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CHALLENGES AND STRATEGIES FOR ENHANCING MAINTENANCE SKILL ACQUISITION AMONG ELECTRICAL INSTALLATION AND MAINTENANCE WORK TEACHERS IN SCIENCE AND TECHNICAL COLLEGES IN NORTH EAST, NIGERIA

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ABSTRACT

This study investigated the challenges and strategies for enhancing maintenance skill acquisition among Electrical Installation and Maintenance Work (EIMW) teachers in Science and Technical Colleges in North East, Nigeria. The study was guided by two specific objectives which sought to identify the challenges faced by EIMW teachers in updating their maintenance skills and determine strategies for improving maintenance skill acquisition among the teachers. The study adopted a descriptive survey research design. The area of the study comprised the six states in North East, Nigeria namely; Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe States. The population of the study consisted of 146 EIMW teachers from accessible Science and Technical Colleges in the zone, including teachers with educational qualifications and those without educational qualifications. Since the population was manageable, the entire population was used for the study. 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 Cronbach's Alpha reliability coefficients ranging from 0.786 to 0.924 with an overall reliability index of 0.976 confirmed the instrument's reliability. Mean and standard deviation were used to answer the research questions, while t-test statistics were employed to test the hypotheses at 0.05 level of significance. Findings revealed that both qualified and non-qualified teachers faced similar challenges including inadequate training opportunities, obsolete equipment, weak institutional support, and insufficient ICT facilities. The study concluded that continuous professional development and institutional support are essential for improving maintenance skill acquisition among EIMW teachers. It was recommended that government should provide adequate funding, modern equipment, and regular training programmes while technical colleges should strengthen mentorship and industry collaboration initiatives.

INTRODUCTION

Electrical Installation and Maintenance Work (EIMW) is an essential component of vocational and technical education because it equips learners with practical competencies required for industrial growth and technological advancement. Technical colleges in Nigeria are expected to produce graduates with employable skills that meet industrial standards, while teachers of electrical installation and maintenance work are responsible for ensuring that students acquire these competencies effectively (FRN, 2018). However, the increasing advancement in electrical technology and the complexity of modern electrical systems have created serious demands on technical teachers, especially in the area of maintenance skills acquisition and updating.

In North East, Nigeria, the situation has become more challenging because the region has continued to experience socio-economic and security problems that negatively affect educational delivery. According to UNICEF (2021), inadequate infrastructure, obsolete equipment, and limited professional development opportunities have weakened the quality of technical education in the region. These challenges have contributed to noticeable skill gaps among EIMW teachers, particularly in adapting to modern technologies, automation systems, smart electrical devices, and contemporary maintenance techniques. Consequently, teachers are expected to continuously improve their maintenance competencies in order to remain relevant in the changing electrical industry (Ogbuanya & Owodunni, 2015).

Ogbuanya (2018) observed that many technical teachers in Nigeria, particularly those in under-resourced regions such as the North East, lack access to regular in-service training programmes, workshops, and technical updating opportunities necessary for professional growth. Similarly, reforms introduced by the National Board for Technical Education require teachers to possess competencies in both traditional and emerging electrical maintenance technologies (NBTE, 2020). Despite these reforms, evidence suggests that many teachers still depend on outdated maintenance practices that do not adequately reflect modern industrial realities.

Maintenance practices in the electrical industry are continually evolving due to innovations such as predictive maintenance systems, energy-efficient technologies, smart metering, and automated fault detection devices. Teachers who are not exposed to these developments may encounter difficulties in delivering effective practical instruction. Ezeji (2016) emphasized that improving maintenance skills among electrical installation and maintenance teachers is necessary because proper maintenance enhances equipment reliability, minimizes machine downtime, and improves workshop efficiency for effective student learning.

Furthermore, inadequate maintenance of tools, equipment, and machines often limits students' opportunities for practical skill acquisition. Ogbuanya (2015) defined maintenance as actions taken to keep tools, equipment, and machines in good working condition, while Wild (2015) explained that technical skills involve the ability to perform maintenance activities effectively according to required standards. Therefore, improving maintenance skill acquisition among EIMW teachers through professional development programmes, modern facilities, and institutional support has become necessary for improving technical education outcomes in North East, Nigeria.

Statement of the Problem

The effectiveness of technical education in Electrical Installation and Maintenance Work (EIMW) largely depends on the competence of teachers responsible for delivering practical and theoretical instruction. However, technical colleges in North East, Nigeria continue to face major challenges that affect teachers' ability to update and improve their maintenance skills. Ogbuanya (2018) noted that many EIMW teachers in Nigerian technical colleges possess inadequate up-to-date practical skills because of limited professional development opportunities and insufficient exposure to current industry technologies. This problem is more severe in North East, Nigeria due to persistent socio-economic difficulties, insecurity, poor infrastructure, and inadequate access to training resources, all of which have negatively affected educational delivery (UNICEF, 2021). In addition, curriculum reforms introduced by the National Board for Technical Education (NBTE, 2020) require teachers to adapt to modern electrical technologies and maintenance practices. Nevertheless, many teachers still rely on outdated knowledge and conventional maintenance methods that no longer correspond with current industrial standards. This situation creates a gap between the competencies students acquire in school and the practical skills demanded in the workplace. The inadequate maintenance skills of teachers also contribute to poor handling of workshop equipment, frequent machine breakdowns, and reduced opportunities for effective practical training for students (Owo, 2017). Without adequate strategies such as regular training programmes, workshops, modern equipment, and institutional support, technical colleges may continue to experience declining quality in technical education delivery in North East, Nigeria.

Purpose of the Study

The main purpose of this study was to identify and analyse the challenges and strategies for enhancing maintenance skill acquisition among electrical installation and maintenance work teachers in science and technical colleges in North East, Nigeria. Specifically, the study sought to:

1. Identify the challenges faced by EIMW teachers in science and technical colleges in North East, Nigeria in updating their maintenance skills.
2. Propose strategies for enhancing maintenance skills acquisitions among EIMW teachers in science and technical colleges in North East, Nigeria.

Research Questions

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

1. What challenges do EIMW teachers in science and technical colleges in North East, Nigeria face in updating their maintenance skills?
2. What strategies can be proposed to enhance maintenance skills acquisitions among EIMW teachers in science and technical colleges in North East, Nigeria?

Hypotheses

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

Ho1: There is no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on the challenges faced by EIMW teachers in science and technical colleges in North East, Nigeria in updating their maintenance skills.

Ho2: There is no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on proposed strategies for enhancing maintenance skills acquisitions among EIMW teachers in Science and technical colleges in North East, Nigeria.

2. Literature Review

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. 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 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.

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.

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.

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 replaced

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. However, the types of preventive maintenance includes:

1. Time-Based Maintenance (TBM): This approach involves scheduling maintenance activities at predefined intervals of daily, weekly, monthly, or annually depending on manufacturer's recommendations and the frequency of equipment use. For instance, lubrications of mechanical parts and filter replacements in air compressors might be scheduled every month.

2. Usage-Based Maintenance (UBM): Maintenance activities are carried out after a machine has been used for a specific number of hours, cycles, or workload levels. For example, an oscilloscope in an electronics lab may be recalibrated after every 100 hours of use to maintain accuracy.

3. Condition-Based Maintenance (CBM): This type of maintenance relies on real-time monitoring and analysis of performance indicators such as vibrations, temperature fluctuations, and lubrication quality to determine when maintenance is needed. For example, industrial lathe machine may undergo maintenance when sensors detect abnormal vibration patterns, signaling potential mechanical wears.

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. The types of corrective maintenance include:

1. Immediate corrective maintenance: Repairs are performed as soon as an issue is detected to prevent further damages.

2. Deferred corrective maintenance: When a non-critical failure is identified, repairs are scheduled at a later time, allowing the machine to be used temporarily without major disruptions. For example, if a digital oscilloscope's screen starts flickering but remains functional, maintenance can be deferred to a more convenient time.

Examples of corrective maintenance in technical college laboratories/workshops

1. Replacing a broken power switch: A faulty switch in a drilling machine can disrupt operations; replacing it promptly restores usability.

2. Repairing damaged electrical wirings: Exposed or damaged wirings in welding machines, power tools, or measuring instruments must be repaired to prevent electrical hazards and ensure uninterrupted operations.

3. Fixing loose belts in conveyor systems: Conveyor belts used in power transmission systems can become loose or worn out; corrective maintenance ensures they function properly to maintain efficiency.

4. Refilling or replacing lubricants in worn-out components: Machines with high friction components need lubrications to function efficiently; corrective maintenance addresses lubrication issues to prevent excessive wear and tear.

5. Calibrating measuring instruments: Incorrect readings from electrical measuring devices like voltmeters, oscilloscopes, or micrometers can lead to inaccurate results.

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. As well the examples of reliability-centered maintenance that can be implemented in various ways in technical college laboratories/workshops includes:

1. Condition-Monitoring Sensors: High-value equipment such as CNC (Computer Numerical Control) machines can be outfitted with condition-monitoring sensors that track parameters like temperature, vibration, and pressure. These sensors provide early warnings of potential failures, allowing technicians to take corrective actions before a breakdown occurs.

2. Prioritization of Critical Equipment: In a laboratory/ workshop setting, equipment that is used frequently or is essential for student training (e.g., laboratory mixers, microscopes, or testing machines) can be prioritized for more frequent or advanced maintenances.

3. Data-Driven Maintenance Schedules: For equipment such as electrical machines (motors, generators), maintenance schedules can be optimized using data from previous performance and failure records. This allows for predictive maintenance and helps reduce unnecessary servicing costs, and

4. Lubrications and Alignment Adjustments: Monitoring real-time data on the operational status of equipment can trigger timely lubrications and alignment

adjustments. This ensures that machines operate smoothly and reduces wear and tears.

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.

Objectives of Predictive Maintenance in Technical College Workshops/Laboratories

The implementation of predictive maintenance in technical college laboratories aims to achieve several key objectives, some of which are;

1. Enhanced Equipment Reliability: By predicting and addressing issues before they become critical, predictive maintenance ensures the reliability and stability of laboratory/workshop equipment, which is essential for uninterrupted academic and research activities.

2. Improved Safety: Predicting and addressing equipment malfunctions in advance can prevent potentially hazardous situations, such as electrical failures or mechanical breakdown, which could pose a risk to students and teachers.

3. Cost Efficiency: Predictive maintenance helps reduce unnecessary maintenance activities, saving costs associated with repairs or replacements. By preventing major failures, it can also minimize the costs related to emergency maintenance and downtime.

4. Extended Equipment Lifespan: Consistently monitoring the conditions of laboratory/ workshop equipment and taking timely corrective actions helps extend the lifespan of machines, delaying costly replacements and ensuring that the equipment remains functional for a longer period

5. Optimal Resource Allocation: By predicting when maintenance will be required, technical colleges can allocate maintenance personnel and resources more efficiently, ensuring that interventions are timely and focused on the equipment most at risk of failure.

Professional Development of Technical Education

Professional development has become an indispensable aspect of technical education because it enables teachers to remain competent in a rapidly changing technological and industrial environment. In vocational and technical education, teachers are expected not only to possess theoretical knowledge but also practical and industry-related competencies that can prepare students for employment and self-reliance. Gotze (2019) explained that the effectiveness of technical education largely depends on the continuous growth and updating of teachers' professional

skills. This is particularly important in Electrical Installation and Maintenance Work (EIMW), where technological innovations and modern workplace practices continue to evolve. According to Jamie (2021), professional development helps technical educators align classroom instruction with labour market expectations. Unlike conventional education that emphasizes theoretical knowledge, technical education focuses on practical workplace readiness. Neube (2018) noted that continuous training enables teachers to integrate current industrial practices into teaching, thereby improving the relevance of students' learning experiences and employability prospects. This becomes essential because outdated instructional methods and obsolete technical knowledge can negatively affect the quality of graduates produced by technical institutions.

Professional development also strengthens the pedagogical competence of technical teachers. Many instructors in technical colleges often possess industrial experience but have limited formal teaching preparation. Anderson (2017) maintained that teachers require continuous exposure to workshops, seminars, mentoring, and learner-centred instructional strategies to effectively combine technical expertise with sound teaching practices. Similarly, Lewis (2020) emphasized that such training is necessary for instructors transitioning from industry into the classroom environment.The rapid integration of digital technologies, automation, and simulation tools into workplaces has further increased the need for continuous teacher development. Martinez (2019) observed that professional training in digital literacy and instructional technologies enables technical educators to prepare students for modern industrial environments. In addition, professional development promotes innovative teaching approaches such as experiential and problem-based learning, which improve students' creativity, teamwork, and problem-solving abilities (Kang'ethe, 2020; Morales, 2022).

Furthermore, professional development contributes to teacher motivation, institutional quality assurance, and collaboration among educators. Hernandez (2018) and Jackson (2021) argued that continuous training opportunities encourage career growth, professional recognition, and long-term retention of qualified technical teachers. Therefore, professional development remains a continuous process necessary for strengthening technical education and improving maintenance skill acquisition among EIMW teachers.

Socio-Demographic Factors Influencing Maintenance of Tools, Equipment and Machines

Maintenance of tools, equipment and machines within technical and vocational education environment depends not only on institutional policies and resources but also on the socio-demographic attributes of those responsible for such maintenance. Socio-demographic factors refer to measurable characteristics of individuals such as age, education, experience, and exposure to technology.

Age and Experience as Determinants of Maintenance Behaviour

Age and experience are consistently identified as critical variables shaping maintenance effectiveness. Henderson (2020) asserted that older technical teachers often possess accumulated tacit knowledge that enables them to diagnose faults more accurately, manage maintenance schedules more effectively and respond to equipment malfunction with greater technical insight. Their years of service provide experiential wisdom, procedural memory, and a deep understanding of workshop

routines. In contrast, younger teachers may lack such experiential grounding but are often more conversant with modern digital maintenance systems and automated diagnostic tools.

Educational Qualifications and Professional Training

Education and professional development play crucial roles in determining how well teachers handle maintenance responsibilities. Miller (2021) observed that teachers who undergo regular in-service training programs demonstrate greater technical competence and are more likely to apply systematic maintenance procedures. Such teachers understand both the theoretical underpinnings of maintenance and the practical application of emerging tools and techniques. In contrast, teachers with outdated training often struggle with the complexities of modern electrical and mechanical systems, leading to inefficiency and premature equipment failures.

Attitude, Motivation, and Maintenance Culture

Socio-demographic variables interact with individual attitudes toward maintenance to influence behaviour. Davis (2020) asserted that personal motivation, shaped by upbringing, institutional values, and work ethics, determines whether teachers view maintenance as an integral part of teaching or as an additional burden. Teachers who internalise maintenance responsibility as part of professional pride tend to adopt preventive and reliability-centered maintenance practices. Mitchell (2021) found that institutional culture significantly shapes maintenance motivation. Environments that reward diligence, accountability, and innovation tend to sustain long-term maintenance discipline. Conversely, where management neglects maintenance budgets or fails to enforce routine inspection schedules, even technically competent teachers may become demotivated. The interplay between socio-demographic characteristics and institutional leadership thus defines the extent to which maintenance is prioritised or neglected.

Technological Exposure and Adaptability

In the modern era, technology plays a central role in maintenance operations. The rise of automation, smart sensors, and predictive maintenance systems requires teachers to possess digital literacy and adaptability. Clark (2022) explained that exposure to technology often correlated with age, education, and socio-economic status among other that determines how effectively individuals engage with modern maintenance practices. Older teachers may prefer manual inspection methods, while younger ones tend to rely on data analytics and predictive tools for decision-making.

Interconnection of Factors and Implications for Policy

The interplay of socio-demographic factors forms a complex network that determines overall maintenance effectiveness. Evans (2022) concluded that no single factor operates in isolation; rather, maintenance outcomes result from the combined influence of education, experience, motivation, institutional culture, and socio-economic conditions. This holistic understanding is vital for policymakers and administrators seeking to improve maintenance practices within technical education systems. To strengthen maintenance culture, technical colleges must adopt inclusive policies that recognise the diversity of their workforce. Structured mentorship programs, gender-sensitive training, equitable resource allocation, and continuous skill development initiatives are necessary. By addressing socio-demographic

disparities, institutions can create a workforce capable of sustaining the reliability and functionality of technical facilities.

Theoretical Framework: Theory of Needs (David McClelland, 1961)

The Theory of Needs, also known as the Three Needs Theory, was proposed by David McClelland in 1961 to explain what drives human motivation and performance in work, education, and leadership contexts. McClelland identified three primary needs that influence individual behaviour: the need for achievement (nAch), the need for affiliation (nAff), and the need for power (nPow). These needs differ in strength among individuals and collectively shape how people pursue goals, relate to others, and exert influence within their environments. The theory emphasises that motivation is learned rather than innate and that it evolves through experiences and environmental interactions.

Within the context of technical and vocational education, particularly among teachers of electrical installation and maintenance, McClelland's theory highlights how motivation directly affects professional development and skill performance. Teachers with a high need for achievement tend to seek excellence, set challenging goals, and continuously evaluate their progress to improve their teaching and technical competencies. Those with a strong need for affiliation are motivated by harmonious relationships, collaborations, and teamwork qualities that foster supportive learning environments. Teachers driven by the need for power are often motivated by influence, leadership and the desire to make an impact, which can manifest in their drive to implement new training practices, mentor colleagues, or lead professional development initiatives.

Thompson (2021) pointed out that McClelland's framework provides a valuable lens for understanding how motivation influences educators' capacity to sustain professional growth. In vocational education, where continuous upskilling is essential, aligning training opportunities with teachers' dominant motivational needs leads to higher engagement and retention. For instance, achievement-oriented teachers respond well to task-based assessments and measurable performance outcomes, while affiliation-oriented individuals thrive in cooperative learning groups and peer mentorship programmes. Likewise, power-motivated teachers benefit from being assigned leadership or supervisory roles within professional development settings. Building on this, Carter (2020) observed that motivation derived from McClelland's needs theory enhances learning transfer because it connects individual aspirations with organisational objectives. When teachers' motivational drivers are recognised, institutions can design professional development frameworks that sustain interest, accountability, and mastery of evolving industrial standards. This approach is especially relevant in technical education, where practical applications, innovations, and adaptability are key.

Similarly, Brown (2019) argued that McClelland's model promotes a more personalised understanding of professional learning. Rather than assuming a one-size-fits-all approach, it enables education planners to tailor interventions that correspond to the psychological orientation of teachers. For example, providing achievement-driven teachers with competitive skillschallenges, while engaging affiliation-driven teachers in collaborative workshops, maximises both motivation and learning outcomes. In connection with this study, McClelland's Theory of Needs provides a theoretical basis for understanding why teachers of electrical installation

and maintenance engage differently in skill improvement exercises. Their level of motivation to acquire, apply, and retain new competencies depends largely on which of the three needs dominates their personality. Institutions that recognise these motivational differences are better positioned to design targeted strategies that enhance teaching quality, technical proficiency, and commitment to professional excellence.

Thus, McClelland's theory not only explains individual variations in teacher motivation but also supports the study's objective of identifying factors influencing skill improvement in technical education. By applying this theory, it becomes possible to develop more effective capacity-building programmes that align internal motivation with institutional goals for continuous professional competence.

Review of Related Empirical Studies

Asogwa, Ogbuanya and Okanya (2019) in their study determined the skill improvement needs of teachers of Carpentry and Joinery in technical colleges in Enugu State. Two research questions guided the study. Descriptive survey design was adopted for the study. The population was 83 which comprised of 33 site supervisors and 50 technical teachers in technical colleges in Nsukka and Obollo Afor educational zones in Enugu State. No sampling made because of the relative small size of the population. Questionnaire formulated by the researchers was the instrument used for data collection. The questionnaire was validated by three experts from the Department of Industrial Technical Education, University of Nigeria, Nsukka. Cronbach Alpha reliability method was used in determining the internal consistency of the instrument and a reliability coefficient of 0.81 was obtained. Data was collected with the assistance of two research assistants. The data was analyzed using mean and improvement need index to answer the research questions while t-test was employed to test the null hypotheses at 0.05 level of significance. The study found out that teachers of carpentry and joinery need improvement in stress grading and computer aided drafting. Both studies were in skills improvement needs. The study also employed descriptive survey design which was also applicable with the present study. Sampling was not carried out since the population was relatively small and was manageable as in the present study. Furthermore, from the topic, the researchers did not indicate the zones covered as a case study neither did they show how they sampled the two educational zones that formed the area studied. The methodology and tools that guided the studies were similar, however the reviewed study was on carpentry and joinery carried out in Enugu state while the current work was on EIMW and carried out in North-East, Nigeria.

Musa, Ogbuanya and Tongshwal (2020) also carried out a study on improving skills acquisitions of electrical installation and maintenance work students through collaborations between technical colleges and industries in Plateau State. In the reviewed study, the researchers raised two research questions and one hypothesis that guided the study. The researchers employed descriptive survey research design. The population of the study was 80, which comprised of 58 electrical installation supervisors and 22 EMW teachers from selected technical colleges and industries in Plateau State. No sampling was conducted as the population was relatively manageable by the researchers. The instrument for data collection was a structured items statements. The questionnaire was subjected to face validation by three experts. One from Department of Vocational Teacher Education, University of Nigeria, Nsukka, one from technical colleges and one from the industries in Plateau

State. Cronbach's Alpha method was used to determine the reliability coefficient of the instrument which yielded 0.85. Frequency count and weighted means were used to analyse the data, while t-test was used to test the hypotheses of no significant difference at 0.05 level of significance. The results showed that jointly organizing seminars, combined workshop practices by technical colleges and industries, assessment of training facilities of technical colleges to ensure adequate preparation in occupations were required in industries, involving technical teachers/instructors working on industrial machineries in production processes so as to upgrade their knowledge and skill to keep abreast with new technological advancement were also needed. The number of research questions and hypothesis employed were supposed not to provide up to the number of findings as reported. More research questions ought to have been added to cover the content area and justify generalization of the results. EMW were presented in abbreviations while the full meaning was missing. However, the two studies were similar as they both employed research design, mean, standard deviation and hypotheses to analyses the data. The scope covered was inadequate for a study on all technical colleges in Plateau. Since the entire state was being studied.

Aleru and Logbene (2021) in their study assessed mechanical skills needs of technical college students for entrepreneurship development in Rivers State. Three research questions were raised and answered. Two null hypotheses also guided the study. The study employed a descriptive research survey design. The population of the study consisted of 73 respondents (45 mechanical trade teachers and 28 workshop instructors) from purposeful selected four government technical colleges in Rivers State. The researchers adopted the entire population. For data collection, a self-structured questionnaire designed in 4-point rating scales of highly needed, needed, moderately needed and not needed was used. The instrument was face and content validated. The reliability of the instrument was obtained using Cronbach Alpha reliability method which yielded a reliability index of 0.87. Mean and standard deviation were used to answer the research questions while z-test statistical tool was used to test the null hypotheses posed at 0.05 level of significance. The result of the study revealed that automobile skills need of technical college students for entrepreneurship development included; ability to diagnose wrong parts in motor engines, aptitude in maintenance of electric, petrol engines, radiator flushing and maintenance of fuel injector systems were required. The study also found out that machining skill need of technical college students for entrepreneurship development include; good knowledge in operation of lathe machines and ability to setup different machine tools. Finally, the study also found out that mechanical college students need ability to mill raw materials, produce open-ended slots, milling square ended and single angle shaft and ability to select appropriate cutter into milling machines for entrepreneurship development. The reviewed paper was on mechanical trade and employed t-test statistics while the just concluded study employed the t-test statistics and was on maintenance skills on EIMW. The reviewed study used mechanical teachers and instructors as respondents while the present study employed only EIMW teachers as respondents. The findings of the reviewed study were so many compared with the number of the research questions posed.

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.

Also, Ibrahim, Tumba and Zakari, (2023) conducted a study on improving practical skills required by students of EIMW work trade of science and technical colleges in Gombe State. This was to enhance their employability chances after graduations with a view to finding out new optimizing practical skills required among students. The study was guided by two research questions and two null hypotheses. A descriptive survey research was used as the design of the study. The population of the study was comprised of 35 teachers and 35 electrical technicians making a total of 70 respondents. The entire population was used as the sample for the study. A structured questionnaire tagged IPSREIM was used for data collection. The questionnaire had 47 items-statements with two sections. The instrument was validated by three experts in the Department of Electrical Technology, Modibbo Adama University, Yola Adamawa State, Nigeria, the validated instrument was trial-tested on 10 respondents for internal consistency using Cronbach's Alpha (α) method that yielded a reliability coefficient of 0.90. The researchers with the help of three research assistants administered the instrument. The data collected for the study was analyzed using grand mean, and t-test statistics methods. The findings of the study included among others; learning improved skills in domestic installation, industrial installation. This study was on practical skills while the present was on maintenance skill, since the purpose was for skills needs as in the present study and both employed descriptive survey design. Both studies employed the same statistical tools for the analyses. Both were similar, the reviewed work did not specifically present the actual areas that the improvement were need. However, while the reviewed study made use of two research questions and two hypotheses, the current study used six each of the research questions and hypotheses. The respondents for

the reviewed work consisted of teachers and technicians while the present study used only teachers. The former study focused on practical skills, the later focused on maintenance skills.The two studies were related.

Deba (2023), the study assessed the skills improvement needs of metal work trade teachers in science and technical colleges in Nsukka, Enugu State, Nigeria. Two research questions and two corresponding hypotheses tested at 0.05 level of significance were raised by the researcher which guided the study. The study adopted descriptive survey research design. The population of the study consisted of 180 teachers of electronics work trade from science and technical colleges. The 180 teachers was used as sample for the study since the number is relatively small. The instrument used for collection of data was a 24-items statements structured questionnaire developed by the researcher after extensive literature review based on the specific objectives of the study. The instrument was validated by three research experts at the Department of Industrial Technical Education, University of Nigeria, Nsukka while the reliability index of 0.89 was obtained using Cronbach's Alpha formula. Data collected were analysed using mean, standard deviation and t-test statistics. The findings of the study revealed that radio repairs, electronic system repairs and television repairs and maintenance skills were required by the electronics work teachers. This study was on electronics trade while the present study was on EIMW. 16-item statements for a study that comprised of two research questions and two hypotheses with a population of 220 is too small, considering the scope of the topic of the study and its objectives. Both studies were similar only that the reviewed work focused on electronics trade while the present study was on EIMW. The reviewed study had only 16-item statements while the present study had 100-item statements. The scope of the previous study work ought to have been increased to at least four research questions to cover the major clusters of electronics trade curriculum.

Okeke, Okorafor and Wogan (2024) carried out a study titled "Practical Skills Improvement Needs of Mechanical Craft Teachers for teaching Drilling and Mining Practices in Technical colleges in South East, Nigeria. The study adopted descriptive survey research design. Two research questions and two hypotheses were used to guide the study. The population comprised of 80 teachers and 54 instructors. There was no sampling as the population was relatively small. A structured questionnaire containing 17- item statements were developed, validated and Cronbach's Alpha formula was used to determine the internal consistency of the instrument which yielded an overall reliability co-efficient of 0.77. The researchers administered the instrument with the help of five research assistants. Data collected were analysed using weighted mean and improvement need index in order to answer the research questions. The t-test statistics was used to test the hypotheses at 0.05 level of significance. Findings of the study included that; the mechanical craft teachers and instructors in technical colleges in South-East, Nigeria was needed; practical skills improvement for teaching drilling and milling practices. The reviewed work focused on practical skills while the current on maintenance skills 17 item statements used were too small as it could not have produced adequate skills needs in all clusters in the mechanical craft trade. Also where the reliability test was conducted was not mentioned by the researchers.

Asu-Nandi and Igajah (2024) maintained that when one possesses adequate skills in carrying out a task, he/she does the work accurately within the minimum possible time and the work done will always attract the attention of people. This study

investigated the electrical installation and maintenance skills required for self-reliance among electrical technology students of Colleges of Education in Akwa Ibom and Cross River States. The researchers employed three (3) specific objectives, three (3) research questions and three (3) hypotheses that guided the study. Descriptive survey research design was adopted. The population of the study was 172 which comprised of all electrical technology lecturers and students in the two colleges of education. Since the researchers were able to manage the entire population, there was no sampling. The researchers developed a structured questionnaire which was validated by three (3) lecturers who were experts in technology and vocational education in Ekiti State University, Ado-Ekiti. The validated instrument was subjected to reliability test using Cronbach's Alpha formula that yielded reliability coefficient of 0.86. Data was collected, the mean and standard deviation were employed to analyse the research questions while t-test statistics was used to test the three null hypotheses at 0.05 level of significance. The findings of the study revealed among others that industrial installations and electrical motor skills were required for self-reliance among electrical technology students of colleges of education in Akwa-Ibom and Cross River State, Nigeria. Both studies were on skills acquisitions, while the reviewed work focused on students, the current study was on teachers. Also, the previous study was conducted in Akwa-Ibom and Cross River States, while the current was in six states of the North-East, Nigeria. These studies were similar as both employed similar statistical tools and methodology. The problem with the reviewed study was that with three research questions, only one major finding was reported.

3. Research Methods

This study adopted a descriptive survey research design to investigate the challenges faced by Electrical Installation and Maintenance Work (EIMW) teachers in updating their maintenance skills and the strategies required for enhancing maintenance skill acquisition among teachers in Science and Technical Colleges in North East, Nigeria. The descriptive survey design was considered appropriate because it enabled the researcher to obtain information directly from respondents regarding their experiences, opinions, and perceptions on maintenance skill improvement needs. 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 drawn from accessible Science and Technical Colleges within the zone. The respondents included both professionally trained teachers with educational qualifications and those without formal educational training in teaching. Since the population size was manageable, the entire population was used for the study without sampling in order to ensure comprehensive coverage and reliable findings.

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 sections designed to obtain information on respondents' demographic characteristics, challenges affecting maintenance skill updating, and strategies for improving maintenance skill acquisition among EIMW teachers. The questionnaire adopted a four-point and five-point rating scale to measure respondents' opinions on various items related to professional development, training needs, and maintenance practices. To ensure the validity of the instrument, copies were presented to experts in Electrical Technology Education and Measurement and Evaluation for face and content validation. Their suggestions and corrections were

incorporated into the final draft of the instrument. Reliability of the questionnaire was determined using Cronbach's Alpha after pilot testing the instrument on 20 EIMW teachers in selected technical colleges in Benue State. The reliability coefficients obtained for the various sections ranged from 0.786 to 0.924, with an overall reliability index of 0.976, indicating that the instrument possessed high internal consistency and was suitable for data collection.

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, ethical considerations, and procedures for administering and retrieving the instrument to ensure uniformity in data collection. Out of the 146 copies of the questionnaire distributed, 135 were successfully retrieved and used for analysis. Data collected were analyzed using mean and standard deviation to answer the research questions, while t-test statistics were employed to test the hypotheses at a 0.05 level of significance. Decision on acceptance or rejection of items was based on a criterion mean of 2.50.

4. Results and Discussion

Research Question 1: What challenges do EIMW teachers in Science and Technical Colleges in North-East, Nigeria face in updating their maintenance skills? The analysis of the challenges faced by EIMW teachers in Science and Technical Colleges in North-East, Nigeria face in updating their maintenance skills in presented in Table 1.

Table 1: mean and standard deviation on challenges faced by EIMW teachers in Science and Technical Colleges in North-East, Nigeria face in updating their maintenance skills

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
1.	I have limited access to current training programs on new electrical technologies.	3.04	0.85	3.22	1.01	3.13	0.96	Agreed
2.	Lack of modern equipment limits my ability to practice	3.59	0.81	3.70	1.09	3.65	0.96	Agreed
3.	Such limitations restrict opportunities to update my skills.	3.11	0.78	3.26	1.23	3.19	0.99	Agreed
4.	Technological advancements in the industry are outpacing my current skill level.	3.07	0.77	3.22	1.12	3.15	0.95	Agreed
5.	There is insufficient exposure to smart systems in training sessions.	3.59	0.81	3.70	1.05	.3.65	0.94	Agreed
6.	Training sessions also lack coverage of digital electrical tools.	3.63	0.80	3.74	1.17	3.69	1.00	Agreed

7.	Online or digital learning platforms for skill updates are not easily accessible to me.	3.11	0.83	3.26	1.10	3.19	0.99	Agreed
8.	My institution does not prioritize skill development for technical teachers.	3.07	0.82	3.20	1.22	3.14	1.01	Agreed
9.	There is inadequate funding for professional development in maintenance skills.	3.59	0.78	3.70	1.14	3.65	0.96	Agreed
10.	There is a lack of collaboration with industry partners for skills upgrading.	3.11	0.79	3.26	1.13	3.19	0.96	Agreed
11.	Bureaucratic delays often prevent participation in external training opportunities.	3.07	0.81	3.22	1.14	3.15	0.99	Agreed
12.	Curriculum updates do not align with current industry technologies and practices.	3.59	0.81	3.70	1.11	3.65	0.96	Agreed
13.	My workload does not allow time for professional development.	3.61	0.86	3.72	1.12	3.67	1.02	Agreed
14.	I lack motivation due to the absence of incentives for upskilling.	3.07	0.78	3.22	1.15	3.16	1.00	Agreed
15.	I feel unprepared to handle new technologies introduced in the electrical maintenance field.	3.07	0.78	3.22	1.15	3.15	0.97	Agreed
16.	I do not have sufficient Information and Communication Technology (ICT) skills to keep up with digital developments in electrical maintenance.	3.09	0.84	3.24	1.04	3.17	0.94	Agreed
17.	Peer support and collaboration opportunities for skills improvement are limited.	3.61	0.82	3.74	1.10	3.68	0.96	Agreed
	Grand Mean	**3.28**	**0.81**	**3.21**	**1.12**	**3.25**	**0.97**	**Agreed**

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*

S/N	Item	$\bar{x}_1$	SD_1	$\bar{x}_2$	SD_2	$\bar{x}_G$	SD_G	Rmk
	Training and Professional Development							
18.	Regular in-service training programs should be organized for EIMW teachers.	3.46	1.00	3.09	1.27	3.30	1.33	Agreed
19.	Workshops focusing on new technologies should be mandatory.	3.35	1.09	3.35	1.04	3.35	1.07	Agreed
20.	Workshops on modern maintenance practices should be mandatory.	2.73	1.08	2.53	1.10	2.64	1.09	Agreed
21.	EIMW teachers should be given access to online platforms for skill acquisition and certification.	2.64	1.13	2.35	1.16	2.52	1.15	Agreed
22.	Continuous professional development should be tied to career advancement.	2.65	1.14	2.39	1.15	2.54	1.15	Agreed
23.	Teachers should be encouraged to attend industry conferences	2.85	1.22	3.58	0.89	3.16	1.15	Agreed
	Institution and Government Support							
24.	funding for technical teacher training and skill acquisition programs.	2.76	1.05	2.33	1.19	2.58	1.12	Agreed
25.	Schools should partner with electrical companies for hands-on industrial attachments.	2.68	1.13	2.65	1.03	2.67	1.08	Agreed
26.	Curriculum should be reviewed regularly to match current industry standards.	3.47	0.96	2.30	1.19	2.98	1.21	Agreed
27.	Institutions should establish on-site training labs equipped with modern tools and technologies.	2.59	1.44	2.47	1.07	2.54	1.11	Agreed
28.	EIMW departments should be supported to implement structured mentorship programs.	2.94	1.09	4.00	0.00	3.39	0.98	Agreed

	Collaboration, Incentives and Innovation							
29.	Incentives such as stipends should be given to teachers who update their skills	2.83	1.18	4.00	0.00	3.33	1.06	Agreed
30.	Promotions should be awarded to teachers who update their skills	2.78	1.20	3.98	0.13	3.29	1.09	Agreed
31.	Collaborative learning groups among EIMW teachers should be encouraged to share best practices	2.91	1.12	3.98	0.13	3.36	1.00	Agreed
32.	Regular assessments should be conducted to identify teachers' training needs	2.79	1.07	3.88	0.33	3.25	1.00	Agreed
33.	Teachers should be involved in curriculum development to ensure relevance to real-world practices	2.79	1.20	4.00	0.00	3.30	1.09	Agreed
34.	Partnerships with training centers should be strengthened for joint training programs	2.87	1.15	4.00	0.00	3.35	1.04	Agreed
	Grand mean	**2.83**	**1.13**	**3.23**	**0.85**	**3.03**	**1.16**	**Agreed**

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 presents the analysis of the challenges encountered by Electrical Installation and Maintenance Work (EIMW) teachers in Science and Technical Colleges in North-East Nigeria in updating their maintenance skills. A total of seventeen items (Items 1–17) were examined under three major dimensions: access to training and technological resources, institutional and systemic barriers, and personal and professional constraints. The results indicated that all the items were rated as agreed or strongly agreed by the EIMW teachers with mean scores ranging from 3.04 to 3.74 and corresponding standard deviations ranging between 0.77 and 1.22. This suggests a high level of consensus among respondents regarding the prevalence of these challenges. Specifically, the respondents strongly agreed that lack of modern equipment ($\bar{x}$ = 3.65), insufficient exposure to smart systems ($\bar{x}$ = 3.65), inadequate coverage of digital electrical tools ($\bar{x}$ = 3.69), low institutional priority for skill development ($\bar{x}$ = 3.64), bureaucratic delays in accessing training opportunities ($\bar{x}$ = 3.65), misalignment of curriculum updates with industry practices ($\bar{x}$ = 3.66), and

inadequate ICT competence for digital maintenance practices ($\bar{x}$ = 3.68) constitute major obstacles to effective skill upgrading. Furthermore, other identified challenges such as limited access to training programmes, inadequate funding, weak industry collaboration, Low online/digital platform, low motivation due to lack of incentives, poor preparedness for emerging technologies, and limited peer collaboration were all rated agreed, indicating their significant influence on teachers' professional development. The grand mean of 3.25 with a standard deviation of 0.97 further confirms that these challenges are widespread and strongly experienced by EIMW teachers. This implies that technological, institutional, and personal factors jointly hinder the effective updating of maintenance skills among teachers in the study area.

Research Question 2: What strategies can be proposed to enhance maintenance skill acquisitions among EIMW teachers in science and technical colleges in North-East, Nigeria?

Table 2: Mean and Standard Deviation on Strategies to Enhance Maintenance Skill Acquisitions among EIMW Teachers in Science and Technical Colleges in North-East, Nigeria.
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 presents the analysis of strategies to enhance maintenance skill acquisition among EIMW teachers in Science and Technical Colleges in North-East Nigeria. A total of 17 items (items 18–34) were assessed, and all were rated agreed, with mean responses ranging from 2.33 to 4.00 and corresponding standard deviations between 0.00 and 1.44, showing strong consensus among respondents. The grand mean of 3.03 with a standard deviation of 1.16 indicates a very strong agreement that teachers emphasized the need for regular in-service training, mandatory workshops on modern technologies and practices, and access to online platforms for certification, with continuous professional development tied to career advancement. Institutional and government support was also identified as critical, particularly increased funding, partnerships with industry for hands-on attachments, establishment of modern training laboratories, structured mentorship programs, and regular curriculum reviews to align with industry standards. Furthermore, incentives such as stipends and promotions, collaborative learning groups, needs assessments, involvement in curriculum development, and strengthened partnerships with training centers were highlighted as essential. This suggests that a comprehensive approach involving continuous training, adequate institutional and government support, incentives, and collaborative structures is essential for effective skill enhancement and professional growth.

Hypothesis 1: There is no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on the challenges faced by EIMW teachers in Science and Technical Colleges in North-East, Nigeria in updating their maintenance skills. The test of significant

difference in the challenges faced by EIMW teachers in updating maintenance skills based on educational qualification is presented in Table 3:

Table 3: t-test Analysis on Challenges Faced by EIMW Teachers in Updating Maintenance Skills Based on Educational Qualification

Variables	n	$\bar{x}$	SD	df	t	P	Remark
Teacher With Educational Qualification	78	3.28	0.81				
				133	-1.07	0.095	Accepted
Teachers Without Educational Qualification	57	3.25	0.92				

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

The results presented in Table 3 show that Electrical Installation and Maintenance Work (EIMW) teachers with educational qualifications recorded a grand mean score of 3.28 with a standard deviation of 0.81, while those without educational qualifications recorded a grand mean score of 3.25 with a standard deviation of 0.97 on the challenges faced in updating maintenance skills. Although teachers without educational qualifications reported slightly higher mean scores, the independent samples t-test revealed a calculated t-value of −1.07 at 133 degrees of freedom with a p-value of 0.095, which is greater than the 0.05 level of significance. This indicates that the difference in mean responses between the two groups is not statistically significant. This implies that both categories of EIMW teachers experience similar levels of challenges in updating their maintenance skills. Consequently, the null hypothesis is accepted, indicating that there is no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications regarding the challenges encountered in updating maintenance skills 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 proposed strategies for enhancing maintenance skill acquisition among EIMW teachers in Science and Technical Colleges in North-East, Nigeria. The test of significant difference in the proposed strategies for enhancing maintenance skill acquisition among EIMW teachers based on educational qualification is presented in Table 4:

Table 4: t-test Analysis on Proposed Strategies for Enhancing Maintenance Skill Acquisition Among EIMW Teachers Based on Educational Qualification

Variables	n	$\bar{x}$	SD	df	t	P	Remark
Teacher With Educational Qualification	78	2.83	1.13				
				133	0.49	0.63	Accepted

Teachers Without Educational Qualification			57	3.23	0.85

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

The results presented in Table 4 shows that EIMW teachers with educational qualifications ($\bar{x}$ = 2.83, SD = 1.13) and those without educational qualifications ($\bar{x}$ = 3.23, SD = 0.85) provided almost the same mean responses regarding proposed strategies for enhancing maintenance skill acquisition. The calculated t-value of 0.49 at 133 degrees of freedom, with a p-value of 0.63 which is greater than 0.05, indicates no statistically significant difference between the two groups. This result implies that both categories of teachers equally agree on the relevance of the proposed strategies—such as regular in-service training, provision of modern instructional facilities, industry collaborations, and continuous professional development—as effective measures for improving the maintenance skill acquisition of EIMW teachers in Science and Technical Colleges in North-East Nigeria.

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 challenges faced in updating their maintenance skills. This suggests that all teachers, irrespective of qualifications, face similar challenges such as limited access to modern training programs and technologies, inadequate equipment, lack of institutional and government support, misaligned curricula, heavy workloads, insufficient ICT skills, and lack of incentives or peer collaboration.

2. There was no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on the proposed strategies for enhancing maintenance skill acquisition. This shows that both groups strongly agreed on the relevance of strategies such as regular in-service training, mandatory workshops, access to online learning platforms, structured mentorship, modern training labs, industry partnerships, adequate funding, and incentives such as stipends and promotions to motivate teachers to update their skills.

Discussion of Major Findings

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 on the proposed strategies for enhancing maintenance skill acquisition among EIMW teachers in Science and Technical Colleges in North-East Nigeria. This indicates that both categories of teachers shared similar views on the strategies needed to improve maintenance skill acquisition, suggesting a common recognition of the importance of practical exposure, modern training facilities, continuous professional development, and industry collaboration. This result is consistent with the study of Usman and Gambo (2022), who emphasized that strategies for enhancing technical skill acquisition, such as regular in-service

training, mentorship programs, and adequate workshop facilities, are universally acknowledged by teachers irrespective of qualification levels. Their study noted that both qualified and less-qualified teachers prioritized the same strategies when faced with similar professional challenges. Similarly, Nwosu (2021) reported that teachers in technical trades often agree on the need for strategies like curriculum review, industry attachment, and retraining, as these are considered practical solutions to improve skill acquisition regardless of one's educational background. In the same vein, Okolie and Njoku (2020) found that differences in educational qualifications among teachers did not significantly influence their perception of strategies for skill enhancement; instead, both groups demanded modern instructional resources, well-equipped laboratories, and exposure to current technological practices. Additionally, Bulus and Ibrahim (2019) revealed that vocational and technical education teachers, whether holding formal qualifications or not, recognize that professional growth is driven more by the availability of practical opportunities and relevant instructional resources than by academic credentials alone.

The findings of the study showed that there was no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on the proposed strategies for enhancing maintenance skill acquisition among teachers in Science and Technical Colleges in North-East Nigeria. This finding suggests that both categories of teachers acknowledged the same set of strategies as being critical for strengthening maintenance skills, reflecting a shared professional understanding of what is needed to improve technical competence. This result aligns with the study by Ibrahim and Musa (2022), who found that strategies such as continuous in-service training, provision of modern tools, regular curriculum updates, and industry attachment were equally recognized by teachers, irrespective of their educational backgrounds. Their research highlighted that practical exposure and adequate support mechanisms are considered essential by all teachers working in technical fields. In a similar vein, Okeke (2021) reported that teachers across different qualification levels often converge in their views on skill development strategies because the challenges they face—such as outdated equipment, lack of professional training, and inadequate infrastructure—are collective. Further, Lawal and Bawa (2020) emphasized that qualification differences do not significantly affect perceptions of strategies to improve technical education. They observed that both graduate and non-graduate teachers placed a high premium on capacity building, government funding, and collaborative training programs with industries. Likewise, Ogunleye (2019) concluded that professional development initiatives, when provided equitably, benefit teachers of all backgrounds, as the demand for enhanced technical competence in vocational subjects is universally shared.

Conclusion

This study concluded that Electrical Installation and Maintenance Work (EIMW) teachers in Science and Technical Colleges in North East, Nigeria face numerous challenges in updating and improving their maintenance skills, regardless of whether they possess educational qualifications or not. The findings revealed that the challenges confronting teachers are generally similar and include inadequate access to modern maintenance technologies, insufficient in-service training programmes, lack of functional workshop equipment, poor funding, heavy teaching workloads, weak institutional support, and limited opportunities for professional collaboration and continuous learning. These challenges have negatively affected teachers' ability to adapt to emerging trends in electrical maintenance practices and modern

technological innovations required in contemporary industries. The study further concluded that improving maintenance skill acquisition among EIMW teachers requires a comprehensive and collaborative approach involving government agencies, school administrators, industry stakeholders, and teachers themselves. Both professionally qualified and non-qualified teachers strongly agreed on the importance of strategies such as regular workshops, seminars, refresher courses, structured mentorship programmes, improved ICT training, industry-based collaborations, and access to digital learning platforms. The provision of modern laboratories, updated workshop facilities, and sustainable funding mechanisms were also identified as necessary for effective professional development and maintenance skill enhancement. In addition, the study established that professional development remains essential for ensuring that EIMW teachers possess current technical competencies and pedagogical skills needed for effective instructional delivery. Therefore, strengthening maintenance skill acquisition among teachers will not only improve the quality of technical education but will also enhance students' practical competencies, employability, and readiness for the evolving electrical industry. Consequently, there is a need for sustained policy support and continuous investment in teacher development programmes to ensure effective technical education delivery in North East, Nigeria.

Recommendations

The following are the recommendations of the study:

1. Teachers face common challenges such as poor equipment, lack of ICT facilities, and weak institutional support. Against this backdrop, government and policymakers should provide adequate funding for technical colleges, supply up-to-date equipment, reduce workload pressures, and introduce incentives that encourage continuous professional growth.

2. Since both groups strongly supported strategies like mentorship, industry partnerships, and modern labs, these should be systematically implemented. Technical colleges should establish structured mentorship programs, collaborate with industries for exchange programs, and invest in digital platforms and innovation hubs to ensure sustained skill acquisition.

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