IDENTIFYING THE CRITICAL SKILLS GAPS IN RESIDENTIAL, COMMERCIAL AND INDUSTRIAL WIRING INSTALLATION: IMPLICATIONS FOR CURRICULUM ENRICHMENT

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ABSTRACT: *The Bachelor of Science in Industrial Technology major in Electrical Technology (BSIT–ET) program aims to develop students' technical and theoretical skills aligned with industry demands. This study evaluates students' proficiency in electrical installation tasks, identifies challenges in acquiring key competencies, and gathers recommendations to enhance curriculum delivery. A descriptive-evaluative method was used, analysing data from student assessments in three major competency areas: roughing-in and wiring, installation of protective devices, and lighting and auxiliary systems. Additionally, qualitative responses were examined to identify recurring challenges and suggestions. Findings revealed strong proficiency in core technical skills, such as safety practices, equipment handling, and interpretation of electrical plans, with over 95% of students demonstrating mastery. However, areas like adaptability, economic performance, and commissioning activities showed lower proficiency, indicating weaknesses in soft skills and real-world application. Students reported challenges such as inadequate tools and equipment, conceptual difficulties, limited hands-on practice, time constraints, and fluctuating motivation. To address these, students recommended improving instructional quality, updating the curriculum to reflect current technologies, expanding experiential learning opportunities, and fostering a growth-oriented academic environment. The study concludes that to prepare students fully for the electrical industry, curriculum enhancements should integrate soft skills training, real-world simulations, updated resources, and improved pedagogical practices. A responsive and holistic approach to curriculum implementation is necessary to bridge the gap between education and workforce expectations.*

Keywords: Curriculum enhancement, Industry readiness, Practical Training, Soft skills

INTRODUCTION

The rapid advancements in technology and the evolving demands of the electrical industry necessitate a reevaluation of educational curricula to ensure that graduates possess the competencies required by employers. In the Philippines, the Bachelor of Science in Information Technology (BSIT) program with a specialisation in Electrical Technology (ET) plays a pivotal role in preparing students for careers in residential, commercial, and industrial wiring installation. However, a significant skills gap exists between the competencies prescribed by the Technical Education and Skills Development Authority (TESDA) and the actual skills possessed by graduates of this program.

The National Technical Education and Skills Development Plan (NTESDP) 2023–2028 emphasizes the need for a responsive and demand-driven Technical-Vocational Education and Training (TVET) system that aligns with industry requirements and prepares the workforce for the challenges of the Fourth Industrial Revolution/1[1]./1Despite these directives, reports indicate that many TVET graduates, including those in electrical technology programs, still face challenges in meeting industry expectations due to outdated curricula, lack of hands-on training, and insufficient industry collaboration [1]./1A study highlighted that while technical skills are crucial, soft skills such as

teamwork, discipline, and problem-solving are equally important in the electrical and electronic industry[2]. The study found that industry players perceived teamwork skills as the most important, emphasizing the need for graduates to master these skills to gain employment. However, these skills can be improved by graduates through industrial training provided by Higher Education Institutions in collaboration with the industry. Therefore, the industry is recommended to provide training to improve the skills of the workforce.

This research aims to identify the specific skills gaps perceived by BSIT Electrical Technology students concerning TESDA's prescribed competencies. By examining areas such as roughing-in activities, wiring and cabling works, installation of electrical protective devices, and wiring devices, the study seeks to uncover the challenges students encounter in acquiring these essential skills. Furthermore, it aims to gather suggestions for enhancing the course curriculum to bridge these gaps and facilitate students' attainment of relevant TESDA qualifications.

Addressing these issues is crucial for ensuring that graduates possess the competencies required by the industry, thereby improving their employability and contributing to the country's economic growth. The findings of this research will inform the development of a contextualised curriculum enrichment plan that aligns with TESDA standards and meets the evolving needs of the electrical technology sector.

STATEMENT OF THE PROBLEM

This research is intended to identify the specific skills gaps of BSIT Electrical Technology (BSIT-ET)of Negros Oriental State University (NORSU) students. As an output of this research, it aimed to produce a contextualised curriculum enrichment that would address the gap between learned skills and the industry standards. Specifically, it answers the following questions:

1. What are the specific skills gaps perceived by BSIT Electrical Technology students in terms of the competencies prescribed by TESDA in terms of the following?

1.1 Performing roughing-in activities, wiring, and cabling works for single-phase distribution, power, lighting and auxiliary systems.
1.2 Install electrical protective devices for distribution, power, lighting, auxiliary, lightning protection and grounding system, and
1.3 Install wiring devices of floor and wall-mounted outlets, lighting fixtures, switches and auxiliary outlets.
2. What challenges and difficulties have you encountered in acquiring the necessary skills and competencies in this subject?
3. What suggestions would you offer to enhance the implementation of the course curriculum?
4. How can these skills gaps be addressed to facilitate BSIT-Electrical technology students to earn relevant TESDA qualifications?
5. What curriculum enrichment can be proposed to the BSIT-Electrical Technology program to address these identified gaps?

SIGNIFICANCE OF THE STUDY

This study addresses the skills gap between BSIT Electrical Technology (BSIT-ET) students and TESDA's competency standards, aiming to support curriculum enrichment that aligns education with industry needs and improves graduate employability. The NTESDP 2023–2028 stresses the importance of a responsive TVET system aligned with the demands of the Fourth Industrial Revolution [1]. However, many graduates still struggle to meet industry expectations due to outdated curricula, limited practical training, and weak industry links [1]. Research also highlights that beyond technical ability, soft skills like teamwork, discipline, and problem-solving are critical for employment in the electrical sector [2]. These can be strengthened through industry-led training and institutional collaboration [2]. This study identifies perceived skill gaps in areas such as roughing-in, wiring, protective devices, and electrical installations, while also collecting student suggestions for curriculum improvement. Ultimately, findings will guide the development of a contextualised, TESDA-aligned curriculum that enhances industry readiness and supports national workforce development.

REVIEW OF RELATED LITERATURE

The alignment between educational curricula and industry standards is crucial in ensuring that graduates possess the necessary skills to meet job market demands. In the context of the Philippines, the Technical Education and Skills Development Authority (TESDA) plays a pivotal role in setting competency standards for various technical-vocational programs, including Electrical Technology. However, existing literature indicates a persistent gap between the competencies prescribed by TESDA and the skills acquired by students in Bachelor of Science in Information Technology (BSIT) programs with a specialisation in Electrical Technology (ET).

Curriculum-Industry Alignment in Electrical Technology. Aligning educational curricula with industry standards is crucial to ensuring graduates possess the skills demanded by the labour market. In the Philippines, TESDA plays a central role in setting competency standards for technical-vocational programs, including Electrical Technology. However, literature reveals a gap between TESDA's prescribed competencies and the actual skills acquired by students in BSIT programs with an Electrical Technology specialisation.

Skills Gaps in Electrical Technology Education Studies have highlighted that while technical skills are essential, soft skills like teamwork, discipline, and problem-solving are equally critical in the electrical and electronics industry [2]. These skills can be improved through industry-linked training initiatives. Similarly, research in Leyte found a significant mismatch between acquired student skills and industry demands, emphasising the need to integrate both technical and soft skills into the curriculum [3]. A lack of practical training has also been identified as a persistent issue in EIM programs, contributing to graduates' unpreparedness for real-world work environments.

Technical and Soft Skills Disparity: Rodzalan, Azmi, and Zainal underscored the gap between what TVET institutions teach and workplace requirements, stressing the importance of integrating interpersonal skills into training [2]. Treceñe, Batan, and Abines supported this, noting the disconnect between theoretical learning and practical competencies in electronics education in Leyte [3].

Curriculum Misalignment and Obsolete Training: Despite TESDA's NTESDP 2023–2028 push for industry-relevant TVET systems [1], many institutions still use outdated equipment and methods, leaving graduates unprepared for modern technologies like smart systems and renewable energy [4]. An ECA 2024 survey also found graduates lacking practical competencies in fault diagnosis, panel wiring, and grounding, revealing inadequacies in hands-on training delivery [5].

Industry Collaboration and Practical Experience Increased partnerships between schools and industry are widely recommended. Rodzalan et al. and Alin &Ermac promoted enterprise-based and dual-training systems that immerse students in real-world settings under expert supervision [2][6]. TESDA's "EBT to the Max" initiative aims to combine institutional and on-the-job learning [1].

Global Labour Trends and Training Needs: Global labor shortages in renewable energy, such as the U.S. demand for electricians skilled in solar and battery systems, emphasise the need to integrate green technologies into TVET programs [7]. In the Philippines, training effectiveness is limited by outdated materials, insufficient simulation tools, and low digital readiness among faculty and students [8, 2]. To address these gaps, curricula should allocate 30–40% of contact time to lab work and simulations [2], align with TESDA's tech-driven initiatives [1], and employ industry-certified instructors for practical training [6]. Embedding soft skills into project-based learning is essential [2, 3], while partnerships with industry can enhance internship opportunities and bridge skills mismatches [1][4]. Programs must also include content on solar PV, automation, and smart grids [5, 7]. Despite TESDA's EBT and dual-training

efforts [1], implementation is uneven, especially in rural areas due to weak industry linkages [2, 9].

Toward Industry-Responsive Curriculum Design: TESDA's NTESDP 2023–2028 calls for innovations in curriculum design and assessment methods to align TVET education with Industry 4.0 requirements [1]. For BSIT-ET programs, this includes contextualising curricula based on industry feedback and emerging technology trends [2]. This ensures students acquire both foundational and advanced skills in areas like smart grids and renewable energy systems.

Integrating Technical and Soft Skills

Incorporating soft skills like communication and critical thinking into every course module strengthens student readiness for collaborative and client-facing roles [3]. These skills are essential in troubleshooting and safety management, especially in real-world installations.

Enhancing Employability and National Development: Industry partnerships enrich training environments and increase access to advanced tools and systems. Students benefit from immersive experiences in areas like solar installations and energy audits [5][7]. Ultimately, such collaborations not only boost employability but also support national goals for energy sustainability and industrial growth [4].

Bridging the skills gap in Electrical Technology requires a curriculum that integrates technical knowledge, soft skills, and practical experience, aligned with TESDA standards and responsive to industry needs. This holistic approach will enhance graduate employability, drive innovation, and support the Philippines' economic and environmental goals.

THEORETICAL BACKGROUND

This study is grounded in Human Capital Theory (HCT), Social Cognitive Career Theory (SCCT), and Constructivist Learning Theory, which together explain the challenges BSIT Electrical Technology students face in developing industry-relevant skills and guide the proposed curriculum enrichment strategies.

Human Capital Theory (Becker, 1964): HCT posits that education and training are investments that enhance individual productivity and employability, contributing to economic growth (Becker, 1964). In the context of BSIT-ET, the skills gap reflects insufficient alignment between educational content and industry demands. From this perspective, curriculum enrichment should include updated training, hands-on experiences, and certifications aligned with TESDA standards to maximise the return on human capital investment [10].

Social Cognitive Career Theory (Lent, Brown, & Hackett, 1994): SCCT focuses on how self-efficacy, outcome expectations, and goals influence career decisions [11]. Students' perceived skills gaps may stem from low self-efficacy, particularly in technical tasks like wiring and installation. Enhancing self-efficacy through real-world exposure, mentorship, and industry interaction can improve students' confidence and motivation to build skills. Curriculum enrichment, therefore, should integrate experiential learning and career support [11].

Constructivist Learning Theory (Piaget, 1973; Vygotsky, 1978): Constructivism argues that learners build knowledge through active engagement and social interaction [12, 13]. For BSIT-ET students, this means learning is most effective when they engage in real-world problem-solving, industry simulations, and collaborative projects. Curriculum enrichment should thus emphasise project-based and experiential learning to help students internalise both theoretical and practical knowledge [12, 13].

THEORETICAL FRAMEWORK

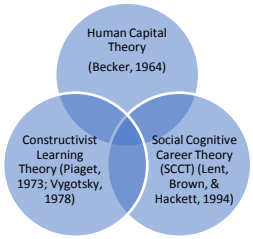

Figure 1: Theoretical Framework of the Study

By integrating these frameworks, the study analyses skill gaps in BSIT-ET education and supports the design of a contextualised, industry-aligned curriculum that enhances technical competence, practical experience, and career readiness.

This study integrates Human Capital Theory (HCT), Social Cognitive Career Theory (SCCT), and Constructivist Learning Theory (CLT) to form a comprehensive framework for addressing skills gaps in BSIT Electrical Technology programs. Each theory contributes unique insights into skills development, employability, and learning.HCT emphasises education as an investment that enhances individual productivity and employability, stressing the importance of aligning training with labour market demands [10]. However, SCCT adds that self-efficacy—or belief in one's ability to succeed—is equally vital for students to apply those skills effectively in real-world contexts [11]. Thus, curriculum enrichment must not only improve technical competencies (HCT) but also foster career confidence (SCCT)./1Linking SCCT with CLT, students build self-efficacy through active, hands-on learning experiences. CLT posits that learning is most effective when students construct knowledge through problem-solving and real-world application [12][13]. Integrating simulations, internships, and collaborative projects can strengthen both skill mastery and self-confidence.

Finally, connecting HCT and CLT highlights the need to bridge theoretical learning with practical application. While HCT supports investing in technical education, CLT stresses the necessity of applying that knowledge in authentic tasks. Curriculum enrichment should therefore combine technical instruction with experiential learning to fully prepare students for industry demands. In conclusion, this triangulated framework ensures that curriculum design addresses technical skill acquisition (HCT), builds student confidence (SCCT), and promotes active, real-world learning (CLT)—a holistic approach to aligning education with TESDA competencies and industry expectations.

RESEARCH DESIGN

Research Design and Approach

This study seeks to identify perceived skills gaps among BSIT Electrical Technology (BSIT-ET) students about TESDA-prescribed competencies, particularly in electrical installation and maintenance. Using a descriptive-evaluative design, the research integrates quantitative and qualitative methods to provide both measurable data and contextual insights.In a quantitative component a structured survey based on TESDA's Self-Assessment Guide was administered to second-year students who completed ELC 102. Students rated their ability to perform specific competencies (YES/NO). Descriptive statistics (mean, frequencies) were used to analyse the data and identify key skill gaps. For the qualitative component, focus group discussions (FGDs) and semi-structured interviews were conducted to explore students' experiences, challenges, and suggestions for curriculum improvement. FGDs included 3–4 groups of 6–8 students each, selected purposively. Interviews were held with faculty and industry practitioners to gather expert perspectives on curriculum alignment with TESDA standards. Data were thematically analyzed to identify recurring patterns and insights.Data triangulation was used to analyse the findings from both methods were integrated to validate results and develop grounded curriculum enrichment strategies. Quantitative data defined the scope of the gaps, while qualitative insights explained their causes and possible solutions.

ETHICAL CONSIDERATIONS

Ethical guidelines will be strictly followed throughout the study. Informed consent will be obtained from all participants, ensuring they understand the purpose of the study, their rights, and how their data will be used. Confidentiality and anonymity will be maintained, with all personal identifiers removed from the data. Participation will be voluntary, and students will be assured that their responses will not affect their academic standing.

RESULTS AND DISCUSSIONS

Question 1: What are the specific skills gaps perceived by BSIT Electrical Technology students in terms of the competencies prescribed by TESDA?

1.1 On performing roughing-in activities, wiring and cabling works for single-phase distribution, power, lighting and auxiliary systems.

BSIT Electrical Technology students show strong core skills in roughing-in, wiring, and system installation, particularly in safety, communication, and equipment checks, with high scores in "Use of safety harness" (100%) and "Tool and PPE checks" (98.77%). However, weaker performance in adaptability-related tasks like "Responding to unplanned events" (88.89%) and "Operational qualifications" (95.06%) highlights gaps in soft skills and decision-making [14][15]. Similarly, in installing protective devices, students showed strong technical skills but lower readiness in "Commissioning" (92.59%) and responding to unplanned events (88.89%) [2]. Rankings confirm strengths in "Safety procedures" (100%), "Tool checks" and "Installation procedures" (98.77%), followed by "Communication and economic performance" (97.53%), "Quality checks" (96.30%), "Plan interpretation and fixture selection" (95.06%), "Commissioning" (92.59%), and "Adaptability" (88.89%).To address gaps, the curriculum should integrate training in adaptability, problem-solving, and operational assessment. Strengthening industry ties, embedding soft skills into technical instruction, conducting continuous assessments, and using updated tools in simulated environments are essential. Emergency preparedness training, regular safety audits, and fostering a culture of feedback and continuous improvement are also recommended.

1.2 Install electrical protective devices for distribution, power, lighting, auxiliary, lightning protection and grounding system.

Data/1 shows that while most respondents are proficient in installing electrical protective devices, areas like "Responding to unplanned events" (88.89%) and "Commissioning activities" (92.59%) had the lowest scores, indicating gaps in adaptability and operational assessment. This supports findings that emphasise the rising importance of soft skills in technical education [2]. Core skills—such as safety harness use (100%, Item d), tool and PPE checks (98.77%, Item c), and installation procedures (Items e, i, j)—are strong. High responses in communication (97.53%, Item a), economic performance (97.53%, Item k), quality checks (96.30%, Item h), plan interpretation (95.06%, Item b), and fixture selection (95.06%, Item g) further show solid technical grounding. However, lower scores in commissioning and adaptability signal a need for focused curriculum updates. To close these gaps, enhanced training on emergency response, regular safety audits, and feedback systems should be implemented. Promoting a culture of continuous improvement among students and instructors can also strengthen both technical and soft skills necessary in today's evolving electrical industry [2].

1.3 On installing wiring devices of floor and wall-mounted outlet lighting fixtures, switches and auxiliary/1 outlets.

The data shows that workers in residential, commercial, and industrial wiring installations generally demonstrate strong proficiency in core areas such as safety procedures, material handling, and quality checks. Tasks like identifying tools and responding to unplanned events scored 100%, highlighting their importance in safe, accurate installations. High responses were also recorded for requisition forms, proper device selection, and safety compliance. However, slightly lower scores in economic performance and commissioning activities suggest gaps in cost-efficiency and system validation skills—echoing studies on the need for soft skills and adaptability in technical training. To address these gaps, curriculum enhancements should prioritize training in cost-effective practices and commissioning, reinforce safety and material quality, and include real-world scenarios to boost adaptability. Key recommendations include real-world simulations, budget-focused modules, advanced quality assurance training, and cross-disciplinary collaboration to better prepare workers for industry demands.

Question 2: What challenges and difficulties have you encountered in acquiring the necessary skills and competencies **in this subject?**

Emergent Framework

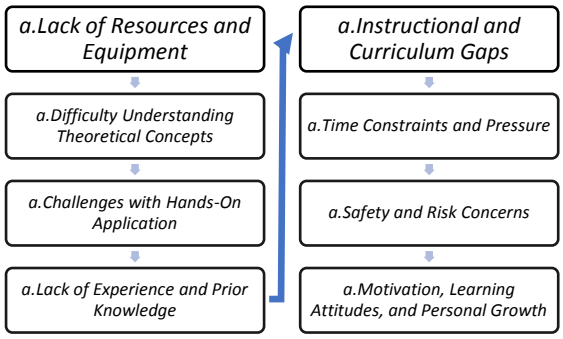

Figure 2: Emergent Framework for Challenges

Students in electrical installation programs face several challenges that impact their skill development. A major issue is the lack of resources and updated equipment, which limits hands-on training and practical readiness [16, 17]. Many also struggle with theoretical concepts, which are better understood when linked to real-world applications [18][Peterson *et al*., 2021]. Limited hands-on experience further weakens practical skills and problem-solving abilities [19, 20], especially for those lacking prior knowledge or foundational understanding [21, 22]. Curriculum and instructional gaps—such as outdated content and poor industry alignment—leave students underprepared [22, 24]. Additionally, time constraints in compressed programs can reduce learning depth, with pressure to meet deadlines hindering mastery [25, 26]. Safety concerns arise when protocols are not adequately embedded in training, increasing risk during practice [27. 28]. Lastly, motivation and learning attitudes are crucial; intrinsically motivated students perform better, and personalised learning fosters greater engagement and growth [29, 30].

Integrating these findings with recent studies highlights the importance of addressing the identified challenges to improve vocational education programs. By focusing on resource availability, theoretical understanding, hands-on practice, safety, and motivation, curricula can be enriched to better prepare students for careers in residential, commercial, and industrial wiring installation. The references cited provide evidence-based insights that can guide curriculum developers, instructors, and policymakers in creating more effective training programs**.**

Question 3: What suggestions would you offer to enhance the implementation of the course curriculum?

At the core of the framework is "Enhanced Curriculum Delivery", supported by three pillars: (1) Quality Instruction, (2) Relevant & Flexible Curriculum, and (3) Student-Centred Time Management. These pillars are, in turn, reinforced by practical enablers such as Modern Equipment & Realistic Environments, Emphasis on Experiential Learning, and Positive Learning Culture & Holistic Development.

Emergent Framework

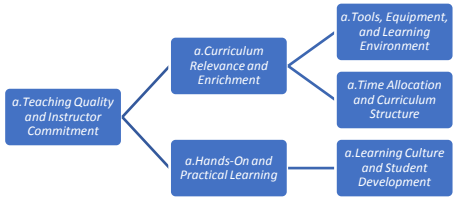

Figure 3: Emergent Framework for Suggestions

Instructors must have both technical skills and teaching expertise, supported by ongoing professional development and industry exposure to uphold instructional quality [31]. Curricula should be regularly updated through industry collaboration to stay aligned with technological advances and competency-based frameworks [32]. Adequate time should be allocated for complex subjects to foster deeper learning and avoid rushed instruction [33]. Investment in modern tools and simulated environments is crucial to build practical competencies and confidence [34]. At least 60% of training should involve hands-on activities to enhance job readiness [35]. Lastly, fostering a supportive learning culture that builds the soft skills of students.

Question 4: How can these skills gaps be addressed to facilitate BSIT-Electrical technology students to earn relevant TESDA qualifications?

To bridge skills gaps and help BSIT-Electrical Technology students earn TESDA qualifications, the program must enhance soft skills and critical thinking through real-world, project-based learning; improve hands-on experience via simulations and industry-aligned training; upgrade tools and facilities; align the curriculum with TESDA standards; invest in faculty development; and adopt learner-centred, competency-based approaches. These strategies will better prepare students for both industry demands and TESDA certification, such as NC II and NC III in Electrical Installation and Maintenance.

Question 5: What curriculum enrichment can be proposed to the BSIT-Electrical Technology program to address these identified gaps?

Based on the findings and conclusion of the study, the following recommendations are proposed to improve the implementation of the BSIT-Electrical Technology program curriculum:

No	Recommendation	Description
1)	Integrate Soft Skills and Adaptability Training	Embed modules on problem-solving, communication, teamwork, and adaptability to better prepare students for dynamic work environments.
2)	Strengthen Commissioning and Economic Performance Instruction	Incorporate practical lessons and assessments focused on system commissioning and cost-efficient installation

		methods.
3)	Upgrade Tools and Laboratory Equipment	Invest in modern tools, testing instruments, and equipment to simulate industry-standard practices and environments.
4)	Expand Experiential and Real-World Learning	Introduce simulations, on-the-job training (OJT), and capstone projects in collaboration with industry partners to enhance hands-on learning.
5)	Enhance Faculty Development Programs	Provide regular training, workshops, and exposure to current industry trends to improve instructional quality and pedagogy.
6)	Update and Align Curriculum with Industry Standards	Collaborate with industry stakeholders to continuously revise course content based on technological advancements and workforce demands.
7)	Reallocate Time for Mastery of Complex Topics	Structure the curriculum to allow more time for in-depth learning, especially for high-order skills and technical competencies.
8)	Foster a Growth-Oriented Learning Environment	Promote a culture that supports motivation, resilience, and self-directed learning through mentoring, peer support, and student engagement initiatives.
9)	Emphasise Safety Across All Course Components	Ensure that safety protocols and risk management are consistently integrated and reinforced in both theoretical and practical components.
10)	Implement Continuous Feedback and Evaluation Systems	Establish regular feedback loops from students, instructors, and industry professionals to inform curriculum improvements and teaching practices.

SUMMARY OF DISCUSSIONS

The findings reveal that *Safety Procedures and Use of Safety Harness* ranked highest with a 100% affirmative response, underscoring their essential role in ensuring worker safety during installations. *Tool, Equipment, and PPE Checks* and *Installation Procedures and Final Checks* were followed closely at 98.77%, highlighting the importance of thorough preparation and adherence to installation standards. Ranking third at 97.53%, *Communication of Work Instructions* and *Economic Performance* emphasize the need for clear communication and efficient, cost-effective work practices. *Ongoing Quality Checks* came next at 96.30%, reflecting the value of continuous monitoring to maintain standards. At 95.06%, *Interpretation of Electrical Plans* and *Selection of Fixtures* indicates that students generally demonstrate competence in reading technical plans and selecting appropriate components. *Commissioning Activities* received a 92.59% rating, showing involvement in system validation processes. Finally, *Response to Unplanned Events* was the lowest-rated area at 88.89%, pointing to the need for improved adaptability and problem-solving in unexpected situations..

CONCLUSION

The study concludes that while students demonstrate strong technical skills in core electrical installation tasks, key areas such as adaptability, commissioning, and economic performance need improvement. High scores in safety and installation procedures highlight the effectiveness of current instruction, but gaps in soft skills, critical thinking, and practical application point to deeper issues, including limited resources, insufficient hands-on experience, and curriculum shortcomings. Students recommend a more holistic, industry-aligned curriculum that enhances technical training, modernises equipment access, improves instructor qualifications, and embeds real-world, learner-centred approaches. To better prepare graduates for industry demands, vocational programs must integrate simulations, applied learning, soft skills development, and technological alignment to produce competent and adaptable professionals.

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