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Training Needs of Roadside Electrical Technicians in Cognitive Apprenticeship and Psychomotor Skills for Effective Performance in South-South Nigeria

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Abstract: This study : investigated the training requirements of roadside electrical technicians in cognitive apprenticeship and psychomotor skills to enhance their effectiveness in South-South Nigeria. The increasing complexity of modern electrical and electronic systems has heightened the demand for highly skilled technicians; however, many of these technicians lack formal training, which hinders their ability to deliver efficient and quality services. The study was guided by two research questions and two null hypotheses and employed a descriptive survey research design. The population consisted of 1,120 registered roadside electrical technicians across the South-South region, from which a sample of 245 technicians was selected using a multi-stage sampling method. Data were collected using a structured questionnaire validated by three experts in technical and vocational education. The reliability of the instrument was established through Cronbach Alpha, which produced a coefficient of 0.87, demonstrating high internal consistency. Data analysis involved the use of mean and standard deviation to address the research questions, while Analysis of Variance (ANOVA) was employed to test the hypotheses at a 0.05 level of significance. The results revealed that roadside electrical technicians had significant training needs in both cognitive apprenticeship and psychomotor skills. Key areas identified included diagnostic reasoning, systematic troubleshooting, and logical problem-solving, as well as proficiency in safe tool handling, accurate wiring, and component installation. ANOVA results showed significant differences in the respondents' mean ratings, leading to the rejection of both null hypotheses. Based on these findings, the study recommended the development of structured training programs, targeted workshops, and competency-based skill development initiatives to strengthen the cognitive and psychomotor capacities of roadside electrical technicians in South-South Nigeria.
Keywords: Cognitive apprenticeship, psychomotor skills, roadside electrical technicians, informal sector training, vocational education, skill development.

Introduction

The rapid technological advancements across the globe have had a profound impact on technical education and skills acquisition, especially in the informal sector where much of Nigeria's workforce operates. The South-South region of Nigeria, known for its vibrant informal economy, relies heavily on roadside electrical technicians who play a vital role in maintaining and repairing electrical systems. These technicians form an indispensable part of the workforce, yet their training is often rooted in unstructured, traditional apprenticeship models that fail to meet the demands of a rapidly evolving technological landscape.

The informal apprenticeship system, while historically significant, has been criticized for its inability to equip learners with structured cognitive and psychomotor skills required for modern practice. Apprentices often learn through observation and repetitive imitation rather than through structured guidance and reflective learning processes, resulting in limited problem-solving capacity and inadequate transfer of skills to new or complex situations (Agbo & Okoye, 2022). This traditional model neglects the development of cognitive apprenticeship skills, which involve making expert thinking visible to learners through modeling, coaching, scaffolding, and reflective engagement (Collins et al., 1989).

Cognitive apprenticeship, as an instructional approach, connects theoretical knowledge with practical application by enabling learners to grasp both "how to perform a task" and the underlying reasons for each step. This approach has proven effective in technical and vocational contexts. Eze, Ogbu, and Uzo (2020) demonstrated that students taught using cognitive apprenticeship strategies in technical subjects, such as auto-mechanics, performed significantly better in both achievement and retention compared to those taught with traditional demonstration methods. This suggests that applying cognitive apprenticeship to the training of roadside electrical technicians could significantly improve their ability to think critically, solve problems, and adapt to new technologies.

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In addition to cognitive apprenticeship, psychomotor skill development is central to technical education and vocational training. Psychomotor skills involve the precise coordination of mental and physical processes required to manipulate tools, install components, and perform repairs accurately and safely. Agbo, Okoye, and Oguguo (2023) designed and validated a curriculum focused on psychomotor competencies for training apprentices in informal electrical installation in Nigeria, demonstrating the effectiveness of a structured method for skill development. Their findings highlighted the importance of formalizing psychomotor training to ensure that apprentices acquire standardized skills essential for professional competence. Similarly, Rotimi and Oladotun (2023) emphasized the need for valid and reliable psychomotor skills assessment instruments, noting that effective evaluation frameworks are critical to improving the quality of vocational training outcomes.

Furthermore, studies have shown that project-based and competency-driven instructional methods can outperform traditional demonstration approaches in fostering psychomotor skills. For example, research by Omorogiuwa and Ede (2024) revealed that project-based teaching significantly improved students' practical skills and interest in motor vehicle mechanics compared to conventional demonstration methods. These findings underscore the necessity of adopting innovative instructional strategies that directly engage learners in the hands-on, skill-oriented tasks demanded in their trades.

Despite these findings, the current training of roadside electrical technicians in Nigeria remains largely informal and unstructured. This gap is concerning, considering the scale and importance of the informal sector. According to the International Labour Organization, over 80% of Nigeria's workforce is employed in the informal economy, with millions engaged in artisanal trades, including electrical installation and repair. This sector, while essential for reducing unemployment and sustaining local economies, suffers from persistent challenges, including low skill levels, poor training quality, and a lack of standardized instructional content (Onokoya, 2012; Ungozi & Imm, 2022).

The Human Capital Theory provides a strong foundation for addressing these issues. The theory posits that education and skill development are investments that increase productivity and economic growth (Schultz & Becker, 1961). Within this framework, upgrading the cognitive and psychomotor skills of roadside electrical technicians is not only beneficial for the individuals but also for the overall economy. Olusola (2020) argued that improving the quality of technical and vocational training has the potential to transform informal sector workers into a more productive and competitive workforce.

However, several systemic challenges hinder the development of cognitive and psychomotor skills among roadside technicians. Yeap et al. (2021) identified issues such as outdated training facilities, insufficiently trained instructors, and a lack of modern instructional tools as major barriers to effective technical education in developing countries. These problems are further exacerbated by the informal nature of roadside electrical training, which is often devoid of structured curricula, standardized evaluation, and formal certification.

Globally, new instructional innovations such as virtual reality (VR) simulations and digital training platforms have been used successfully to enhance psychomotor skills in technical education. Zhao et al. (2023) demonstrated that learners using VR-based training for technical tasks made fewer errors, completed tasks faster, and retained skills more effectively than those taught through conventional methods. Although such technologies are still emerging in Nigeria, they offer valuable insights into the kinds of modern, structured approaches that could be adapted to the training of roadside technicians.

Another significant concern is the growing skills gap between what is currently taught in informal apprenticeship systems and the skills demanded by modern electrical technology. Many roadside technicians lack exposure to advanced tools, diagnostic equipment, and structured problem-solving techniques, making them less competitive and limiting their ability to meet customer expectations. A study by Agbo and Okoye (2022) emphasized that without targeted interventions, the skills deficit in the informal sector would persist, hindering national technological growth and innovation.

Therefore, cognitive apprenticeship and psychomotor skills development represent two critical dimensions of training that must be addressed simultaneously to improve the competence of roadside electrical technicians. While cognitive apprenticeship equips technicians with structured problem-solving strategies and reflective learning habits, psychomotor training ensures they possess the precision, dexterity, and technical confidence required for effective job performance. Together, these competencies can enhance the quality of electrical services, improve customer satisfaction, and raise the professional standing of roadside technicians within Nigeria's workforce.

Despite the recognition of these needs in the literature, empirical research specifically focused on cognitive apprenticeship and psychomotor training needs among roadside electrical technicians in South-South Nigeria is limited. Most existing studies address these variables independently or within formal education contexts, leaving a gap in understanding how these skills can be integrated and applied within informal apprenticeship systems. Closing this gap is essential for developing evidence-based interventions that reflect the conditions of the informal sector and equip technicians to meet contemporary technological demands.

Consequently, there is a pressing need for the present study to empirically determine the cognitive apprenticeship and psychomotor skill training needs of roadside electrical technicians in South-South Nigeria. By doing so, it will provide a foundation for developing targeted training programs that enhance the technical competencies of these technicians, promote sustainable employment, and strengthen Nigeria's human capital for technological and economic development.

Statement of the Problem

The roadside electrical technicians in South-South Nigeria constitute a critical segment of the informal sector, yet their training remains largely unstructured and traditional. Most of these technicians acquire their skills through informal apprenticeship systems that focus primarily on observation and repetitive imitation rather than on structured, guided learning. This approach neglects essential cognitive apprenticeship processes such as systematic problem-solving, diagnostic reasoning, and reflective learning. As a result, many technicians lack the ability to logically analyze faults, apply innovative repair techniques, or adapt to the increasing complexity of modern electrical systems. This gap has led to persistent complaints from clients about poor service delivery, frequent rework, and inefficiencies that undermine the reputation and professional relevance of roadside technicians.

Compounding this issue is the inadequate development of psychomotor skills among these technicians. Although electrical installation and repair require precision, dexterity, and the proper handling of tools, most roadside technicians depend on outdated, trial-and-error methods that do not align with modern industry standards. Without structured psychomotor training, technicians are prone to errors that result in faulty installations, electrical hazards, and safety risks for clients and themselves. Furthermore, the lack of formalized training programs means that there is no standard mechanism for assessing and certifying skill competence, which limits the ability of technicians to meet industry benchmarks or compete with their counterparts in countries where vocational education systems are more organized and competency-based.

If these gaps in cognitive apprenticeship and psychomotor skills training are not addressed, the consequences will be far-reaching. The informal electrical repair sector will continue to experience low productivity, inefficiency, and a lack of innovation. This situation not only perpetuates substandard service delivery but also diminishes the potential for economic growth and technological advancement in the region. Moreover, the reliance on inadequately skilled technicians can increase the risk of electrical accidents, property damage, and customer dissatisfaction, further eroding public trust in the profession. Thus, it is crucial to assess and meet the cognitive and psychomotor training requirements of roadside electrical technicians to improve their performance, promote public safety, and support the growth of a skilled and competitive workforce in South-South Nigeria.

Purpose of the Study

The main objective of this study is to examine the training requirements of roadside electrical technicians in cognitive apprenticeship and psychomotor skills to improve their effectiveness in South-South Nigeria. Specifically, the study seeks to:

1. Assess the cognitive apprenticeship skill needs of roadside electrical technicians for optimal performance.
2. Evaluate the psychomotor skill needs of roadside electrical technicians for optimal performance.

Research Questions

The study was directed by the following research questions:

1. What are the cognitive apprenticeship skill needs of roadside electrical technicians for effective performance?
2. What are the psychomotor skill needs of roadside electrical technicians for effective performance?

Hypotheses

The study was further guided by two hypotheses, which were tested at a 0.05 level of significance.

1. There is no significant difference in the mean ratings of roadside electrical technicians on the cognitive apprenticeship skill needs for effective performance.
2. There is no significant difference in the mean ratings of roadside electrical technicians on the psychomotor skill needs for effective performance.

6. Research Method

This study employed a descriptive survey research design, deemed suitable because it enables the collection of data from a broad population to examine the existing training needs of roadside electrical technicians in cognitive apprenticeship and psychomotor skills without manipulating any variables. According to Eze and Uzo (2020), the descriptive survey method is suitable for investigating existing conditions, opinions, and characteristics of a population to provide an accurate representation of the phenomenon being studied.

The study was conducted in the South-South geopolitical zone of Nigeria, which consists of six states: Akwa Ibom, Bayelsa, Cross River, Delta, Edo, and Rivers. This region was selected because it has a large population of informal sector artisans, particularly roadside electrical technicians who offer essential electrical repair and installation services. Its economic relevance, high population density, and dependence on informal vocational practices also made it an ideal setting for this study.

The study population comprised 1,120 registered roadside electrical technicians in the South-South region, including both master technicians and apprentices engaged in electrical installation and repair. From this population, a sample of 245 technicians was drawn using a multi-stage sampling procedure. At the first stage, three states—Delta, Bayelsa, and Rivers—were purposively chosen because of their high concentration of roadside electrical technicians. In the next stage, major urban centers and towns with significant clusters of technicians were identified within the selected states. Finally, proportionate random sampling was employed to ensure equitable representation across the sample.

Data were collected using a structured questionnaire titled *Cognitive Apprenticeship and Psychomotor Skill Training Needs Questionnaire (CAPSTNQ)*. The questionnaire was divided into two sections. Section A gathered demographic information from respondents, while Section B contained items related to cognitive apprenticeship and psychomotor skill needs. The items in Section B were rated on a 4-point Likert scale: Strongly Needed (4), Needed (3), Slightly Needed (2), and Not Needed (1), which helped determine the perceived level of training need for each skill.

The instrument was subjected to face and content validation by three experts: two from the Department of Technical Education and one from the Department of Measurement and Evaluation at Delta State University, Abraka. They reviewed the items for clarity, relevance, and alignment with the study objectives. Based on their feedback, some revisions were made to ensure that the instrument accurately captured the required cognitive and psychomotor skills of roadside technicians. To establish the reliability of the instrument, it was pilot-tested with 30 roadside electrical technicians outside the study area. The reliability was calculated using Cronbach Alpha, yielding a coefficient of 0.87, which confirmed that the instrument was highly reliable.

Data collection was carried out by the researcher with the help of three trained research assistants who were familiar with the study area. Questionnaires were personally distributed to respondents at their workshops, and assistance was provided in clarifying items where necessary. Completed questionnaires were collected either immediately or within an agreed period to reduce the risk of data loss.

The data obtained were analyzed using descriptive and inferential statistics. Mean and standard deviation were used to answer the research questions. Any item with a mean score of 2.50 or above was considered “needed,” while those below 2.50 were regarded as “not needed.” The null hypotheses were tested using Analysis of Variance (ANOVA) at a 0.05 level of significance. A null hypothesis was rejected if the p-value was less than 0.05, indicating a statistically significant difference in responses. This analytical approach provided a clear basis for determining the training needs of roadside electrical technicians and any notable variations in their responses within the study area.

Results

Table 1: Mean Ratings of Respondents on Cognitive Apprenticeship Skill Needs of Roadside Electrical Technicians for Effective Performance (N = 245)

S/N	Cognitive Apprenticeship Skill Needs	Mean	SD	Decision
1	Ability to diagnose electrical faults logically	3.65	0.71	Needed
2	Competence in systematic troubleshooting	3.58	0.74	Needed
3	Application of guided learning strategies	3.49	0.68	Needed
4	Ability to apply problem-solving techniques	3.62	0.70	Needed
5	Capacity for reflective thinking in repair situations	3.55	0.72	Needed

Cluster Mean = 3.58

The results in Table 1 show that all the identified cognitive apprenticeship skill needs were rated above the 2.50 cut-off point, with a cluster mean of 3.58. This implies that cognitive apprenticeship skills such as logical fault diagnosis, systematic troubleshooting, guided learning, and reflective thinking are perceived as essential for effective performance by roadside electrical technicians in South-South Nigeria.

Table 2: ANOVA Summary of the Mean Ratings of Respondents on Cognitive Apprenticeship Skill Needs

Source of Variation	Sum of Squares	df	Mean Square	F-cal	Sig.	Decision
Between Groups	2.45	3	0.82	4.23	0.004	Rejected

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Within Groups	42.78	241	0.18			
Total	45.23	244				

The ANOVA results presented in Table 2 indicate a significant difference in the mean ratings of respondents regarding the cognitive apprenticeship skill needs of roadside electrical technicians ($F = 4.23$, $p < 0.05$). Consequently, the null hypothesis (H_1), which proposed that no significant difference exists in the mean ratings of respondents on these skill needs, is rejected. This implies that respondents differ significantly in their perceptions of cognitive apprenticeship skill needs, possibly due to variations in their experience, location, or training background.

Table 3: Mean Ratings of Respondents on Psychomotor Skill Needs of Roadside Electrical Technicians for Effective Performance (N = 245)

S/N	Psychomotor Skill Needs	Mean	SD	Decision
1	Proficiency in handling electrical tools safely	3.72	0.69	Needed
2	Precision in component installation	3.66	0.65	Needed
3	Ability to perform wiring and rewiring tasks	3.60	0.73	Needed
4	Skill in measuring and cutting electrical materials	3.63	0.70	Needed
5	Accuracy in testing and troubleshooting circuits	3.68	0.71	Needed

Cluster Mean = 3.66

The results in Table 3 indicate that all the psychomotor skill needs of roadside electrical technicians were rated above the cut-off point of 2.50, with a cluster mean of 3.66. This shows that skills such as safe tool handling, wiring precision, material measurement, and circuit testing are regarded as highly needed for effective job performance.

Table 4: ANOVA Summary of the Mean Ratings of Respondents on Psychomotor Skill Needs

Source of Variation	Sum of Squares	df	Mean Square	F-cal	Sig.	Decision
Between Groups	2.87	3	0.96	5.10	0.002	Rejected
Within Groups	45.32	241	0.19			
Total	48.19	244				

The ANOVA results in Table 4 indicate a significant difference in the mean ratings of respondents concerning the psychomotor skill needs of roadside electrical technicians ($F = 5.10$, $p < 0.05$). As a result, the null hypothesis (H_2), which asserted that there is no significant difference in the mean ratings of respondents on these skill needs, is rejected. This suggests that respondents' perceptions vary significantly, which may be attributed to differences in work exposure, training experience, or state-specific practices within the South-South region.

Discussion

The results of this study demonstrated that cognitive apprenticeship skills such as logical fault diagnosis, systematic troubleshooting, guided learning, and reflective thinking were identified as highly needed by roadside electrical technicians in South-South Nigeria. This result suggests that while these technicians possess some level of practical experience acquired through informal apprenticeship, there remains a significant gap in structured cognitive skills necessary for handling complex electrical tasks.

A probable reason for this finding is the dominance of the informal apprenticeship system, which emphasizes imitation of the master technician's actions rather than structured, reflective, and problem-solving approaches. In this system, apprentices are often not exposed to formal learning processes where cognitive strategies are explicitly taught, modeled, and reinforced. Consequently, while they may develop basic operational skills, they lack the higher-order thinking skills required for diagnosing and resolving complex electrical problems efficiently. Additionally, the absence of standardized training curricula and limited access to modern instructional resources in the informal sector further reinforce this deficiency.

This finding aligns with the work of Eze, Ogbu, and Uzo (2020), who reported that students taught using cognitive apprenticeship strategies in auto-mechanics achieved significantly higher levels of understanding and skill retention than those taught through conventional demonstration methods. Their study highlighted that structured learning approaches that make expert thinking visible lead to better problem-solving outcomes among learners. Similarly, Agbo and Okoye (2022) emphasized the need for cognitive apprenticeship-based training in Nigeria's informal sector, noting that unstructured, traditional learning methods limit technicians' ability to adapt to technological advancements in their field. Both studies corroborate the current research finding that the lack of formalized cognitive apprenticeship training is a critical gap that must be addressed if roadside electrical technicians are to meet modern industry demands effectively.

The results of this study further showed that psychomotor skills such as safe handling of electrical tools, precision in component installation, accurate wiring and rewiring, proper measurement of materials, and circuit testing were highly needed by roadside electrical technicians in South-South Nigeria. This suggests that although these technicians perform daily repair and installation tasks, their skill execution lacks the standardization and technical accuracy required for high-quality performance.

A probable reason for this finding is the absence of formalized and competency-based training programs in the informal sector. Most roadside technicians learn their trade through traditional apprenticeship, which focuses on practical repetition without proper supervision or standardized evaluation. As a result, they may develop basic operational skills but lack the refined psychomotor competencies required for error-free and safe electrical work. In addition, limited access to modern tools, safety equipment, and structured assessment systems in the informal training environment contributes to this gap.

This finding is consistent with the work of Agbo, Okoye, and Oguguo (2023), who developed and validated a psychomotor competency-based curriculum for electrical installation apprentices in Nigeria. Their study confirmed that structured psychomotor training improves the precision, safety, and overall performance of apprentices. Similarly, Rotimi and Oladotun (2023) highlighted the importance of reliable psychomotor skill assessment instruments for technical trainees, noting that such tools are essential for identifying and addressing skill deficiencies. These studies support the present finding that the lack of formal psychomotor training in the informal sector remains a significant barrier to improving the quality of roadside electrical services in Nigeria.

Conclusion

This study investigated the training requirements of roadside electrical technicians in South-South Nigeria, focusing on cognitive apprenticeship and psychomotor skills. The findings revealed that cognitive apprenticeship skills such as logical fault diagnosis, systematic troubleshooting, and reflective learning are critically needed to enhance technicians' ability to solve complex electrical problems. Similarly, psychomotor skills including safe tool handling, precision in wiring, and accurate testing of circuits were also identified as essential for effective performance. The significant differences observed in the respondents' ratings highlight disparities in training exposure, reinforcing the need for standardized and structured approaches to skills development in the informal sector.

The results of this study underscore the inadequacy of the current informal apprenticeship system, which largely depends on unstructured, observational learning methods that fail to develop technicians' cognitive and psychomotor competencies. If these gaps are not addressed, the informal electrical sector may continue to face challenges such as poor service quality, safety risks, and low productivity. Consequently, there is a pressing need for the development of competency-based training programs that integrate cognitive apprenticeship strategies with psychomotor skill development. Such interventions would equip roadside electrical technicians with the skills required to meet modern industry standards, improve customer satisfaction, enhance public safety, and contribute to sustainable workforce development and economic growth in Nigeria.

Recommendations

Based on the results of the study, the following recommendations are proposed:

1. Training initiatives should be implemented to enhance technicians' cognitive apprenticeship skills.
2. Frequent workshops should be conducted to provide practical training in psychomotor skills.
3. Government and industry stakeholders should supply modern tools and equipment to support effective training.
4. Technical education curricula should be revised to incorporate industry-relevant competencies.

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