Electrical Safety Standards Awareness and Compliance: A Pathway to Achieving SDG 7, SDG 11, and SDG 9

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DOI: https://doi.org/10.47772/IJRISS.2025.91100641

Received: 08 December 2025; Accepted: 17 December 2025; Published: 29 December 2025

ABSTRACT

This study aims to evaluate the level of awareness and compliance of residents in Laoag City, Ilocos Norte, Philippines with electrical installation safety standards, identify factors affecting compliance, and propose strategies to improve awareness and adherence. Using a convergent parallel mixed-methods design, quantitative data are collected through survey questionnaires and compliance checklists, while qualitative insights are gathered through semi-structured interviews with key informants, including electricians, local government officials, and safety inspectors. Stratified random sampling is employed for the quantitative component, while purposive sampling is used for the qualitative component to ensure diverse and representative perspectives.

The findings reveal that residents demonstrate a moderate level of awareness of electrical safety standards. However, gaps are identified in their understanding of specific guidelines, such as the Philippine Electrical Code, and their ability to recognize potential hazards. Compliance with safety standards is generally high, but certain areas, such as the installation of tamper-resistant receptacles and Ground Fault Circuit Interrupters, show lower adherence. Key factors influencing compliance include limited awareness and education, economic constraints, and insufficient enforcement mechanisms.

To address these challenges, the study proposes strategies such as public awareness campaigns, regular safety seminars, financial assistance programs, and strengthened enforcement mechanisms, including inspections and stricter penalties for non-compliance. These strategies aim to improve awareness, reduce barriers to compliance, and foster a culture of safety within communities.

The study underscores the importance of awareness and compliance with electrical safety standards in promoting public safety, reducing risks, and supporting sustainable development goals. Addressing these challenges and implementing the proposed strategies can lead to safer electrical installations and contribute to more resilient and sustainable communities.

Keywords: Electrical safety standards, Awareness and compliance, Sustainable development goals (SDGs) Public safety, Enforcement mechanisms

INTRODUCTION

Electrical safety is a critical aspect of modern living, as improper electrical installations and practices pose significant risks to human life and property. Faulty wiring, overloaded circuits, and the use of substandard materials can lead to devastating consequences such as fires, electrocution, and equipment damage. Globally, electrical hazards are a leading cause of residential and industrial accidents, underscoring the need for strict adherence to safety standards and regulations. The importance of electrical safety is further emphasized by its link to global sustainable development goals, particularly those focusing on affordable and clean energy, resilient infrastructure, and sustainable cities and communities [1]. As urbanization and industrialization continue to accelerate, ensuring compliance with electrical safety standards is essential to safeguarding lives, promoting public safety, and fostering sustainable development.

Existing research highlights the importance of electrical safety awareness and compliance in reducing risks and preventing accidents. For example, adherence to national and international electrical codes has been shown to significantly minimize the likelihood of electrical hazards [2]. Studies reveal that compliance with safety standards reduces fire-related disasters in residential and industrial settings by ensuring proper wiring, grounding, and the installation of protective devices [3]. However, research also identifies persistent challenges, such as limited public awareness of safety standards, economic barriers to compliance, and inadequate enforcement mechanisms [4]. In many developing countries, these challenges are exacerbated by outdated infrastructure, limited access to resources, and insufficient training for electricians and inspectors [5].

In the Philippines, the Philippine Electrical Code (PEC) serves as the primary regulatory framework for ensuring safe electrical installations. Despite its existence, compliance with the PEC remains inconsistent, particularly in residential areas where unlicensed electricians and substandard materials are often used to reduce costs. According to the Bureau of Fire Protection, electrical faults remain one of the leading causes of fires in the country, with thousands of incidents reported annually [6]. This highlights a significant gap in the effective implementation and enforcement of electrical safety standards. Furthermore, while national regulations emphasize the importance of compliance, there is limited data on the level of awareness and adherence to these standards among local communities, particularly in rapidly urbanizing areas such as Laoag City. The lack of localized studies makes it difficult to develop targeted interventions that address the specific challenges faced by residents in these communities.

Laoag City, a growing urban area in the province of Ilocos Norte, Philippines, presents a unique context for examining electrical safety standards. While the city has been recognized for its commitment to sustainability and safety [7], it still faces challenges related to urbanization and infrastructure development. The increasing use of renewable energy systems, such as solar panels, further underscores the importance of ensuring safe and compliant electrical installations. However, the extent to which residents are aware of and adhere to electrical safety standards in Laoag City remains unclear. Moreover, the factors influencing compliance, such as economic constraints, lack of awareness, and enforcement challenges, have not been thoroughly investigated at the local level.

This study addresses these critical gaps by assessing the level of awareness and compliance of residents in Laoag City with electrical installation safety standards. It also seeks to identify the factors affecting compliance and propose actionable strategies to improve awareness and adherence. By addressing these gaps, the research aims to contribute to the existing body of knowledge on electrical safety and provide valuable insights for policymakers, local government units, and other stakeholders. The findings of this study will support the development of targeted interventions to enhance compliance with electrical safety standards, ultimately reducing risks, improving public safety, and contributing to sustainable urban development.

The specific objectives of this study are to: (1) evaluate the level of awareness of residents in Laoag City regarding electrical installation safety standards; (2) assess the compliance of residents with the provisions of the Philippine Electrical Code; (3) identify the factors affecting compliance with electrical safety standards; (4) propose strategies to improve awareness and compliance with electrical safety standards; and (5) explore how awareness and compliance with electrical safety standards contribute to the achievement of Sustainable Development Goals, particularly SDG 7, SDG 9, and SDG 11.

In conclusion, this study is necessary to address the pressing challenges associated with electrical safety in Laoag City, where rapid urbanization and diverse socio-economic conditions present unique barriers to compliance. By investigating the awareness and compliance of residents and proposing evidence-based strategies, this research seeks to bridge critical gaps in knowledge and practice, ultimately contributing to safer, more sustainable, and resilient communities.

Conceptual Framework

Grounded in principles of asset management and risk reduction, this study is guided by a conceptual framework that links residents' awareness and compliance with electrical safety standards to public health and safety outcomes, with broader implications for sustainable development. As illustrated in Figure 1, the independent

variables are residents' awareness of electrical safety practices, economic capacity, and regulatory enforcement, while the dependent variable is the condition and management of residential electrical assets, which ultimately affects exposure to electrical hazards and related public health outcomes. The framework aims to analyze how awareness, economic capacity, and enforcement individually and collectively influence compliance and the safe management of electrical systems, while also exploring the role of preventive measures in promoting sustainable development.

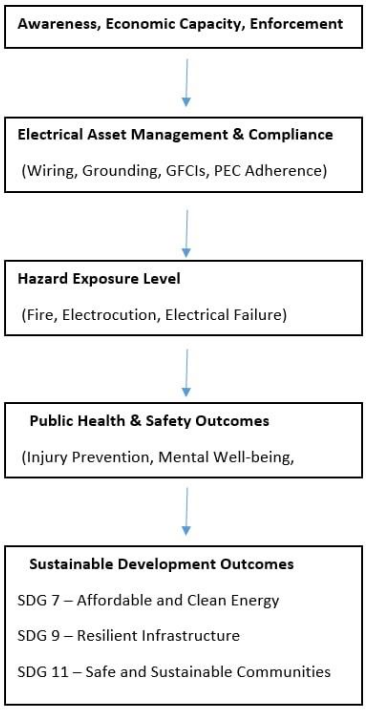

Figure 1. Research Paradigm of the Study.

At the core of the framework are four primary constructs: electrical safety awareness, compliance, hazard exposure, and public health outcomes. Electrical safety awareness refers to residents' knowledge of proper electrical installation, maintenance, grounding, and use of protective devices in accordance with the Philippine Electrical Code (PEC). Compliance reflects the degree to which residents adhere to these safety standards and maintain the condition of their electrical assets. These constructs are interconnected, as higher awareness can promote better compliance, while consistent compliance reinforces residents' understanding of safe practices.

Hazard exposure serves as a mediating variable, representing the risk of electrical fires, shocks, and electrocution associated with poorly maintained or unsafe electrical systems. Even if residents are knowledgeable, inadequate compliance may lead to higher exposure to hazards. The framework also examines the interplay between awareness and compliance, exploring whether greater knowledge can mitigate risks or whether persistent gaps in practice increase vulnerability.

Public health outcomes include injury prevention, enhanced household safety, reduced stress, and increased community resilience. These outcomes are influenced by the condition of electrical assets and residents' compliance with safety standards. The framework positions improved electrical safety compliance as both a technical safety measure and a preventive public health strategy, highlighting the feedback loop between safe practices and reduced hazard exposure.

Finally, the framework links electrical safety practices to Sustainable Development Goals, specifically SDG 7 (Affordable and Clean Energy), SDG 9 (Resilient Infrastructure), and SDG 11 (Safe and Sustainable Communities). By examining these relationships, the conceptual framework provides a structured understanding of how awareness and compliance interact to improve household and community safety, guiding interventions for more resilient and sustainable residential electrical systems.

RESEARCH METHODS

Research Design

The study employed a convergent parallel mixed-methods research design to address its objectives. This design involved the simultaneous collection of both quantitative and qualitative data to provide a comprehensive understanding of the research problem. Quantitative data were gathered through structured survey questionnaires and compliance checklists to assess the level of awareness, compliance status, and perceptions of residents regarding electrical safety standards. Qualitative data, on the other hand, were collected through semi-structured interviews and open-ended survey questions to explore in-depth insights into the factors affecting compliance, challenges faced by residents, and strategies for improvement.

The integration of these data sets allowed the study to identify actionable strategies for enhancing awareness and compliance while also examining how these contribute to achieving Sustainable Development Goals (SDG 7, SDG 9, and SDG 11). By analyzing quantitative and qualitative data independently and then merging the results, the research design ensured a holistic and robust approach to understanding the issues surrounding electrical safety standards in Laoag City.

Locale of the Study

The study was conducted in Laoag City, located in the province of Ilocos Norte, Philippines. Laoag City served as an ideal research setting due to its status as a rapidly urbanizing area with diverse residential, commercial, and industrial zones. The city's population, composed of individuals from varying socioeconomic backgrounds, education levels, and occupations, provided a representative sample for assessing awareness and compliance with electrical safety standards.

Laoag City has also earned recognition as the Cleanest, Safest, and Greenest City in Region 1, an award it received in 2013 as part of regional efforts to promote sustainable and environmentally friendly urban development. This distinction highlights the city's commitment to maintaining safety and sustainability, making it a fitting location for a study that examines the relationship between electrical safety standards and sustainable development goals.

Furthermore, Laoag City is becoming known for its efforts in solar power projects, which align with global initiatives for sustainable energy and the Sustainable Development Goals (SDG 7). This focus on renewable energy and infrastructure development further emphasized the importance of evaluating electrical installation practices and standards to ensure safety and sustainability.

The presence of local government units (LGUs), electricians, and safety inspectors in the area also facilitated the collection of qualitative data, as these key stakeholders played crucial roles in enforcing and promoting electrical safety standards. The city's dynamic growth, commitment to renewable energy, and demographic diversity made it an ideal locale for analyzing the factors affecting compliance and exploring strategies to enhance awareness and adherence to electrical safety standards.

Population and Sampling Procedure

The population of the study consisted of the residents of Laoag City, including homeowners, renters, and building owners, as well as key informants such as electricians, local government officials, and safety inspectors. To ensure a representative sample of the city's geographic diversity, the study utilized a stratified random sampling technique, with stratification based on the clustered barangay structure of Laoag City. The city's 80 barangays were grouped into clusters, such as Cluster 1 (Barangays 1, 2, 3, 4, 5), Cluster 2 (Barangays 6, 7A, 7B, 8, 9), and so on, up to Cluster 13 (Barangays 52A, 52B, 53, 54B, 56A, 55B). Each cluster served as a distinct stratum, ensuring that the sample adequately represented the geographic and demographic diversity of Laoag City.

Within each cluster, participants were randomly selected from the barangays to capture variations in awareness and compliance with electrical safety standards across different localities. Further stratification was applied within each cluster based on demographic variables such as age, education level, and socioeconomic status, ensuring that the sample reflected the diversity of the population. This approach allowed the study to assess differences in awareness and compliance levels across both geographic and demographic groups.

For the quantitative component, survey respondents were randomly selected from each cluster and stratified by demographic variables to provide a comprehensive assessment of awareness and compliance levels. For the qualitative component, purposive sampling was employed to identify key informants, such as electricians, local government officials, and safety inspectors, who possessed relevant expertise and insights into the factors affecting compliance and strategies for improvement. These key informants provided in-depth perspectives on the challenges faced by residents and actionable recommendations for enhancing compliance with electrical safety standards.

The combination of stratified random sampling for the quantitative data and purposive sampling for the qualitative data ensured that the study captured both broad and detailed perspectives. This sampling strategy enabled the researchers to conduct a holistic analysis of awareness, compliance, and the factors influencing adherence to electrical safety standards in Laoag City.

Research Instruments

The study utilized a combination of researcher-made survey questionnaires and semi-structured interview guides as primary tools for data collection. These instruments were carefully developed based on a thorough review of related literature and were aligned with the research questions to ensure their relevance and effectiveness in addressing the objectives of the study.

To assess the level of awareness of residents regarding electrical safety standards, a survey questionnaire was employed. This instrument included 5-Likert scale items designed to measure respondents' awareness levels, with interpretations ranging from Extremely Aware to Not at all Aware. The questionnaire also collected demographic information such as age, education level, and socioeconomic status to provide a comprehensive understanding of the participants' profiles. Descriptive statistics, such as mean scores were used to evaluate the overall level of awareness among residents.

To determine the status of compliance with electrical installation safety standards, another survey questionnaire was utilized. This questionnaire featured a checklist of compliance indicators, which was adapted from the Philippine Electrical Code (PEC). The PEC is a set of safety standards and regulations for electrical installations in the Philippines, published by the Institute of Integrated Electrical Engineers of the Philippines (IIEE), allowing the researchers to quantify the extent to which residents adhered to established safety standards. The data collected provided insights into compliance levels across different demographic groups.

To identify the factors affecting compliance with electrical installation safety standards, the study used a semi-structured interview guide was used to collect qualitative insights from key informants, including electricians, local government officials, and safety inspectors. The open-ended format of the interview guide allowed participants to share detailed responses, providing a deeper understanding of the barriers and challenges influencing compliance.

To propose strategies for improving awareness and compliance with electrical installation safety standards, the study employed a semi-structured interview guide to gather actionable recommendations from key stakeholders such as local government officials, electricians, and safety inspectors. This qualitative instrument enabled the researchers to identify recurring themes and practical strategies for addressing gaps in awareness and compliance.

Finally, to explore how awareness and compliance with electrical safety standards contributed to achieving Sustainable Development Goals (SDG) 7, SDG 9, and SDG 11, a semi-structured interview guide was used to collect qualitative data from key informants. This approach ensured that both quantitative and qualitative

perspectives were captured, providing a holistic understanding of the connection between electrical safety practices and sustainable development.

To ensure the validity and reliability of the research instruments, content validation was conducted by a panel of experts, including safety inspectors, electricians, and research specialists. A pilot test was also carried out with a group of participants who were not part of the actual study sample, resulting in high reliability scores. The finalized instruments were made available in both printed and digital formats to ensure accessibility for all respondents. This multi-method approach enabled the researchers to collect a comprehensive and triangulated dataset that effectively addressed the study's objectives.

Data Gathering Procedure

The researchers employed a systematic approach to collect data for the study. A formal request letter was sent to the local government of Laoag City to seek approval for the conduct of the study among the target population, which included residents such as homeowners, renters, and building owners, as well as key informants like electricians, local government officials, and safety inspectors. Once approval was granted, the researchers coordinated with barangay officials and other relevant authorities to schedule data collection activities and ensure the convenience of the participants.

The survey questionnaires were distributed in both printed and digital formats to accommodate participants' preferences and availability. Printed copies were distributed face-to-face in barangay halls or during community meetings, while digital copies were shared via email or messaging platforms for those who preferred an online format. A cover letter was attached to each questionnaire, explaining the purpose of the study, the voluntary nature of participation, and the assurance of confidentiality and anonymity of responses. The researchers provided assistance to participants in case of any clarifications and ensured that completed questionnaires were collected promptly to avoid delays.

For the qualitative component, semi-structured interviews were conducted with purposively selected key informants, such as electricians, local government officials, and safety inspectors. These interviews were scheduled in advance and conducted face-to-face or virtually, depending on the availability and preference of the participants. The interviews were held in a comfortable and non-intrusive environment to encourage participants to freely share their experiences and insights regarding awareness and compliance with electrical safety standards. The interview guide included open-ended questions designed to explore the challenges, barriers, and strategies for improving compliance with electrical safety regulations.

To ensure the study's objectives were met, the quantitative data collection focused on capturing a representative sample of Laoag City's population. The city's 80 barangays were grouped into clusters, such as Cluster 1 (Barangays 1, 2, 3, 4, 5), Cluster 2 (Barangays 6, 7A, 7B, 8, 9), and so on, up to Cluster 13 (Barangays 52A, 52B, 53, 54B, 56A, 55B). Random sampling was employed within each cluster to select participants, ensuring geographic diversity. Further stratification was applied based on demographic variables such as age, education level, and socioeconomic status, ensuring the sample reflected the diversity of the population.

The data collection process lasted for five months to allow sufficient time for participation and to ensure a high response rate. Regular follow-ups were conducted through announcements during barangay meetings and reminders from local officials to encourage participation. All collected data, including printed surveys and interview transcripts, were manually encoded into a spreadsheet for organization and analysis. This systematic procedure ensured the accuracy, reliability, and comprehensiveness of the data gathered for the study.

Statistical Treatment

The data collected in this study were analyzed using a mixed-methods approach, combining quantitative and qualitative analyses to systematically address the research questions.

For the assessment of residents' level of awareness regarding electrical safety standards, descriptive statistics were employed to summarize responses to the Likert-scale items in the survey questionnaire. Weighted means

were calculated to determine the overall awareness levels of residents, allowing for a clear understanding of how well respondents recognize the risks and requirements associated with proper electrical installations. Similarly, compliance with electrical installation safety standards was analyzed using descriptive statistics in the form of frequencies and percentages, based on the Philippine Electrical Code (PEC) checklist included in the survey. This approach provided a structured overview of the extent to which residents adhere to established safety requirements.

To examine the factors affecting compliance with electrical installation safety standards, thematic analysis was conducted following Braun and Clarke's (2006) six-phase framework. The process involved repeated reading of interview transcripts for data familiarization, generation of initial codes from meaningful data segments, and organization of these codes into potential themes. Themes were then reviewed, refined, defined, and named to accurately represent the perspectives of participants. This analysis focused on identifying recurring patterns, barriers, and challenges that influence residents' compliance with safety standards.

Thematic analysis was similarly applied to evaluate strategies for improving awareness and compliance with electrical safety standards. Qualitative data from interviews with key stakeholders—including electricians, local government officials, and safety inspectors—were analyzed to identify actionable strategies perceived as effective in promoting electrical safety practices. The analysis highlighted the most frequently mentioned approaches and provided structured insights into practical measures for improving compliance.

Additionally, the contribution of electrical safety awareness and compliance to the achievement of Sustainable Development Goals (SDG 7, SDG 9, and SDG 11) was explored using the same thematic framework. Recurring themes emerged that linked residents' electrical safety practices to sustainable energy use, resilient infrastructure, and the development of safe and sustainable communities.

To enhance analytical rigor, the coding process involved multiple iterative reviews to ensure consistency, coherence, and alignment with the research objectives. Although formal inter-coder reliability statistics were not computed, consistency was maintained through repeated comparison of codes with the original transcripts and refinement of themes until conceptual clarity was achieved.

By integrating quantitative measures with qualitative insights, this mixed-method approach provided a comprehensive understanding of electrical safety awareness, compliance behaviors, influencing factors, and potential strategies, situating the findings within the broader context of public safety and sustainable development.

Ethical Considerations

The study adhered to strict ethical guidelines to ensure the protection of participants' rights and the integrity of the research process. Prior to data collection, approval was secured from the local government of Laoag City and relevant barangay officials, ensuring that the study complied with local regulations and community protocols. Participants were informed about the purpose of the study, their role in the research, and the voluntary nature of their participation through a detailed cover letter attached to the survey questionnaire and interview guide.

Informed consent was obtained from all participants before their involvement in the study. The consent process emphasized that participation was voluntary, and participants could withdraw at any time without any consequences. Additionally, participants were assured of confidentiality and anonymity in handling their responses. Personal identifiers were excluded from the survey and interview data, and all information was stored securely to prevent unauthorized access.

For the qualitative component, interviews were conducted in a respectful and non-intrusive manner, ensuring that participants felt comfortable sharing their insights. The researchers followed Braun and Clarke's six-phase framework for thematic analysis, which included ethical considerations such as maintaining the integrity of participants' narratives and avoiding misrepresentation of their responses. Participants were informed that their responses would be used solely for research purposes and that their identities would remain confidential.

The study also took steps to avoid potential risks or harm to participants. Questions in the survey and interviews were designed to be non-sensitive and non-invasive, focusing solely on the study's objectives related to awareness, compliance, and strategies for improvement. Participants were given the option to skip questions they were uncomfortable answering.

To ensure fairness and inclusivity, the researchers employed a stratified random sampling technique for the quantitative component and purposive sampling for the qualitative component. This ensured that all demographic groups and key stakeholders were adequately represented while respecting their individual rights and perspectives.

Finally, the study adhered to ethical principles of transparency and accountability. The researchers conducted a pilot test of the research instruments to ensure their validity and reliability and disclosed the study's findings accurately and objectively. By following these ethical considerations, the study upheld the highest standards of integrity and respect for the participants and the community of Laoag City.

RESULTS AND DISCUSSIONS

A. Residents' Awareness Regarding Electrical Safety Standards

Table I presents the residents' level of awareness of electrical safety standards. The overall mean score of 3.83, interpreted as "Moderately aware," indicates that residents have a fair understanding of electrical safety practices but may lack deeper knowledge of specific guidelines and standards.

Table I Residents' Level of Awareness of Electrical Safety Standards

Statements	**Mean**	**DI**
I am aware that the Philippine Electrical Code (PEC) provides guidelines for safe electrical installations in the Philippines.	3.67	Moderately aware
I understand the risks associated with improper electrical installations, such as electrocution, fires, and shocks.	4.00	Moderately aware
I know the basic safety precautions to follow when using electrical appliances and devices.	3.82	Moderately aware
4. I can recognize signs of faulty wiring or potential electrical hazards in my household.	3.73	Moderately aware
I understand that hiring licensed electricians ensures compliance with electrical safety standards.	3.89	Moderately aware
I am aware of the need to regularly check and maintain electrical systems to prevent accidents.	3.75	Moderately aware
I know that overloading electrical outlets or circuits can lead to fires and other hazards.	3.92	Moderately aware
I understand that failing to comply with electrical safety standards can result in severe accidents or property damage.	3.94	Moderately aware
I know where to report electrical safety concerns or violations within my community.	3.73	Moderately aware
Overall Mean	**3.83**	Moderately aware

Note: *DI-Descriptive Interpretation; 1.00 - 1.80 - Not at all aware; 1.81 - 2.60 - Slightly aware; 2.61 - 3.40 - Somewhat aware; 3.41 - 4.20 - Moderately aware; 4.21 - 5.00 - Extremely aware*

Among the individual items, the highest mean score of 4.00 was observed for the statement, "I understand the risks associated with improper electrical installations, such as electrocution, fires, and shocks," suggesting that residents are particularly aware of the dangers posed by unsafe electrical setups. Similarly, the statement, "I understand that failing to comply with electrical safety standards can result in severe accidents or property damage," received a mean score of 3.94, further highlighting residents' awareness of the consequences of non-compliance.

However, the lowest mean score of 3.67 was recorded for the statement, "I am aware that the Philippine Electrical Code (PEC) provides guidelines for safe electrical installations in the Philippines." This suggests a gap in residents' awareness of formal regulatory frameworks, which could hinder effective compliance with safety standards. Additionally, while residents demonstrated moderate awareness of the importance of hiring licensed electricians (mean = 3.89) and the dangers of overloading electrical outlets (mean = 3.92), their ability to recognize signs of faulty wiring or potential hazards (mean = 3.73) remains an area for improvement. These results point to the need for targeted awareness campaigns to address specific areas of concern, particularly those related to regulatory guidelines and hazard identification.

The implications of these findings emphasize the importance of improving public awareness initiatives to strengthen residents' knowledge of electrical safety standards. As Adelani and Olatunde [1] noted, insufficient awareness of electrical safety guidelines remains a critical barrier to the effective implementation of safety practices. Similarly, Fabiosa [11] highlighted that limited knowledge of electrical safety measures among families often leads to increased risks of electrical fires and accidents. This is consistent with the findings of Baflor et al. [3], who underscored the necessity of promoting awareness of the PEC and its compliance requirements, particularly in areas where outdated electrical systems are prevalent.

Furthermore, the moderate awareness levels observed in this study align with the research of Kulor et al. [17], which found that many residential electricity consumers lack sufficient knowledge of electrical hazards, often resulting in unsafe practices. This trend is further corroborated by Cvetković et al. [7], whose study on fire safety behavior in residential buildings demonstrated that increased awareness of safety standards significantly reduced the risk of fire-related disasters. These studies collectively highlight the importance of bridging knowledge gaps through targeted education and community-based initiatives.

In summary, while the residents of Laoag City exhibit moderate awareness of electrical safety standards, there is a clear need to enhance their understanding of specific guidelines, such as those outlined in the PEC, and to improve their ability to identify potential hazards. These findings suggest that strengthening public education campaigns and fostering community engagement in safety practices could play a crucial role in promoting safer electrical installations and reducing the risks of accidents and fires.

B. Status of Compliance with Electrical Installation Safety Standards Among Residents

Table II presents the frequency and percentage distribution of residents' compliance with electrical installation safety standards. The results reveal that the majority of respondents were "Compliant" with the listed safety standards, as indicated by compliance rates ranging from 55.45% to 74.26%.

Table II. Frequency and Percentage Distribution of Residents' Compliance with Electrical Installation Safety Standards

Statements	**Compliant**		**Non-Compliant**		**Not Applicable**	
	F	*%*	*F*	*%*	*F*	*%*

1. All electrical installations conform to the Philippine Electrical Code (PEC) requirements.	70	69.31%	24	23.76%	7	6.93%
2. Electrical wiring systems are installed using approved materials (e.g., wires, conduits).	72	71.29%	21	20.79%	8	7.92%
3. Proper grounding is implemented for all electrical systems to ensure safety.	75	74.26%	18	17.82%	8	7.92%
4. Electrical connections are properly insulated and protected from physical damage.	71	70.30%	24	23.76%	6	5.94%
5. Wiring systems are sized appropriately for the electrical load to prevent overheating.	72	71.29%	21	20.79%	8	7.92%
6. Circuit breakers and fuses are installed correctly and are accessible for maintenance.	72	71.29%	19	18.81%	10	9.90%
7. Overcurrent protection devices are sized according to the PEC standards.	63	62.38%	29	28.71%	9	8.91%
8. Service entrance conductors and electrical panels are installed in compliance with PEC.	64	63.37%	31	30.69%	6	5.94%
9. Circuits are properly labeled for identification and maintenance.	70	69.31%	20	19.80%	11	10.89%
10. Electrical outlets are securely mounted and comply with PEC spacing requirements.	68	67.33%	26	25.74%	7	6.93%
11. Tamper-resistant receptacles are installed in homes with children, as required by PEC.	56	55.45%	36	35.64%	9	8.91%
12. Switches and outlets are free from damage and securely connected to the wiring system.	72	71.29%	23	22.77%	6	5.94%
13. Ground Fault Circuit Interrupters (GFCIs) are installed in wet and outdoor areas.	60	59.41%	34	33.66%	7	6.93%
14. Surge protectors are installed where necessary to protect appliances and systems.	67	66.34%	25	24.75%	9	8.91%
15. Outdoor electrical installations are weatherproof and comply with PEC standards.	64	63.37%	27	26.73%	10	9.90%
16. Electrical systems are regularly inspected by a licensed electrician to ensure compliance.	66	65.35%	27	26.73%	8	7.92%
17. Faulty wiring, damaged outlets, or exposed conductors are promptly repaired.	70	69.31%	22	21.78%	9	8.91%
18. Residents are aware of the importance of periodic maintenance of electrical systems.	66	65.35%	26	25.74%	9	8.91%
19. Electrical installations were performed by a licensed electrician or contractor.	70	69.31%	24	23.76%	7	6.93%
20. Necessary permits and certifications for electrical installations were obtained.	72	71.29%	23	22.77%	6	5.94%

The highest compliance was observed for the statement, "Proper grounding is implemented for all electrical systems to ensure safety," with 75 respondents (74.26%) reporting compliance. This suggests that residents place significant importance on grounding as a fundamental safety measure in their electrical systems. Similarly, high compliance rates were reported for the use of approved materials in electrical wiring systems (71.29%) and the proper installation of circuit breakers and fuses (71.29%), indicating that many residents adhere to these critical safety practices.

On the other hand, the lowest compliance rate was observed for the statement, "Tamper-resistant receptacles are installed in homes with children, as required by PEC," with only 55.45% of respondents reporting compliance. This finding raises concerns about the safety of children in households and highlights the need for greater awareness and enforcement of this specific standard. Additionally, compliance rates for the installation of Ground Fault Circuit Interrupters (GFCIs) in wet and outdoor areas (59.41%) and the use of weatherproof outdoor electrical installations (63.37%) were relatively lower compared to other standards. These results suggest that residents may not fully recognize the risks associated with moisture and outdoor exposure, which could increase the likelihood of electrical hazards in these areas.

The implications of these findings highlight the need for targeted interventions to improve compliance with electrical safety standards, particularly in areas where compliance rates are lower. As noted by Calipayan and Espinola [5], compliance with building wiring installations is critical to ensuring public safety and reducing the risks associated with electrical faults. The study by Baflor et al. [3] also emphasized the importance of adhering to PEC standards, particularly in areas prone to faulty installations, which can lead to significant safety hazards. Furthermore, research by Cvetković et al. [7] demonstrated that compliance with safety standards in residential buildings plays a crucial role in disaster risk reduction, particularly in mitigating fire hazards caused by electrical faults.

These findings are consistent with those of Kulor et al. [17], who identified that non-compliance with electrical safety standards in residential areas is often linked to a lack of awareness and inadequate enforcement of regulations. Similarly, studies by Li et al. [20] and Darcy et al. [10] have highlighted the role of compliance with electrical safety standards in preventing electrical fires and ensuring the safety of residential and commercial buildings. The moderate compliance rates observed in this study suggest that while many residents are taking steps to adhere to safety standards, there is still a significant portion of the population that remains non-compliant, particularly in areas where awareness and enforcement are lacking.

In summary, the findings indicate that while residents of Laoag City generally comply with many electrical installation safety standards, there are specific areas, such as the use of tamper-resistant receptacles and GFCIs, that require further attention. These results underscore the importance of strengthening educational campaigns, enforcing safety regulations, and encouraging regular inspections by licensed electricians to ensure full compliance with the Philippine Electrical Code and enhance overall electrical safety in residential areas.

C. Factors Affecting Compliance with Electrical Installation Safety Standards

Table III presents the results of the thematic analysis of factors affecting compliance with electrical installation safety standards. Three major themes emerged: Awareness and Education, Economic Constraints, and Enforcement and Regulation, each with specific codes and ranks based on frequency and percentage.

Table Iii Thematic Analysis Of Factors Affecting Compliance With Electrical Installation Safety Standards

Themes (Factors)	**Codes**	***F***	***%***	**Rank**
Awareness and Education	Lack of knowledge about safety standards	4	40%	1
	Limited access to safety training	3	30%	2
	Poor dissemination of information	3	30%	2

Economic Constraints	High cost of hiring licensed electricians	5	50%	1
	Expensive safety materials and equipment	3	30%	2
	Financial priorities over safety	2	20%	3
Enforcement and Regulation	Lack of strict monitoring by authorities	7	70%	1
	Inconsistent implementation of policies	2	20%	2
	Limited penalties for non-compliance	1	10%	3

The theme Awareness and Education ranked highly, with "Lack of knowledge about safety standards" being the most frequently mentioned factor (40%). Respondents highlighted the limited access to safety training and poor dissemination of information (both at 30%) as additional barriers to compliance. One respondent remarked, *"I never knew there were specific guidelines for electrical installations until I experienced an electrical fire at home."* This highlights the critical role of education in promoting compliance and reducing risks.

The theme Economic Constraints also emerged as a significant factor, with "High cost of hiring licensed electricians" being the most frequently cited (50%). Respondents noted that financial priorities often take precedence over safety, as reflected in the code "Financial priorities over safety" (20%). One participant shared, *"We try to do electrical work ourselves because hiring professionals is too expensive."* This sentiment underscores the challenge of balancing household budgets with safety investments, particularly in low-income communities. The findings align with the study by Kulor et al., which identified economic challenges as a major barrier to safe electrical practices in residential areas, further emphasizing the need for affordable safety solutions [17].

Finally, Enforcement and Regulation was identified as the most critical theme, with "Lack of strict monitoring by authorities" receiving the highest frequency (70%). Respondents expressed concerns about inconsistent implementation of policies (20%) and the limited penalties for non-compliance (10%). One respondent stated, *"Even if we don't follow the standards, there's no one checking or penalizing us."* This highlights the need for stronger enforcement mechanisms to ensure compliance. Research has emphasized that strict monitoring and enforcement of safety standards are vital in reducing electrical hazards, particularly in public infrastructure buildings [5].

These findings suggest that addressing these factors requires a multi-faceted approach. First, improving awareness through targeted education campaigns and accessible training programs can help bridge knowledge gaps. Effective dissemination of safety information is crucial to fostering compliance, particularly in communities with limited access to formal education [1]. Second, financial barriers must be mitigated by promoting affordable safety materials and services. Subsidizing safety equipment has been recommended to encourage compliance [2]. Finally, enforcement mechanisms must be strengthened, with regular inspections and stricter penalties for non-compliance. Improved regulatory oversight has been shown to significantly reduce disaster risks, including those associated with electrical hazards [7].

In summary, the factors affecting compliance with electrical installation safety standards reveals that awareness, economic constraints, and enforcement are critical areas that require attention. Addressing these barriers through education, financial support, and stronger regulatory frameworks can significantly enhance compliance and improve electrical safety in residential communities.

D. Strategies to Improve Awareness and Compliance with Electrical Installation Safety Standards

Table IV presents the thematic analysis of proposed strategies to improve awareness and compliance with electrical installation safety standards. Three major themes emerged: Education and Training, Financial Assistance, and Strengthened Enforcement, each with specific codes ranked according to frequency and percentage.

Table IV Thematic Analysis of Proposed Strategies to Improve Awareness and Compliance with Electrical Installation Safety Standards

Themes (Strategies)	**Codes**	***f***	***%***	**Rank**
Education and Training	Conduct regular safety seminars and workshops	6	60%	1
	Integrate electrical safety in school curricula	2	20%	2
	Provide accessible online safety resources	2	20%	2
Financial Assistance	Offer subsidies for hiring licensed electricians	7	70%	1
	Provide discounts on safety materials and equipment	2	20%	2
	Establish financial aid for low-income households	1	10%	3
Strengthened Enforcement	Increase penalties for non-compliance	8	80%	1
	Conduct random inspections of electrical installations	1	10%	2
	Create a dedicated task force for monitoring	1	10%	2

The theme Education and Training highlights the importance of knowledge dissemination as a key strategy for improving compliance with electrical safety standards. The most frequently mentioned code, "Conduct regular safety seminars and workshops," was cited by 60% of respondents, indicating that community-based education initiatives are critical in raising awareness. One respondent shared, *"Workshops and seminars would help us understand the risks and the importance of following electrical safety standards."* Other suggestions included integrating electrical safety into school curricula (20%) and providing accessible online safety resources (20%). These strategies emphasize the need to instill a culture of safety awareness at both the community and institutional levels. This aligns with the findings in [1], which emphasized that education and training are essential for fostering compliance with safety standards, particularly in communities with limited access to formal education. Furthermore, Alfalah et al. [2] highlighted the importance of leveraging digital platforms to provide accessible and widespread safety resources.

The theme Financial Assistance emerged as the most frequently mentioned overall, with "Offer subsidies for hiring licensed electricians" receiving 70% of responses. This finding reflects the significant financial burden that compliance with safety standards can place on households, particularly in low-income communities. One participant remarked, *"The cost of hiring a licensed electrician is too high for many families, so we end up doing the work ourselves."* Other proposed strategies under this theme included providing discounts on safety materials and equipment (20%) and establishing financial aid programs for low-income households (10%). These findings are consistent with the study in [2], which recommended financial support mechanisms, such as subsidies and discounts, to alleviate the economic barriers to compliance. Similarly, Kulor et al. [17] identified financial constraints as a major obstacle to safe electrical practices in residential areas, emphasizing the need for targeted financial assistance to improve compliance.

The theme Strengthened Enforcement was the most frequently mentioned strategy overall, with 80% of respondents identifying "Increase penalties for non-compliance" as the most effective way to ensure adherence to safety standards. Participants emphasized that stricter penalties would serve as a deterrent and encourage individuals and organizations to prioritize safety. One participant stated, *"People will take electrical safety seriously if there are consequences for not following the rules."* Other proposed strategies included conducting random inspections of electrical installations (10%) and creating a dedicated task force for monitoring compliance (10%). These findings align with the research in [5], which emphasized the importance of strict enforcement mechanisms to ensure adherence to safety standards. Furthermore, Cvetković et al. [7] found that

increased penalties and regular inspections significantly reduce risks associated with electrical hazards by promoting accountability.

The implications of these findings highlight that improving awareness and compliance with electrical safety standards requires a multi-faceted approach. Education and training initiatives, such as workshops and school-based programs, can help raise awareness and instill a culture of safety from an early age. Financial assistance is crucial to overcome economic barriers, as subsidies and discounts can make compliance more affordable for low-income households. Finally, strengthened enforcement through increased penalties, random inspections, and dedicated monitoring teams can ensure accountability and foster a commitment to safety. These strategies are consistent with findings in [1], [2], [5], and [7], which emphasize the importance of education, financial support, and enforcement in improving electrical safety compliance.

In conclusion, the findings from Table 4 underscore the importance of implementing a combination of educational, financial, and regulatory strategies to improve awareness and compliance with electrical safety standards. By addressing these key areas, communities can enhance safety, reduce risks, and contribute to sustainable development goals.

E. Contribution of Awareness and Compliance with Electrical Safety Standards to Achieving SDG 7, SDG 9, and SDG 11

Table V presents the thematic analysis of the contributions of awareness and compliance with electrical safety standards to Sustainable Development Goals (SDG) 7, SDG 9, and SDG 11. The analysis identified three major themes: Promoting Safe Renewable Energy Systems (SDG 7), Ensuring Safe and Resilient Infrastructure (SDG 9), and Enhancing Urban Safety and Sustainability (SDG 11). Each theme includes specific codes ranked according to frequency and percentage.

Table V Thematic Analysis of Contributions of Awareness and Compliance with Electrical Safety Standards to SDG 7, SDG 9, and SDG 11

Themes	Codes	*f*	%	Rank
Promoting Safe Renewable Energy Systems (SDG 7)	Ensures safe and reliable use of renewable energy systems	7	70%	1
	Reduces risks of electrical accidents in solar energy systems	2	20%	2
	Encourages energy-efficient electrical systems	1	10%	3
Ensuring Safe and Resilient Infrastructure (SDG 9)	Improves safety in industrial electrical installations	6	60%	1
	Enhances resilience of electrical infrastructure	3	30%	2
	Promotes innovation in electrical safety technologies	1	10%	3
Enhancing Urban Safety and Sustainability (SDG 11)	Reduces electrical hazards in residential and urban areas	8	80%	1
	Supports sustainable urban development	1	10%	2
	Contributes to disaster risk reduction	1	10%	2

The theme Promoting Safe Renewable Energy Systems (SDG 7) underscores the role of electrical safety awareness and compliance in advancing the safe use of renewable energy technologies. The most frequently mentioned code, "Ensures safe and reliable use of renewable energy systems," was cited by 70% of respondents, indicating that compliance with safety standards is a vital component in ensuring the efficiency and reliability of renewable energy systems. One participant shared, *"Without proper safety measures, even renewable energy sources like solar panels can become a hazard rather than a solution."* Furthermore, respondents noted that compliance reduces risks of electrical accidents in solar energy systems (20%) and encourages the adoption of energy-efficient electrical systems (10%). These findings align with research in [1], which highlights the importance of safety standards in ensuring the effective and safe utilization of renewable energy systems. Additionally, Alfalah et al. [2] emphasized the role of safety standards in supporting the transition to sustainable energy systems by minimizing risks and promoting efficiency.

The second theme, Ensuring Safe and Resilient Infrastructure (SDG 9), focuses on the importance of electrical safety compliance in improving industrial and infrastructural resilience. The most frequently cited code, "Improves safety in industrial electrical installations," was mentioned by 60% of respondents, highlighting the critical role of compliance in preventing industrial accidents and ensuring the safety of workers. One respondent noted, *"Adhering to safety standards in factories prevents electrical faults that could harm workers or damage equipment."* Other respondents emphasized that awareness and compliance enhance the resilience of electrical infrastructure (30%) and promote innovation in electrical safety technologies (10%). This finding is consistent with the study in [5], which emphasized the importance of compliance in ensuring the safety and reliability of electrical systems in industrial settings. Similarly, Cvetković et al. [7] noted that resilient electrical infrastructure is a key factor in disaster risk reduction and sustainable development.

The theme Enhancing Urban Safety and Sustainability (SDG 11) received the highest overall frequency, with 80% of respondents identifying "Reduces electrical hazards in residential and urban areas" as a key contribution. This suggests that awareness and compliance with safety standards play a significant role in protecting urban populations from electrical hazards. One participant stated, *"Compliance with safety standards ensures that homes and public spaces are safe from electrical risks."* Other codes under this theme included "Supports sustainable urban development" (10%) and "Contributes to disaster risk reduction" (10%). These results align with findings in [16], which highlighted the importance of electrical safety in developing sustainable and disaster-resilient urban areas. Additionally, research in [7] emphasized that reducing electrical hazards in urban areas is essential for achieving the goals of sustainable cities and communities.

The findings are significant, as they demonstrate the interconnectedness of electrical safety awareness and compliance with broader global goals. By promoting safe renewable energy systems, ensuring resilient infrastructure, and enhancing urban safety, communities can contribute to achieving SDG 7, SDG 9, and SDG 11. This highlights the need for continued efforts in education, financial support, and enforcement of safety standards to maximize these contributions. Moreover, the findings corroborate studies that emphasize the critical role of electrical safety in advancing sustainable development and reducing risks in residential, industrial, and urban settings [1], [2], [5], [7].

In conclusion, this underscores the broader societal benefits of electrical safety awareness and compliance. By addressing the identified strategies and strengthening their implementation, stakeholders can contribute to achieving global sustainability goals while ensuring the safety and well-being of individuals and communities.

CONCLUSION

This study sought to evaluate the level of awareness and compliance of residents in Laoag City with electrical installation safety standards, identify the factors affecting compliance, and propose strategies to improve awareness and adherence. The findings revealed that while residents are moderately aware of electrical safety standards, there are gaps in their understanding of specific guidelines, such as those outlined in the Philippine Electrical Code, and in their ability to identify potential electrical hazards. Compliance with safety standards was generally high, but certain areas, such as the installation of tamper-resistant receptacles and Ground Fault Circuit Interrupters (GFCIs), exhibited lower compliance rates. Key factors influencing compliance include limited awareness and education, economic constraints, and insufficient enforcement of regulations. Proposed

strategies to address these challenges include education and training programs, financial assistance, and stronger enforcement mechanisms.

These findings emphasize the importance of a comprehensive approach to improving awareness and compliance with electrical safety standards. Education and training initiatives, such as safety seminars, school-based programs, and online resources, can address knowledge gaps and foster a culture of safety. Providing financial assistance in the form of subsidies for licensed electricians and discounts on safety materials can help alleviate economic barriers to compliance. Strengthened enforcement, including increased penalties, random inspections, and dedicated monitoring teams, is essential to ensure adherence to safety standards and accountability.

While the study offers valuable insights, its findings are limited to the specific context of Laoag City and may not fully capture the experiences of other regions with different socio-economic and cultural contexts. Additionally, the reliance on self-reported data may introduce biases or inaccuracies. Future research should expand to other regions and explore the effectiveness of targeted interventions, such as educational campaigns and financial assistance programs, in improving compliance with electrical safety standards.

In summary, the study highlights the critical role of awareness and compliance with electrical safety standards in promoting safety, reducing risks, and contributing to sustainable development. By addressing the identified challenges and implementing the proposed strategies, stakeholders can enhance public safety, promote resilience, and support the achievement of sustainable development goals. These findings provide a foundation for future initiatives aimed at improving electrical safety practices in residential and industrial settings.

Limitations Of The Study

While this study provides valuable insights into the awareness and compliance of residents in Laoag City regarding electrical installation safety standards, several limitations must be acknowledged.

First, the study is geographically limited to the residents of Laoag City, which may not fully represent the experiences, practices, and challenges faced by residents in other regions with different socio-economic, cultural, and regulatory contexts. The findings may not be generalizable to areas with varying levels of infrastructure development, economic conditions, or access to electrical safety resources.

Second, the study relied on self-reported data from respondents, which may be subject to biases such as social desirability bias, recall bias, or misreporting. Some participants might have overestimated their level of awareness or compliance with safety standards to present themselves in a more favorable light. This could affect the accuracy and reliability of the reported results.

Third, while the study identified key factors affecting compliance and proposed strategies for improvement, it did not assess the actual effectiveness of these strategies in practice. The study is limited to identifying theoretical solutions rather than evaluating their implementation or impact on improving awareness and compliance.

Lastly, the study did not account for other potential influencing factors, such as the role of local government initiatives, the availability of safety resources, or the influence of cultural attitudes toward safety practices. These factors could provide additional insights into the challenges and opportunities for improving compliance with electrical safety standards.

Despite these limitations, the study provides a strong foundation for understanding the current state of awareness and compliance with electrical safety standards in Laoag City. Future research should address these limitations by expanding the study to other regions, incorporating objective measurements of compliance, and evaluating the effectiveness of proposed interventions. These efforts will help develop more comprehensive and actionable strategies for improving electrical safety awareness and practices at a broader scale.

RECOMMENDATIONS

Based on the findings and limitations of this study, several recommendations are proposed to improve awareness and compliance with electrical installation safety standards among residents. First, targeted public awareness

campaigns should be implemented to address gaps in knowledge, particularly regarding the provisions of the Philippine Electrical Code (PEC) and the importance of compliance with safety standards. These campaigns can utilize various platforms, such as social media, radio, television, and community events, to ensure widespread dissemination of information. Additionally, regular safety seminars and training programs should be conducted to provide residents with practical knowledge on hazard identification, proper maintenance of electrical systems, and the risks associated with non-compliance. Schools should also integrate electrical safety topics into their curricula to instill awareness at an early age.

To address economic constraints identified in the study, financial assistance programs should be established to provide subsidies for hiring licensed electricians and discounts on safety materials and equipment. These programs can alleviate the financial burden on low-income households and encourage them to prioritize safety in their electrical installations. Incentives such as tax breaks or rebates can also be introduced to further promote compliance with safety standards. Strengthened enforcement mechanisms are equally crucial, and local authorities should conduct regular and random inspections of electrical installations to ensure adherence to the PEC. Increasing penalties for non-compliance and creating a dedicated task force to oversee enforcement can deter unsafe practices and foster accountability.

Furthermore, residents should be encouraged to schedule regular inspections and maintenance of their electrical systems by licensed electricians. Local authorities can support this initiative by providing free or subsidized inspection services to ensure compliance and reduce the risk of electrical hazards. Collaboration among stakeholders, including local government units, schools, private organizations, and non-governmental groups, is essential to effectively implement these initiatives. By pooling resources and expertise, stakeholders can maximize the impact of educational and financial assistance programs.

The study also highlights the importance of fostering a culture of safety within communities. Residents should be encouraged to take an active role in identifying and reporting electrical hazards. Establishing community-based safety committees can promote collective responsibility and ensure that safety practices are upheld at the local level. Finally, future research should explore the effectiveness of specific interventions, such as financial assistance programs or educational campaigns, in improving compliance with electrical safety standards. Expanding the scope of research to include other regions and examining cultural, economic, and institutional factors will provide more tailored and effective strategies to enhance electrical safety compliance.

By addressing these recommendations, stakeholders can overcome the barriers identified in this study, improve awareness and compliance, and reduce the risks of electrical hazards. These efforts will contribute to safer communities, more resilient infrastructure, and the achievement of sustainable development goals.

ACKNOWLEDGMENT

The researchers would like to express their heartfelt gratitude to everyone who contributed to the success of this study. Sincere thanks go to the residents of Laoag City who participated in the survey and provided valuable insights that made this research possible. The researchers are also deeply grateful to their adviser for their guidance, expertise, and encouragement throughout the study. Appreciation is extended to the local government units and organizations that supported the research by sharing relevant data and resources. Lastly, the researchers thank their families and friends for their unwavering support, patience, and understanding, which served as a source of motivation throughout this journey. This study would not have been possible without the collective efforts and support of all those involved.

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