient was established using Cronbach's Alpha having a value of 0.92. Mean, standard deviation and grand mean were used to analyze the data collected relating to the research questions while t-test was used to test the hypotheses at 0.05 level of significance. The findings of the study included among others: That electrical installation and maintenance work teachers needed pedagogical skills such as; ability to examine the electrical installation curriculum program module, ability to use relevant instructional methods to link the previous experience with new lessons, ability to assess the learner's performances, Significance differences did not exist in the mean responses of education graduate teachers and non-education graduate teachers of electrical installation and maintenance work on the needs of pedagogical skills in instructional planning, instructional management and instructional evaluation. The study employed similar methods and statistical tools. The name of the instrument should have been shortened for easier comprehension. The two studies focused on skills improvement needs and employed research questions and hypotheses to guide their studies. However, the reviewed study had 3 research questions and 3 hypotheses while the current one had 6 each. Method of data collection and analysis were similar. In addition, while the reviewed study focused on pedagogical skills the current study was on maintenance skills. The study was conducted in Kano state while the current study was conducted in North-East, Nigeria.

Furthermore, Bello, Dauda and Deba (2023) carried out a study titled "Skills improvement needs of electronics work trade teachers in science and technical colleges in North East, Nigeria". The researchers raised two research questions and two hypotheses which were tested at 0.05 level of significance. The population consisted of 220 teachers of electronics works trade from 34 science and technical colleges in the study area. 140 teachers constituted the sample that was used. The instruments used was developed by the researchers and validated by three experts, while the reliability index of 0.89 was obtained using Cronbach's Alpha formula. The instrument was adjudged reliable. The data collected was analysed using mean, standard deviation and t-test statistics. The findings of the study revealed that radio and electronic system repairs skills were required. The reviewed study was similar to the present study. Both studies focused on assessing the skills improvement needs. the population of 220 teachers of Electronics and the number of Science and Technical Colleges in North East, Nigeria in 2023 were not realistic as of compared with results available from other reports in the Zone. However, the reviewed study was on maintenance skills improvement needs of electronics work trade teachers while the present study focused on maintenance skills improvement needs of EIMW teachers. Both studies adopted descriptive survey research design. The researcher failed to explain the sample techniques adopted in selecting 140 respondents out of 220.

Buba (2024), carried out a study on assessment of pedagogical competency improvement needs of electrical installation and maintenance work trade teachers in Government Science and Technical Colleges in Yobe State. Two research questions and two null hypotheses guided the study. Descriptive survey research design was used in the conduct of the study. The population was 121 which consisted of 81 electrical installation and maintenance work trade teachers and 40 school administrators. The population was relatively small and therefore the entire population constituted the sample for the study. A twenty-eight (28) item statements was developed from the literature and used for data collection. Three experts validated the instruments and its reliability coefficient of 0.78 was established through Cronbach's Alpha formula which was carried out in Gombe State. The data collected were analyzed using mean and standard deviation to answer the research questions and z-test for testing all the two null hypotheses. The results indicated among others that electrical installation and maintenance work trade teachers in Government Science and Technical Colleges in Yobe State needed improvement on pedagogical competency improvement needs. Although this work was on pedagogical competence, while the present was on general maintenance skills needs, both were for improvement needs, the methodology and statistical tools were similar. However, teachers and school administrators were used in the reviewed study, the z-test statistics were employed while the current study used EIMW teachers only and t-test statistics.

3. Research Methods

This study adopted a descriptive survey research design to assess the maintenance skills improvement needs of Electrical Installation and Maintenance Work (EIMW) teachers in Science and Technical Colleges in North East, Nigeria. The design was considered appropriate because it enabled the researcher to collect, describe, and analyze data from respondents regarding the current level of maintenance skills possessed by EIMW teachers and the areas where improvement was required. The study was conducted in the North-East geopolitical zone of Nigeria, which comprises Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe States. The zone has thirty-six accessible Science and Technical Colleges that provide technical and vocational education aimed at developing skilled manpower for industries and other sectors of the economy. The population of the study consisted of 146 EIMW teachers drawn from the Science and Technical Colleges in the study area. The respondents included teachers with educational qualifications such as B.Sc. (Ed) and NCE in Electrical Installation and Maintenance Work, as well as teachers with B.Sc. or HND qualifications without professional teaching credentials. Since the population size was manageable, the entire population was used for the study without sampling.

Data for the study were collected using a structured questionnaire titled "Technical College Skills Improvement Needs (TCSIN)" developed by the researcher. The instrument consisted of two sections: Section A elicited personal information of respondents, while Section B contained items related to maintenance skills possessed by teachers and the maintenance skill areas requiring improvement. The questionnaire employed rating scales that measured respondents' perceived skill levels and training needs. To ensure the validity of the instrument, copies of the questionnaire were given to experts in Electrical Technology Education and Measurement and Evaluation for face and content validation. Their observations and corrections were incorporated into the final draft of the instrument. The reliability of the instrument was determined through a pilot study involving twenty EIMW teachers from selected technical colleges in Benue State. Using Cronbach's Alpha statistical technique, reliability coefficients ranging from 0.786 to 0.924 were obtained, with an overall reliability index of 0.976, indicating that the instrument possessed high internal consistency and was suitable for the study.

The researcher, with the assistance of six trained research assistants drawn from the six states in the study area, administered the questionnaire directly to respondents in their respective schools. The assistants were trained on the objectives of the study, administration procedures, and ethical considerations to ensure uniformity in data collection. Out of the 146 copies of the questionnaire distributed, 135 were successfully retrieved and used for analysis, representing a high return rate. Data collected were analyzed using mean and standard deviation to answer the research questions, while t-test statistics were used to test the null hypotheses at 0.05 level of significance. Mean ratings of 2.50 and above were regarded as accepted for both maintenance skills possessed and maintenance skills improvement needs, while mean values below 2.50 were rejected.

4. Results and Discussion

Research Question 1: What is the current level of maintenance skills possessed by EIMW teachers in science and technical colleges in North East, Nigeria?

Table 1: Mean and Standard Deviation of the current level of maintenance skills possessed by EIMW teachers in science and technical colleges in North East, Nigeria

$N_1 = 78$, $N_2 = 57$

S/N	Item	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	$\bar{X}_{\bar{G}}$	SD_G	Rmk
1	Diagnosing faults in single-phase electrical systems	2.05	0.85	2.26	0.74	2.14	0.81	LL
2	Diagnosing faults in three-phase electrical systems	1.97	0.81	2.00	0.78	1.99	0.79	LL
3	Repairing damaged electrical wiring and fixtures	2.09	0.78	1.58	0.78	1.87	0.81	LL
4	Replacing damaged electrical wiring appliances	2.05	0.77	2.04	0.84	2.04	0.80	LL
5	Installing electrical lighting systems	2.21	0.81	2.21	0.82	2.21	0.81	LL
6	Maintaining electrical lighting systems	1.95	0.80	1.93	0.84	1.94	0.82	LL
7	Mounting electrical distribution boards	1.92	0.83	2.04	0.87	1.97	0.85	LL
8	Wiring electrical distribution boards	1.97	0.82	1.75	0.85	1.88	0.84	LL
9	Carrying out earthing in electrical systems	2.09	0.78	2.11	0.86	2.10	0.81	LL
10	Carrying out bonding in electrical systems	2.05	0.79	2.00	0.82	2.03	0.80	LL
11	Using testing instruments such as multi-meter and megger	1.94	0.81	2.00	0.87	1.96	0.83	LL
12	Performing continuity resistance tests	2.06	0.81	1.93	0.75	2.01	0.79	LL
13	Performing insulation works on electrical systems	1.83	0.86	2.05	0.85	1.93	0.86	LL
14	Troubleshooting faults in electrical machines	1.88	0.85	1.86	0.79	1.87	0.82	LL
15	Troubleshooting faults in simple appliances	2.01	0.78	1.93	0.82	1.98	0.80	LL
16	Detecting overload and short circuit problems	1.88	0.84	2.04	0.71	1.95	0.79	LL
17	Fixing overload in circuit problems	2.08	0.82	1.93	0.78	2.01	0.80	LL

18	Identifying faults in control circuits	2.00	0.85	2.00	0.82	2.00	0.84	LL
19	Correcting faults in electrical panels	1.85	0.79	2.00	0.82	1.91	0.81	LL
20	Applying safety procedures during electrical maintenance	2.14	0.78	1.93	0.84	2.05	0.81	LL
21	Adhering to electrical installation regulations	2.03	0.82	1.91	0.81	1.98	0.81	LL
22	Adhering to electrical installation codes (e.g., Nigerian Electrical Code)	2.03	0.82	1.89	0.82	1.97	0.82	LL
23	Keeping correct repair records	1.99	0.86	2.04	0.80	2.01	0.83	LL
24	Keeping accurate maintenance records	2.26	0.76	1.93	0.86	2.12	0.82	LL
25	Interpreting electrical diagrams accurately	2.15	0.85	2.14	0.79	2.15	0.82	LL
26	Interpreting electrical circuit schematics properly	2.05	0.84	1.79	0.82	1.94	0.84	LL
27	Performing preventive maintenance on electrical equipment	2.01	0.78	2.02	0.74	2.01	0.76	LL
	Grand mean	**2.02**	**0.81**	**1.97**	**0.81**	**2.34**	**0.82**	**LL**

Source: Field Work, 2025

***Note**: N_1 = number of EIMW teachers with educational qualifications, N_2 = EIMW number of EIMW teachers without educational qualifications, $\bar{x}_1$ = mean of EIMW teachers with educational qualifications, $\bar{x}_2$ = EIMW teachers without educational qualifications, SD_1 = standard deviation of EIMW teachers with educational qualifications, SD_2 = standard deviation of EIMW teachers without educational qualifications, $\bar{x}_G$ = grand mean of EIMW teachers*

Table 1 showed the analysis of the current level of maintenance skills possessed by EIMW teachers in science and technical colleges in North East, Nigeria. The mean scores ranged from 1.87 to 2.21, while the standard deviation values ranged from 0.76 to 0.86, indicating relative consistency in the responses across all items. The grand mean of 2.00 with a standard deviation of 0.81 revealed that EIMW teachers generally possess a low level (LL) of maintenance skills. This implies that the teachers require substantial improvement in technical, troubleshooting, and safety-related competencies to meet the demands of electrical installation and maintenance in science and technical colleges.

Research Question 2: In which specific areas of electrical maintenance do EIMW teachers require improvement?

Table 2: Mean and Standard Deviation on Specific Areas of Electrical maintenance requiring Improvement among EIMW Teachers in Science and Technical Colleges in North East, Nigeria.

N_1 = 78, N_2 = 57

S/N	Item	$\bar{x}_1$	SD_1	$\bar{x}_2$	SD_2	$\bar{x}_G$	SD_G	Rmk
28	Locating faults in single-phase system	4.54	0.50	4.46	0.50	4.50	0.50	VHN
29	Locating faults in three-phase system	4.46	0.50	4.42	0.50	4.44	0.50	HN
30	Diagnosing faulty control circuits	4.48	0.50	4.47	0.50	4.48	0.50	HN
31	Repairing electrical faults	4.42	0.50	4.46	0.50	4.44	0.50	HN
32	Interpreting electrical symbols	4.42	0.50	4.46	0.50	4.44	0.50	HN

33	Identifying troubleshooting faults	4.50	0.50	4.58	0.50	4.53	0.50	VHN
34	Interpreting troubleshooting faults from wiring diagrams	4.50	0.50	4.46	0.50	4.48	0.50	HN
35	Interpreting troubleshooting faults from wiring circuit layouts	4.44	0.50	4.56	0.50	4.49	0.50	VHN
36	Using diagnostic tools effectively such as multimeter, clamp meter	4.50	0.50	4.47	0.50	4.49	0.50	HN
37	Identifying intermittent electrical faults	4.42	0.50	4.53	0.50	4.47	0.50	VHN
38	Identifying root cause for electrical faults	4.42	0.50	4.42	0.50	4.42	0.50	HN
39	Servicing electrical motors, generators	4.47	0.50	4.32	0.50	4.41	0.49	HN
40	Servicing electrical transformers	4.54	0.50	4.54	0.50	4.54	0.50	VHN
41	Maintaining electrical distribution boards	4.58	0.50	4.51	0.50	4.55	0.50	VHN
42	Maintaining electrical panels	4.58	0.50	4.46	0.50	4.53	0.50	HN
43	Identifying fault lines in electric circuit	4.46	0.50	4.44	0.50	4.45	0.50	HN
44	Performing preventive maintenance on electrical installations	4.44	0.50	4.56	0.50	4.49	0.50	VHN
45	Calibrating electrical measuring instruments	4.49	0.50	4.56	0.50	4.52	0.50	HN
46	Maintaining electrical measuring instruments	4.49	0.50	4.44	0.50	4.47	0.50	HN
47	Replacing worn-out components in electrical machines	4.51	0.50	4.56	0.50	4.53	0.50	VHN
48	Applying electrical safety rules	4.50	0.50	4.44	0.50	4.47	0.50	HN
49	Applying lockout/tagout procedures	4.62	0.49	4.49	0.50	4.56	0.50	VHN
50	Ensuring proper earthing	4.47	0.50	4.40	0.50	4.44	0.50	HN
51	Ensuring correct bonding for safety	4.46	0.50	4.53	0.50	4.49	0.50	HN
52	Complying with national electrical codes	4.41	0.50	4.53	0.50	4.46	0.50	HN
53	Complying with national installation standards	4.35	0.48	4.51	0.50	4.41	0.49	HN
54	Using protective equipment (PPE) correctly during maintenance tasks	4.45	0.50	4.47	0.50	4.46	0.50	HN
55	Conducting risk assessments before beginning maintenance work	4.50	0.50	4.47	0.50	4.49	0.50	HN
	Grand mean	**4.48**	**0.50**	**4.48**	**0.50**	**4.48**	**0.5O**	**HN**

Source: Field Work, 2025

Note: *N_1 = number of EIMW teachers with educational qualifications, N_2 = EIMW number of EIMW teachers without educational qualifications, $\bar{x}_1$ = mean of EIMW teachers with educational qualifications, $\bar{x}_2$ = EIMW teachers without* *educational qualifications, SD_1 = standard deviation of EIMW teachers with educational qualifications, SD_2 = standard deviation of EIMW teachers without educational qualifications, $\bar{x}_G$ = grand mean of EIMW teachers*

Table 2 shows the analysis of the specific areas of electrical maintenance where EIMW teachers in science and technical colleges in North East, Nigeria require improvement. A total of 28 items (items 28–55) were assessed. Specifically, items 28, 33, 40, 41, 42, 45, 47, and 49 were rated very highly needed with means responses ranging between 4.58 to 4.50 with their corresponding standard deviations ranged from 0.49 and 0.50 indicating strong agreement among respondents. However, 30–32, 34–39, 43–46, 48, 50–55 were rated as highly needed with mean values ranging between 4.41 and 4.49, while the corresponding standard deviations was 0.50 each, indicating strong agreement among respondents. The grand mean of 4.48 with a standard deviation of 0.50 revealed that the skills improvement needs of EIMW teachers were generally rated as highly needed (HN). This indicated that although all areas of electrical maintenance required substantial improvement, particular attention should be given to troubleshooting faults, maintaining distribution boards and panels, servicing transformers and motors, applying lockout/tagout procedures, and replacing worn-out components, as these represent the most critical skill gaps among EIMW teachers.

Hypothesis 1: There is no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on the current level of maintenance skills possessed by EIMW teachers in Science and Technical Colleges in North-East, Nigeria. The test of significant difference in the current level of maintenance skills of EIMW teachers based on educational qualification is presented in Table 3:

Table 3: t-test Analysis on the Current Level of Maintenance Skills of EIMW Teachers Based on Educational Qualification

Variables	n	$\bar{x}$	SD	df	t	P	Remark
Teacher With Educational Qualification	78	2.02	0.14	133	1.76	0.08	Accepted
Teachers Without Educational Qualification	57	1.97	0.17				

n = Number of Respondents, $\bar{x}$ = Mean Response, SD = Standard Deviation, t = t-Value, p = p-Value

The result in Table 3 shows that EIMW teachers with educational qualifications ($\bar{x}$ = 2.02, SD = 0.82) and those without educational qualifications ($\bar{x}$ = 1.97, SD = 0.81) recorded very close mean scores on the current level of maintenance skills possessed. The calculated t-value of 1.76 with 133 degrees of freedom and a p-value of 0.08, which is greater than the 0.05 level of significance, indicates that there is no statistically significant difference between the two groups. This implies that both qualified and non-qualified EIMW teachers generally possess a low level of maintenance skills, suggesting that educational qualification alone does not significantly influence the current level of maintenance skills of EIMW teachers in Science and Technical Colleges in North-East Nigeria. Hence, the null hypothesis is accepted and there is no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on the current level of maintenance skills possessed by EIMW teachers in Science and Technical Colleges in North-East, Nigeria.

Hypothesis 2: There is no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on the areas of maintenance skills where EIMW teachers in Science and Technical Colleges in North-East, Nigeria require improvement. The test of significant difference in the areas of maintenance skills requiring improvement among EIMW teachers based on educational qualification is presented in Table 4:

Table 4: t-test Analysis on Areas of Maintenance Skills Requiring Improvement among EIMW Teachers Based on Educational Qualification

Variables	n	$\bar{x}$	SD	df	t	P	Remark
Teacher With Educational Qualification	78	4.48	0.50	133	0.20	0.84	Accepted
Teachers Without Educational Qualification	57	4.48	0.50				

n = Number of Respondents, $\bar{x}$ = Mean Response, SD = Standard Deviation, t = t-Value, p = p-Value

The result in Table 4 indicates that EIMW teachers with educational qualifications ($\bar{x}$ = 4.48, SD = 0.50) and those without educational qualifications ($\bar{x}$ = 4.48, SD = 0.50) had identical mean scores on the areas of maintenance skills requiring improvement. The calculated t-value of 0.20 with 133 degrees of freedom and a p-value of 0.84, which is greater than the 0.05 level of significance, shows that there is no statistically significant difference between the two groups. This finding implies that both qualified and non-qualified EIMW teachers uniformly acknowledged that they require substantial improvement in various areas of maintenance skills. Therefore, the need for skill enhancement cuts across all categories of EIMW teachers, regardless of their educational qualifications. Hence, the null hypothesis is accepted which means that there is no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on the areas of maintenance skills where EIMW teachers in Science and Technical Colleges in North-East, Nigeria require improvement.

Findings of the Study

Based on the results presented, the following are the findings of the study:

1. There was no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on the current level of maintenance skills possessed. This indicates that both groups of teachers generally possess a low level of maintenance skills irrespective of their educational qualification.

2. There was no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on the areas of maintenance skills requiring improvement. This shows that both groups identified similar areas of deficiencies, suggesting that the need for improvement in technical, troubleshooting, and safety-related skills cuts across both categories of teachers.

Discussion of Major Findings

The findings of the study revealed that there was no significant difference in the responses of EIMW teachers with academic qualifications and those without such qualifications on their existing maintenance skills. This outcome indicates that irrespective of formal qualifications, teachers in the field generally demonstrate low competency in the practical skills required for effective electrical installation and maintenance, suggesting an overall weakness in their technical capacity. The finding is in agreement with the study of Buba (2024) who emphasized that practical skill acquisition in technical education is not automatically guaranteed by formal qualifications but rather by continuous exposure to hands-on training and industry practices. Buba noted that many teachers in science and technical colleges tend to rely heavily on theoretical backgrounds, which results in poor performance in diagnostic, repair, and troubleshooting activities in the workshop. Similarly, Okeke, Okorafor, and Wogan (2024) maintained that competence in maintenance-related practices is a product of repeated training and constant upgrading of knowledge through professional development, rather than merely holding certificates. Their study showed that even well-qualified teachers often exhibit weak performance when tested on real-life maintenance situations. In addition, Musa, Ogbuanya, and Tongshwal (2020) supported this position by pointing out that both qualified and less-qualified instructors in technical fields often share similar deficiencies in technical expertise, largely due to outdated instructional approaches, inadequate exposure to industry innovations, and insufficient opportunities for retraining. The authors stressed that unless teachers engage with practical workshops and industry-based training, the gap between qualification and actual competence will persist. Furthermore, Asogwa, Ogbuanya, and Okanya (2019) highlighted that technical competence in maintenance cannot be divorced from regular practice; they found that teachers with different educational backgrounds performed at almost the same level when asked to execute real maintenance tasks, suggesting that qualifications alone do not necessarily reflect competence levels.

The findings of the study revealed that there was no significant difference in the responses of EIMW teachers with educational qualifications and those without educational qualifications regarding the areas of maintenance skills where improvement is needed. This indicates that both groups consistently identified deficiencies in technical operations, troubleshooting, and safety-related practices, suggesting that professional development gaps are widespread across all categories of teachers. This finding aligns with Deba (2023), who noted that teachers in technical education frequently identify similar skill deficiencies regardless of their academic standing, particularly in the areas of testing, fault diagnosis, and safety compliance. Deba argued that these weaknesses stem from outdated training curricula and limited access to industry-standard equipment. Likewise, Bello, Dauda, and Deba (2023) emphasized that technical teachers often struggle with applying theoretical knowledge to practical contexts, and these gaps cut across teachers with varying qualifications, showing that the challenge is systemic rather than individual. Similarly, Eze, Ezenwafor, and Oluka (2018) highlighted that both trained and less-trained instructors in technical fields often require retraining in modern troubleshooting and electrical safety practices. Their study demonstrated that professional qualifications do not automatically guarantee competence in rapidly evolving technical areas, thereby making retraining essential. In the same direction, Wampana and Shanga (2017) found that technical teachers consistently pointed to the same weak areas—diagnostic testing, electrical documentation, and compliance with safety standards—suggesting that the areas of deficiency are universal and not dependent on the level of formal qualifications attained.

Conclusion

This study assessed the maintenance skills improvement needs of Electrical Installation and Maintenance Work (EIMW) teachers in Science and Technical Colleges in North East, Nigeria with particular focus on determining the current level of maintenance skills possessed by teachers and identifying the areas where improvement is required. The findings of the study revealed that both professionally qualified and non-professionally qualified EIMW teachers possessed relatively low maintenance skills needed for effective instructional delivery and proper maintenance of workshop tools, equipment, and machines. This suggests that educational qualification alone does not guarantee adequate technical maintenance competence among teachers in Science and Technical Colleges. The study further established that there was no significant difference between the responses of teachers with educational qualifications and those without educational qualifications regarding the areas of maintenance skills requiring improvement. Both categories of teachers identified similar deficiencies in technical operations, troubleshooting procedures, safety practices, and maintenance of modern electrical equipment. This indicates that maintenance skill gaps are common among EIMW teachers irrespective of their qualification status and therefore require urgent intervention. Anchored on the Experiential Learning Theory of Kolb (1984), the study emphasized the importance of continuous practical experience and professional development in enhancing teachers' competencies. The inability of teachers to keep pace with technological advancement in electrical installation and maintenance may negatively affect students' practical skill acquisition and the achievement of technical education objectives in Nigeria. Therefore, the study concluded that EIMW teachers in Science and Technical Colleges in North East, Nigeria require substantial improvement in maintenance-related competencies through regular training, workshops, and practical exposure to modern electrical technologies. Strengthening teachers' maintenance skills will enhance instructional effectiveness, improve workshop management, and better prepare students for employment and self-reliance in the electrical industry.

Recommendations

The following are the recommendations of the study:

1. Since both qualified and non-qualified teachers were found to possess low levels of maintenance skills, the Ministries of Education and Technical Boards should prioritize periodic skill-upgrading workshops and refresher courses focused on core maintenance practices to bridge the knowledge gap and raise the competency of all EIMW teachers.

2. Given that both groups indicated similar deficiencies in technical, troubleshooting, and safety-related skills, specialized training modules should be developed to address these specific areas. Colleges should integrate simulation-based learning, problem-solving drills, and safety practice sessions into teacher professional development programs.

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