

AVAILABILITY AND ADEQUACY OF IN-SERVICE TRAINING PROGRAMMES FOR ENHANCING MAINTENANCE SKILLS OF ELECTRICAL INSTALLATION AND MAINTENANCE WORK TEACHERS IN SCIENCE AND TECHNICAL COLLEGES IN NORTH EAST, NIGERIA

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ABSTRACT

This study investigated the availability and adequacy of in-service training programmes for enhancing the maintenance skills of Electrical Installation and Maintenance Work (EIMW) teachers in Science and Technical Colleges in North East, Nigeria. The study was guided by two objectives which sought to examine the available in-service training programmes for EIMW teachers and determine the adequacy of such programmes in updating teachers' maintenance skills. The study adopted a descriptive survey research design. The study was conducted in the six states of North East Nigeria namely: Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe. The population of the study comprised 146 EIMW teachers from thirty-six Science and Technical Colleges in the region, including professionally qualified and non-professionally qualified teachers. 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 three experts, while its reliability was established using Cronbach's Alpha which yielded an overall reliability coefficient of 0.976. Data collection was carried out with the assistance of six trained research assistants, and 135 completed copies of the questionnaire were retrieved and analyzed using mean, standard deviation, and t-test statistics at 0.05 level of significance. The findings revealed that in-service training programmes for EIMW teachers were fairly available but not adequately sufficient for updating teachers' maintenance skills. The study concluded that existing training programmes were inadequate in addressing contemporary maintenance competencies required in the electrical industry. The study recommended regular industry-based training programmes, improved funding for teacher development, provision of modern facilities, and consistent professional development opportunities 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 manpower development. Technical colleges in Nigeria are established to equip students with practical and employable skills that meet industrial standards and workplace expectations. The effectiveness of these institutions therefore depends largely on the competence and professional capacity of teachers responsible for training students in electrical installation and maintenance practices. According to the Federal Republic of Nigeria (FRN, 2018), teachers of electrical installation and maintenance work are expected to possess up-to-date technical knowledge and practical skills capable of meeting the changing demands of the electrical industry.

The rapid advancement in electrical technologies, automation systems, smart devices, and modern maintenance techniques has increased the need for continuous professional development among EIMW teachers. Teachers are expected to constantly update their knowledge and competencies in order to effectively train students in current industrial practices. Ogbuanya and Owodunni (2015) observed that teachers in electrical installation and maintenance work must continuously improve their technical and maintenance skills to cope with emerging technologies and modern safety requirements in the industry. In-service training programmes therefore become essential mechanisms through which teachers acquire new competencies, improve existing skills, and remain professionally relevant.

In-service training programmes include workshops, seminars, conferences, refresher courses, industrial attachments, and other professional development activities organized to improve teachers' instructional and technical competencies. These programmes are particularly important in technical education because of the practical nature of the trades and the constant technological innovations in the electrical sector. However, Ogbuanya (2018) maintained that many technical teachers in Nigeria, particularly those in under-resourced regions such as North East Nigeria, have limited access to regular in-service training opportunities and technical workshops required for effective skills improvement. This situation negatively affects teachers' ability to update their maintenance skills and deliver quality practical instruction to students.

The National Board for Technical Education (NBTE, 2020) introduced curriculum reforms aimed at aligning technical college education with contemporary industrial requirements. These reforms demand that teachers possess competencies in both traditional and emerging maintenance technologies. Despite these efforts, evidence suggests that many teachers are yet to receive adequate training required to implement the curriculum effectively. Furthermore, UNICEF (2021) reported that socio-economic challenges, insecurity, inadequate infrastructure, and limited educational resources in North East Nigeria have further constrained opportunities for teacher professional development. Consequently, the availability and adequacy of in-service training programmes for EIMW teachers have become critical issues requiring investigation. Assessing these programmes is necessary to determine whether they sufficiently equip teachers with relevant maintenance skills needed for effective teaching, improved workshop practices, and enhanced students' skill acquisition in science and technical colleges across North East Nigeria.

Statement of the Problem

The effectiveness of technical education in Electrical Installation and Maintenance Work (EIMW) depends greatly on the availability and adequacy of in-service training programmes designed to improve teachers' maintenance skills and professional competencies. Teachers are expected to update their knowledge regularly in response to rapid technological changes in

electrical systems, maintenance practices, automation, and safety procedures. However, evidence indicates that many EIMW teachers in technical colleges do not receive sufficient professional development opportunities required to keep pace with current industrial trends and technological innovations. Ogbuanya (2018) observed that many electrical installation and maintenance teachers in Nigerian technical colleges possess inadequate up-to-date practical skills due to poor access to training opportunities and modern industry practices. This challenge is more pronounced in North East Nigeria where insecurity, inadequate infrastructure, and socio-economic difficulties have negatively affected educational development and teachers' access to continuous training programmes (UNICEF, 2021). Consequently, many teachers continue to rely on outdated maintenance techniques and instructional methods that no longer correspond with current industrial requirements. Furthermore, although the National Board for Technical Education (NBTE, 2020) introduced curriculum reforms intended to align technical education with modern workplace expectations, many teachers have not received adequate in-service training necessary for effective curriculum implementation. The absence or inadequacy of such programmes limits teachers' maintenance competencies, weakens practical instruction, and affects students' acquisition of relevant technical skills. Therefore, there is need to assess the availability and adequacy of in-service training programmes for EIMW teachers in science and technical colleges in North East Nigeria.

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. Examine the available existing in-service training programs for EIMW teachers in science and technical colleges in North East, Nigeria.
2. Determine the adequacy of in-service training programs related to EIMW teachers in science and technical colleges in North East, Nigeria in updating their maintenance skills.

Research Questions

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

1. How available are the existing in-service training programs for EIMW teachers in science and technical colleges in North East, Nigeria?
2. How adequate are the in-service training programs related to EIMW teachers in-science and technical colleges in North East, Nigeria in updating their maintenance skills?

Hypotheses

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

H₀: There is no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on the availability of in-service training programs for EIMW teachers in-Science and technical colleges in North East, Nigeria.

H₀₄: There is no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on the adequacy of in-service training programs related to EIMW teachers in-science and technical colleges in North East, Nigeria in updating their maintenance skills.

2. Literature Review

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 also according to Morales (2022) plays a strategic role in sustaining teacher motivations and retentions in technical education institutions. Many technical educators face the challenge of balancing heavy workloads, limited resources, and, in some cases, lower remunerations compared to their counterparts in industry. Participations in professional development programmes creates opportunities for career progressions, recognitions, and a sense of belongings to a professional community. (Hernandez, 2018) and Jackson (2021) had variously opined that the long-term sustainability of technical education systems depends not only on the recruitment of qualified instructors but also on the retention of those who have developed specialised pedagogical and industry-relevant expertise. Another dimension of professional development in technical education is its contributions to quality assurance. Governments, accreditation agencies, and industry stakeholders increasingly demanding accountability in technical and vocational institutions. Furthermore, teacher professional development has emerged as a core indicator of quality, ensuring that teachers demonstrate competence not only in technical fields but also in delivering inclusive and equitable education (Mwangi, 2019). Also, Mendez (2020) stated that continuous training in areas such as safety standards, ethics, environmental sustainability, and emerging workplace regulations ensures that graduates from technical institutions meet the expectations of employers and society at large. He emphasized that professional development fosters collaborative practices that are vital in strengthening technical education systems and that when teachers engage in peer-learnings, mentorships, and communities of practices, they contribute to collective institutional growth and innovations. Such collaborative models move beyond the traditional focus on

individual improvement and instead build institutional techniques of continuous learning and adaptations.

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.

(i) Perceptual skills are also related to vision. If the student perceives information incorrectly, then it is extremely difficult to come up with correct answers in a learning environment. Perceptual skills comprise of the student's ability to analyze, interpret, and give meaning to what is seen. This is the processing portion of vision, and these so important skills should not be overlooked when trying to repair an improperly working visual system.

(ii) Perceptual motor skills refer to our ability to coordinate small and/or large muscle groups to accomplish some tasks we visualize doing. It requires our integrating eye-hand or eye-foot coordination (or eye-any other body part) so we can button our shirts, writing our names, jumping ropes, shooting hoops, skilling, etc. also handling different types, sizes, and weights of equipment requiring perceptual motor skills.

(iii) Cognitive skill is a term referring to a human's ability to process thoughts that should not deplete on a large scale in healthy individuals. Cognitions mainly refers to things like memory, the ability to learn new information, speech, understanding of written materials. The brain is usually capable of learning new skills in the aforementioned areas, typically in early childhood, and of developing personal thoughts and beliefs about the world. Humans generally have a capacity for cognitive function once born, so almost every person is capable of learning or remembering. However, this is tested using tests like the Intelligent Quotient (IQ) test. In these tests, the patient will be asked a series of questions or to perform tasks, with each measuring a cognitive skill, such as level of consciousness, memory, awareness, problem-solving, motor skills, analytical abilities, or other similar concepts.

(iv) Motor skill is a learned sequence of movements that combine to produce a smooth efficient action in order to master a particular task. The development of motor skill occurs in the motor cortex, the region of the cerebral cortex that controls voluntary muscle groups. Due to the immaturity of the human nervous system at the time of birth, children grow continually throughout their childhood years. Many factors contribute to the ability and the rate that children develop their motor skills. Uncontrollable factors include: genetic or inherited traits and children with learning disorders. A child born to short and overweight parents is much less likely to be an athlete than a child born to two athletically built parents. Controllable factors include: the environment/society and technique they are born to. A child born in the city is much less likely to have the same opportunities to explore, hike, or trek the outdoors than one born in the rural area. For a child to successfully develop motor skills, he or she must receive many opportunities to physically explore the surroundings.

Maintenance Policies in EIMW Workshops/Laboratories

To realize the dreams of effective maintenance of tools, equipment and machines in technical college EIMW workshop efficient, effective and goal-oriented teaching and learning various forms of maintenance policies, are supposed to be adopted. According to Imachiagbe (2018) the practice of maintenance in technical college workshop can be broadly classified into two major categories, namely; planned and unplanned maintenance, it can also be classified into preventive and corrective maintenance practices which are adopted according to the nature, situations and gravity of maintenance to be carried out. Consequently, on various forms of maintenance practices Nelson (2015), Mbata (2016), Nwachukwu (2016) and Ogbuanya (2017), variously opined that the following are some form of maintenance practices:

- i. **Overhaul Maintenance:** This refers to the servicing of equipment or machines by cleaning, lubricating and in some instances dismantling of some parts for thorough servicing while the machines have not developed faults
- ii. **Breakdown Maintenance:** In this policy, the equipment operates until it breaks-down and is then repaired. This occurs in a situation where the costs of preventing failure are more than the cost of repairing the breakdown equipment. This policy is usually applied where many items of equipment operate as individual units or are separated from the actual manufacturing processes, so their failures will not have immediate effect on the overall production processes or constitute a safety hazard
- iii. **Replacement Instead of Maintenance:** In this policy, the equipment is operated until it breaks down beyond repairs and is then scrapped and a new one is bought. This happens in a situation where the cost of repairs exceeds the cost of replacement. Sometimes, technological advancement causes some equipment to become obsolete rapidly and thus their repairs may not be economical compared to their replacements.
- iv. **Planned Replacement:** In this policy, the equipment is operated and then sold before it either breaks-down or requires expensive overhaul. This policy is suitable for equipment which operates as an individual unit, e.g small power plants, machine tools, motor vehicles e.t.c. Some important advantages of this policy include reduction in downtime caused by breakdowns and prevent costly overhauls while restricting maintenance functions, to lubrications, servicing, cleaning and inspections only.
- v. **Preventive Maintenance:** Preventive maintenance is the anticipation of failures and the adoption of necessary measures to curtail them. The main objective of preventive maintenance is to effect the work of inspections, servicing and adjustments and to prevent the failure of equipment during operations.

Policy Decisions that Affect Maintenance Works

Administrative policy decisions that affect maintenance functions in our nation's set-up are numerous and vary from one set-up to another. However, the major ones that have serious effect on maintenance works and sometimes constitute bottle neck are;

- i. **Selection and Purchase of Machinery and Equipment:** According to Okwa (2017), policies or strategies adopted by an organization in the selection and purchase of equipment and machineries can enhance or reduce the effectiveness of the maintenance functions. The active participations of the maintenance personnel in the processes of selection and purchase of equipment and machineries either in a new installation or in additions to an existing plant can go a long way in minimizing cost of maintenance. He

went on to say that many administrators nowadays for what he described as selfish reasons, select and purchase equipment and machineries without the participations of maintenance personnel. In such institutions, he maintained that maintenance cost could be high and in some serious cases, the need to make maintenance practicable at all, could arise with very high cost and where the high cost cannot be met, the equipment and the machineries are then left un-maintained as the cases in some educational institutions in Nigeria today, he maintained. An experienced maintenance technician draws on his experiences to suggest modifications or the designs that would ease maintenance operations. He would also be in good position to recommend the brand or model that would lead to reduced maintenance cost.

- ii. **The Use of External Contractors:** Oftentimes, according to Akpan (2016), an institution may decide on the use of external contractors to carry out maintenance work either as a permanent arrangement or on adhoc basis. The primary factor that engenders such a decision, he opined is usually cost. He further emphasized that it should be understood that in strict financial terms, the cost of hiring a contractor is bound to be higher than the wage bill of own staff due to such factors as higher wages paid to contractors. It is worthy mentioned here that some institutions award maintenance work contracts to an external body not because their own staff members are incompetent to handle but the desire to make quick money from such contract thereby compounding the whole problem. In some very serious cases, the maintenance fund are even diverted with flimsy excuse of lack of spare parts and some other reasons. The use of external contractors should only be limited to specialized services as well as major works for which own staff may be inadequate or ill-trained to handle.

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

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- 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.

Theoretical Framework: Human Capital Theory (Becker, 1964)

The Human Capital Theory was developed by Gary Becker in 1964 to explain how education, training and skill development functions as investments that enhance the productive capacity of individuals and societies. The theory maintains that knowledge, expertise and health represent valuable assets in much the same way as physical resources, since they yield long-term benefits through higher productivity and improved performance. Becker stressed that when individuals acquire specialised training or education, the returns are manifested in their ability to contribute more meaningfully to economic and social progress. This idea positions human capital as central to both personal advancement and the broader development of nations, particularly in fields that depend on specialised skills and evolving technologies.

The application of this theory to the present study is particularly relevant, since teachers of electrical installation and maintenance work in science and technical colleges embody a significant dimension of human capital within Nigeria's educational and industrial system. Their role extends beyond transmitting knowledge to shaping the technical competence of students who are future participants in the labour market. For their teaching to remain effective, these teachers must undergo continuous training and professional upgrading that align with industry standards. Gotze (2019) explains that the rapid pace of technological innovation demands that technical educators consistently update their skills to maintain relevance and prevent instructional obsolescence. This view supports Becker's position that human capital must be nurtured and renewed for it to generate sustained benefits.

Jamie (2021) reinforces this perspective by stressing that the productivity of human capital is directly tied to the degree of investment societies make in its development. Inadequate investment in technical teachers leads to stagnation, a widening mismatch between classroom training and industry expectations and ultimately a weakening of the nation's capacity for economic growth. Within the present study, this underscores the urgency of assessing skills improvement needs for electrical installation teachers as their effectiveness has direct implications for the employability of graduates and the technological advancement of the country.

Additional insights from Alabi (2020) highlighted that in zones facing persistent developmental challenges, technical education serves as a vital mechanism for equipping individuals with employable skills, but this is only possible when teachers themselves are equipped with up-to-date competencies. Similarly, Peterson (2022) emphasised that human capital development in technical education should not be treated as a one-time investment but as a continuous process of renewal, particularly in fast-changing fields such as electrical installation. These perspectives extend Becker's argument by situating teacher development as a crucial strategy for building sustainable economic resilience in Nigeria.

The Human Capital Theory therefore provides a solid foundation for the present research by framing teachers of electrical installation and maintenance as pivotal assets whose professional development is integral to the progress of students, industries, and the wider economy. Skill improvement among these teachers represents not only a means of enhancing instructional quality but also a long-term investment in the nation's human resources, thereby reinforcing the need for systematic assessment and targeted interventions in their professional growth.

Review of Related Empirical Studies

Makinde (2015) also conducted a study to find out the Strategies adopted in Maintenance of Equipment in Electrical/Electronic Workshops of Science and Technical Colleges in Northern States of Nigeria. The population of the study consisted of 37 principals and 58 technical teachers in the study area. The study made use of survey research design while the data was collected by means of questionnaire items. Mean, standard deviation and z-test statistics were used to analyze the collected data. Findings showed that corrective maintenance policies were mostly adopted in the study area, and preventive maintenance was rated as the most effective strategy. Although the researcher ought to have stated the number of research questions and hypotheses used. He failed to present them. Since the entire states in Northern Nigeria was the area of the study the researcher failed to state how the selected 36 principals and the 38 teachers.

In another study by Onyebuchi (2015) titled "Workshop Facilities for Skills' Acquisitions in Electrical/Electronic Technology Courses in Technical Colleges in Lagos State". Three research questions were posed by the researcher, survey research design was used and the population was 120 electrical/electronic students in semi-final year classes in six technical colleges in Lagos State. The population was manageable and therefore the entire population was used. A structured questionnaire developed by the researcher and validated by three experts were employed. The validated instrument was subjected to reliability test using Cronbach's Alpha formula which yielded a high coefficient of 0.87. Mean and standard deviation were employed to analyze the data. The researcher listed 30 tools, equipment and machines required for effective teaching. Although, the reviewed study focused on skills acquisition, employed survey research design with three research questions. It differs from the present study as there were only three research questions as against six, there were no hypotheses also as against six in the current study. The research ought to have included hypotheses for valid results. The reviewed work respondents were students while that of the current study were teachers. This study focused on the workshop facilities available for skills acquisitions rather than the identification of skills needs which is the concern of the present study.

In another study by Mbagha, Wampana and Yusuf (2017), carried out on the Strategies for improving maintenance of laboratory equipment in Universities in Abia State for effective delivery. Survey research design was adopted, four research questions and one hypotheses were raised that guided the study. The instrument for the study was formulated by the researcher and validated by two experts. The reliability of the instrument was established with an index of 0.76. 137 teachers made up the population as there was no sample as the researchers managed the entire population. Reliability of the instrument was established with reliability index of 0.76. The data was collected with the assistance of two research assistants, analyzed using mean, standard deviation and t-test statistics. The findings showed that seven practical and seven corrective measures suggested by the respondents in the technical colleges EIMW curriculum should be included in the technical college EIMW curriculum. There should have been hypotheses testing for all the four maintenance strategies mentioned. However, they are related because both are on improvement needs for educational delivery.

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.

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.

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 investigate the availability and adequacy of in-service training programmes for enhancing maintenance skills among Electrical Installation and Maintenance Work (EIMW) teachers in Science and Technical Colleges in North East, Nigeria. The descriptive survey design was considered appropriate because it enabled the researcher to collect data from a relatively large population and describe existing conditions regarding teachers' professional development and maintenance skills improvement needs. The study was conducted in the North-East geopolitical zone of Nigeria, comprising Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe States. The zone has thirty-six accessible Science and Technical Colleges that contribute significantly to technical manpower development in the region. The population of the study consisted of 146 EIMW teachers from these colleges, including teachers with educational qualifications such as B.Sc. (Ed) and NCE, as well as teachers without professional teaching qualifications but possessing B.Sc., HND, or ND certificates in related technical fields. Since the population was relatively 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)" designed by the researcher. The instrument contained two sections: Section A elicited demographic information from respondents, while Section B

focused on issues relating to maintenance skills improvement and professional development needs of EIMW teachers. The questionnaire employed rating scales that measured respondents' perceptions regarding the availability and adequacy of in-service training programmes and related maintenance skills improvement needs. To ensure validity, the instrument was subjected to face and content validation by three experts comprising two lecturers from the Department of Electrical Technology Education, Modibbo Adama University, Yola, and one specialist in Measurement and Evaluation from Taraba State University, Jalingo. Their observations and corrections were incorporated into the final version of the instrument. Reliability of the instrument was established through a pilot test conducted among twenty EIMW teachers in selected technical colleges in Benue State. Using Cronbach's Alpha statistical method, reliability coefficients ranging from 0.786 to 0.924 with an overall reliability index of 0.976 were obtained, indicating that the instrument possessed high internal consistency and was suitable for the study.

The researcher collected data through face-to-face administration of printed questionnaires with the assistance of six trained research assistants, one from each state in the study area. The assistants were trained on the objectives of the study, procedures for administering the instrument, and ethical considerations to ensure uniformity in data collection. A total of 146 copies of the questionnaire were administered to respondents across the Science and Technical Colleges, out of which 135 completed copies were retrieved and used for analysis, representing a high retrieval rate. The 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, where items with mean ratings of 2.50 and above were regarded as accepted, while those below 2.50 were rejected.

4. Results and Discussion

Research Question 1: How available are the existing in-service training programs for EIMW teachers in science and technical colleges in North-East, Nigeria?

Table 1: Mean and Standard Deviation on Existing in-Service Training Programs for EIMW Teachers in North East, Nigeria

		<i>N₁ = 78, N₂ = 57</i>						
S/N	Item	\bar{x}_1	<i>SD</i> ₁	\bar{x}_2	<i>SD</i> ₂	\bar{x}_G	<i>SD</i> _G	Rmk
1.	In-service training programs related to electrical maintenance are regularly organized.	1.70	0.76	2.41	0.99	2.06	0.95	Disagreed
2.	Training workshops specific to EIMW skills are available in my region.	2.15	0.87	2.26	0.83	2.20	0.85	Disagreed
3.	I have attended at least one professional development program in the last two years.	3.13	0.78	3.37	0.84	3.25	0.81	Agreed
4.	Training opportunities are accessible without major logistical/financial challenges.	2.07	0.87	2.33	0.90	2.20	0.90	Disagreed
5.	There is sufficient awareness among EIMW teachers about available training programs.	2.04	0.88	2.26	0.93	2.15	0.85	Disagreed
Grand mean		2.22	0.83	2.53	0.90	2.38	0.87	Disagreed

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 presents the analysis of the availability of existing in-service training programs for EIMW teachers in Science and Technical Colleges in North-East Nigeria. Specifically, items 1, 2, 4 and 5 were rated disagreed with mean responses ranging between 2.04 and 3.37, while their corresponding standard deviations ranged from 0.76 to 0.99, showing a consistent level of agreement. However, only item 3 had a mean response of 3.25 with a standard deviation of 0.81. The grand mean of 2.38 with a standard deviation of 0.87 indicated that in-service training opportunities for EIMW teachers are not generally available and accessible across the region. This suggests that training opportunities should be available for teachers across the region.

Research Question 2: How adequate are the in-service training programs related to EIMW teachers in Science and Technical Colleges in North-East, Nigeria in updating maintenance skills?

Table 2: Mean and Standard Deviation on Adequacy of In-Service Training Programs related to 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
6.	The training Program I have attended were relevant to current industrial standard	2.01	0.89	2.22	0.83	2.12	0.86	Disagreed
7.	The training covered practical maintenance skills effectively.	1.93	0.88	2.11	0.89	2.02	0.89	Disagreed
8.	The duration of the training sessions was adequate to gain meaningful skills.	2.04	0.79	2.19	0.77	2.11	0.79	Disagreed
9.	Trainers were experienced in electrical maintenance.	1.89	0.80	2.04	0.80	1.96	0.80	Disagreed
10.	The training content included updates on safety standards	1.63	0.77	1.47	0.81	1.69	0.83	Disagreed
11.	The training featured newly introduced guidelines within the safety codes.	1.59	0.80	1.42	0.86	1.48	0.83	Disagreed
Grand Mean		1.85	0.82	1.90	0.83	1.90	0.83	Disagreed

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 adequacy of in-service training programmes for Electrical Installation and Maintenance Work (EIMW) teachers in Science and Technical Colleges in North-East, Nigeria with respect to updating maintenance skills. Six items (Items 6–11) were examined. The findings indicated that all the items were rated as disagreed or strongly disagreed by the respondents. Specifically, Items 1 to 10 recorded mean scores ranging from 1.42 to 2.19, with corresponding standard deviations between 0.77 and 0.89. This suggests that the respondents perceived the training programmes as inadequate in terms of relevance to current industry standards, coverage of practical maintenance skills, sufficiency of training duration, trainers' professional experience, and inclusion of updated safety standards. Furthermore, Item 11, which assessed the inclusion of newly introduced safety guidelines within the safety codes, recorded the lowest mean score of 1.48 with a standard deviation of 0.83, indicating strong disagreement among the respondents. This implies that recent safety updates were largely not incorporated into the training programmes. The grand mean of 1.90 with a standard deviation of 0.83 further confirms an overall disagreement, suggesting that the in-service training programmes are generally inadequate for enhancing and updating the maintenance skills of EIMW teachers in the study area.

Hypothesis 1: There is no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on the availability of in-service training programs for EIMW teachers in Science and Technical Colleges in North-East, Nigeria. The test of significant difference in the availability of in-service training programs for EIMW teachers based on educational qualification is presented in Table 3:

Table 3: t-test Analysis on Availability of In-Service Training Programs for EIMW Teachers Based on Educational Qualification

Variables	n	\bar{x}	SD	df	t	P	Remark
Teacher With Educational Qualification	78	2.22	0.83				
Teachers Without Educational Qualification	57	2.53	0.87	133	-2.189	0.49	Accepted

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

The results presented in Table 3 indicate that Electrical Installation and Maintenance Works (EIMW) teachers with educational qualifications ($\bar{x} = 2.22$, $SD = 0.83$) and those without educational qualifications ($\bar{x} = 2.53$, $SD = 0.90$) differed slightly in their mean responses regarding the availability of in-service training programmes. However, the independent samples t-test result revealed a computed t-value of -2.189 at 133 degrees of freedom with a p-value of 0.31, which is greater than the 0.05 level of significance. This shows that the observed difference between the two groups is not statistically significant. This implies that teachers' educational qualifications do not significantly influence their perception of the availability of in-service training programmes. 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 availability of in-service training programmes 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 adequacy of in-service training programs related to EIMW teachers in Science and Technical Colleges in North-East, Nigeria in updating maintenance skills. The test of significant difference in the

adequacy of in-service training programs for updating maintenance skills of EIMW teachers based on educational qualification is presented in Table 4:

Table 4: t-test Analysis on the Adequacy of In-Service Training Programs for EIMW Teachers Based on Educational Qualification

Variables	n	\bar{x}	SD	df	t	P	Remark
Teacher With Educational Qualification	78	1.85	0.82	133	-1.23	0.546	Accepted
Teachers Without Educational Qualification	57	1.90	0.83				

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

The results presented in Table 4 indicate that Electrical Installation and Maintenance Work (EIMW) teachers with educational qualifications recorded a grand mean score of 1.85 with a standard deviation of 0.82, while those without educational qualifications recorded a mean score of 1.90 with a standard deviation of 0.83 on the adequacy of in-service training programmes for updating maintenance skills. Although teachers without educational qualifications had a slightly higher mean score, the independent samples t-test revealed a computed t-value of -1.23 at 133 degrees of freedom with a p-value of 0.546, which is greater than the 0.05 level of significance. This indicates that the observed difference in mean responses between the two groups is not statistically significant. This finding implies that teachers' educational qualifications do not significantly influence their perception of the adequacy of in-service training programmes for updating 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 adequacy of in-service training programmes 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 availability of in-service training programs. This means that both groups experienced similar levels of limited availability of training opportunities, In-service training opportunities for EIMW teachers are fairly available and accessible, with teachers acknowledging the existence of regular workshops, professional development programs, and awareness of such opportunities, though consistency and inclusiveness still need improvement.
2. There was no significant difference in the mean responses of EIMW teachers with educational qualifications and those without educational qualifications on the adequacy of in-service training programs in updating maintenance skills. This implies that both groups perceived the existing training programs as inadequate for meeting their professional development needs.

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 availability of in-service training programs. This means that both groups experienced similar limitations in access to professional development opportunities, with teachers acknowledging that such programs exist but are not consistent or widely accessible to meet their needs. This finding is in agreement with Okeke, Okorafor, and Wogan (2024), who reported that although technical teachers were aware of in-service training initiatives, access was inconsistent, and the programs were often poorly coordinated. Their work highlighted that availability does not always translate into meaningful participation, particularly when workshops are limited to select groups. Similarly, Buba (2024) observed that technical education teachers across North-East Nigeria noted that while training opportunities are occasionally provided, they are sporadic, underfunded, and fail to reflect current industrial demands. This lack of regularity undermines the overall goal of building sustainable technical capacity. Supporting this, Okedawuayo and Toyin (2022) pointed out that in-service training opportunities for teachers in vocational and technical education were available but insufficiently structured, leaving many teachers without access to continuous professional growth. They emphasized that availability must be complemented with inclusivity to ensure wider teacher participation. Likewise, Nkwachi and Onyebuenyi (2018) found that technical teachers often reported minimal access to workshops and skill-updating seminars, which were sometimes concentrated in urban centers, thereby excluding teachers in remote locations.

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 adequacy of in-service training programs in updating maintenance skills. This implies that both groups perceived the training programs they had access to as inadequate, particularly in terms of relevance, duration, and depth in addressing modern maintenance practices and technological advancements. This finding is consistent with Deba (2023), who established that while teachers occasionally attend professional development programs, the content is often outdated and fails to address the practical realities of emerging electrical technologies. His study highlighted that inadequacy in training content leaves teachers unable to match the speed of industry transformation. Similarly, Benson, Oke, and Oluwaitayo (2022) observed that many vocational education training initiatives were too theoretical, lacking sufficient hands-on activities required to improve teachers' competencies in troubleshooting, safety, and preventive maintenance. In further support, Shanga (2021) reported that in-service training programs in technical colleges were inadequately structured, lacking modern equipment and qualified facilitators, thereby limiting their impact on skill development. The inadequacy was traced not only to poor program design but also to the lack of alignment with industry needs. Likewise, Aleru and Logbene (2021) argued that inadequacy of teacher training programs is a persistent challenge in Nigerian technical education, as many workshops and seminars remain generic, short in duration, and unable to update teachers with cutting-edge competencies in electrical maintenance.

Conclusion

This study assessed the availability and adequacy of in-service training programmes for enhancing the maintenance skills of Electrical Installation and Maintenance Work (EIMW) teachers in Science and Technical Colleges in North East, Nigeria. The findings revealed that although in-service training opportunities such as workshops, seminars, and professional development programmes are fairly available to teachers, the level of accessibility, consistency, and inclusiveness of such programmes remains inadequate. Both professionally qualified and non-professionally qualified teachers shared similar perceptions regarding the limited availability of training opportunities, indicating that the challenge affects all categories of EIMW teachers within the study area. The study further established that the existing in-service training programmes are inadequate in equipping teachers with the modern

maintenance skills required to effectively respond to current technological advancements in the electrical industry. The inability of these programmes to sufficiently address emerging maintenance techniques, practical competencies, and contemporary industrial practices suggests that many teachers may continue to rely on outdated knowledge and methods of instruction. This situation has serious implications for effective teaching and learning in technical colleges, as students may not acquire the practical skills needed to meet labour market demands and industrial expectations. The study therefore concludes that improving the quality of technical education in North East Nigeria requires deliberate efforts toward strengthening teacher professional development through regular, practical, and industry-based in-service training programmes. Government agencies, educational administrators, and relevant stakeholders must prioritize the provision of adequate training opportunities, modern facilities, and supportive policies that will enhance teachers' maintenance competencies. Such interventions will contribute significantly toward improving instructional delivery, students' practical skill acquisition, and the overall effectiveness of Electrical Installation and Maintenance Work programmes in Science and Technical Colleges across the region.

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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