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# Evaluating the Compliance Levels of Electrical Safety Rules and Guidelines in Selected Technical and Vocational Education and Training Institutions in Nyeri County, Kenya

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***Abstract:*** *Electrical safety is critical in TVET institutions due to frequent handling of live circuits, machinery, and electrical tools. This study evaluated electrical safety compliance in selected TVET institutions in Nyeri County, Kenya. Using a descriptive survey design, quantitative data were gathered via questionnaires from 290 respondents (234 trainees, 56 trainers) and analyzed using descriptive and inferential statistics. Qualitative data from six administrator interviews and six observation checklists were analyzed thematically. The results demonstrated moderate overall compliance ($M = 3.11$, $SD = 0.91$). Specifically, guideline adequacy recorded a mean of 3.12 ($SD = 0.96$), compliance with safety rules 3.09 ($SD = 0.95$), safety equipment 3.14 ($SD = 0.95$), and safety training 3.11 ($SD = 0.94$). A significant association was found between safety training and compliance levels, $\chi^2(4, N = 290) = 232.81$, $p < .001$ (Cramer's $V = .634$). Multiple regression revealed that guideline adequacy, safety equipment, and safety training jointly explained 84.7% of compliance variance, $F(3, 286) = 527.885$, $p < .001$. Safety equipment was the strongest predictor ($\beta = .370$), followed by safety training ($\beta = .305$) and guideline adequacy ($\beta = .289$). Qualitative and observation findings revealed outdated or generic guidelines, weak routine inspection, equipment serviceability gaps, irregular practical safety training, supervision challenges and budgetary constraints. The study concludes that compliance is moderate and requires an integrated institutional approach combining accessible workshop-specific guidelines, functional safety equipment, continuous practical training, routine inspection and stronger supervision.*

***Keywords:*** *Electrical safety rules, Safety compliance, TVET institutions, Electrical safety training, Safety equipment.*

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# 1. Introduction

Technical and Vocational Education and Training institutions are central to technical skills development, industrial development and youth employability. Their practical orientation, however, exposes learners and instructors to hazards that are less prominent in purely theoretical learning environments. Electrical and electronics workshops involve live circuits, power distribution panels, machines, control systems, testing instruments and electrical tools. Consequently, inadequate safety instruction, faulty equipment, improper wiring, unsafe work practices and human error can result in electric shock, burns, fire, equipment damage and other injuries (International Labour Organization [ILO], 2022).

International approaches to electrical safety increasingly combine regulatory requirements with engineering controls, visual management, safe work procedures, Lockout/Tagout (LOTO), hazard communication and continuous training. Standards such as IEC 60364 and IEEE 1584 provide technical guidance for electrical installations and arc-flash hazard assessment, while ISO 45001 emphasizes systematic occupational health and safety management. High-performing systems therefore treat safety not as an isolated administrative requirement but as an integral component of technical training and institutional management.

Across many African TVET environments, the implementation of occupational safety requirements is affected by resource limitations, ageing infrastructure, inadequate maintenance and inconsistent enforcement. Studies of vocational institutions have reported gaps between formal safety requirements and everyday workshop practices, including inadequate safety equipment, limited practical safety training and weak inspection systems (Adu Gyamfi et al., 2022; Kintu et al., 2015; Mukhtar & Kantsi, 2019). These conditions can create a situation in which trainees understand safety rules in principle but cannot consistently apply them because the physical and organisational environment does not adequately support compliance.

In Kenya, electrical safety in TVET institutions is informed by the Occupational Safety and Health Act, 2007, TVET regulatory requirements and relevant international standards. The expansion of TVET and the increased emphasis on competency-based education and training have made safe practical learning increasingly important. However, evidence continues to indicate gaps in policy implementation, safety equipment, supervision and institutional safety management (Olayo, 2022; Ochieng et al., 2024; TVET Authority, 2024).

Nyeri County provides an important context for examining these issues because it contains a range of TVET institutions offering electrical installation, electrical and electronics engineering and renewable energy programmes. The rapid growth of technical training increases the need to ensure that workshop safety systems expand alongside enrolment and technological change. The present study therefore focuses on the extent to which electrical safety rules and guidelines are implemented and complied with in selected TVET institutions in the county.

Electrical safety is a mandatory requirement in TVET workshops because trainees and trainers routinely interact with electrical installations, machines, tools and equipment that can cause serious injury when improperly handled. Although safety legislation and institutional guidelines exist, the existence of formal rules does not necessarily mean that they are consistently accessible, functional or followed during practical work. Previous studies have identified challenges relating to occupational safety compliance, safety equipment and institutional safety management in technical training environments (Mwangi, 2017; Ochieng et al., 2024; TVET Authority, 2024).

The problem is particularly important because electrical safety failures can arise from the interaction of several factors: outdated or inaccessible guidelines, inadequate or poorly maintained equipment, insufficient practical training, weak supervision and limited institutional resources. Much of the available evidence also relies on self-reported safety practices, while less attention has been given to combining questionnaire evidence with direct workshop observations and administrator perspectives. In Nyeri County, there remains a need for localized empirical evidence showing the level of compliance and the institutional factors associated with it. This study addressed that gap by examining guideline adequacy, compliance with safety rules, availability and condition of safety equipment, and institutional safety training, while triangulating questionnaire findings with observations and administrator interviews.

## 1.1 Research Objective

The objective of this study was to evaluate the compliance levels of electrical safety rules and guidelines in selected TVET institutions in Nyeri County, Kenya.

## 1.2 Research Questions

This study was guided by the following research questions:

1. How adequate are electrical safety guidelines implemented in selected TVET institutions in Nyeri County?
2. To what extent do trainers and trainees comply with established electrical safety rules and guidelines?
3. What electrical safety equipment is available in TVET workshops and what is its condition?
4. How are institutional safety training programmes associated with safe electrical practices among trainers and trainees?

# 2. Literature Review

## 2.1 Empirical Literature

Electrical safety guidelines provide the formal framework through which institutions communicate acceptable practices, hazard controls and emergency procedures. Internationally, effective safety systems have moved beyond broad policy statements toward task-specific procedures, LOTO, hazard communication and point-of-use instructions. The adequacy of guidelines therefore depends on whether they are current, accessible, technically appropriate and consistently implemented.

In Kenya, the Occupational Safety and Health Act, 2007 provides a legal foundation for workplace safety, while TVET institutions operate within national quality and safety requirements. However, the literature suggests a policy-practice gap: an institution may possess a written policy but still lack workshop-specific procedures, visible signage or effective monitoring. Olayo (2022) and Ochieng et al. (2024) indicate that implementation weaknesses can undermine the practical value of formal safety requirements.

A related issue is the 'dead document' phenomenon, in which safety manuals exist for administrative or accreditation purposes but are not readily available at the point of work. In electrical workshops, safety information should be visible near high-risk equipment and should address specific activities such as live testing, isolation, grounding, PPE use, emergency shutdown and LOTO. Systems Theory suggests that a policy becomes effective only when it interacts with other parts of the safety system, including equipment, supervision and training.

Compliance is influenced by both individual behaviour and institutional conditions. Heinrich's Domino Theory emphasizes unsafe acts as immediate contributors to accidents, but unsafe behaviour may itself be shaped by organisational pressures and environmental constraints. Studies in vocational training contexts show that safety awareness alone does not guarantee safe practice where supervision is weak or resources are inadequate (Kintu et al., 2015; Mukhtar & Kantsi, 2019).

In Kenyan TVET institutions, non-compliance may include inconsistent PPE use, inadequate reporting of hazards, weak enforcement of rules and unsafe shortcuts during practical tasks. The transition toward competency-based training may also create pressure to complete practical activities within limited time, making strong safety supervision essential. Effective compliance therefore requires consistent modelling by trainers, clear rules, corrective guidance, adequate resources and management commitment.

Safety equipment is a critical part of the physical safety system. It includes PPE, fire extinguishers, emergency switches, first aid kits, insulated tools, grounding arrangements, warning signs and other protective devices. The literature emphasizes that availability should not be interpreted merely as physical presence. Equipment must be functional, maintained, accessible, correctly rated and suitable for the hazard concerned (Isaac et al., 2020; Mwashighadi & Kitainge, 2023).

A workshop may therefore appear compliant during a visual inspection while still containing latent risks if equipment is expired, damaged, insufficient or poorly maintained. This distinction between visible availability and functional readiness is important for electrical safety because emergency devices must operate immediately when needed. Systems Theory supports a serviceability perspective in which equipment performance is part of the wider institutional safety system.

Safety training is most effective when it is continuous, practical and integrated into technical instruction. Kintu et al. (2015) found that practical occupational safety training is important in vocational environments, while wider safety literature emphasizes repeated drills, demonstrations and simulation. Electrical safety training should therefore include hazard identification, PPE use, safe isolation, insulation testing, LOTO, emergency shutdown, electric-shock response and fire response.

In many training institutions, however, safety may be introduced during orientation and reinforced mainly through verbal reminders. Such approaches may not develop the practical competence required for high-risk electrical work. The present study therefore examined training as an institutional factor and tested its statistical association with overall compliance.

Four related gaps emerge from the literature. First, there is limited localized evidence on the adequacy and practical accessibility of electrical safety guidelines in TVET workshops in Nyeri County. Second, previous studies have often emphasized self-reported safety practices without sufficiently triangulating them with direct workshop observations. Third, the physical presence of safety equipment has received more attention than its functional condition and readiness. Fourth, relatively limited evidence directly examines the association between institutional safety training programmes and compliance with electrical safety rules among trainers and trainees. The present study addressed these gaps through a mixed-source assessment involving questionnaires, administrator interviews and workshop observations.

## 2.2 Theoretical Underpinning

The study was anchored on Systems Theory and Heinrich's Accident Causation (Domino) Theory. Systems Theory views an organisation as a set of interdependent components whose interaction produces overall system performance (von Bertalanffy, 1968). Applied to TVET electrical safety, these components include institutional policies, safety equipment, training, supervision, inspection, reporting mechanisms and user behaviour. A weakness in one component can affect the performance of the whole safety system.

Heinrich's Domino Theory explains accidents as a chain involving unsafe conditions and unsafe acts (Heinrich, 1959). In the present context, unsafe conditions may include faulty sockets, non-functional emergency switches, inadequate PPE or poor workshop layout, while unsafe acts may include failure to wear PPE, bypassing protective devices or unsafe handling of electrical equipment. The theory therefore helps explain why effective prevention requires interruption of the accident chain before an incident occurs.

Together, the theories provide complementary explanations. Systems Theory emphasizes the interaction of institutional and technical components, while Accident Causation Theory highlights the immediate unsafe conditions and behaviours through which system weaknesses may contribute to accidents.

# 3. Methodology

A descriptive survey research design was used to assess existing electrical safety practices without manipulating the study variables. The design was appropriate for describing compliance levels and examining associations among safety guidelines, equipment, training and compliance (Creswell & Creswell, 2014). The study was conducted in selected TVET institutions in Nyeri County, Kenya, offering electrical and related technical programmes.

The target population comprised 520 electrical trainees, 65 electrical trainers and 15 institutional administrators, giving a total population of 600. Stratified sampling was used to ensure representation across the selected institutions and respondent categories. The intended sample was 302 participants, comprising 234 trainees, 56 trainers and 12 administrators. The final quantitative analysis used 290 valid questionnaires, while six administrator interviews and six workshop observation checklists were used for qualitative and observational triangulation.

Three instruments were used. Structured questionnaires measured guideline adequacy, compliance with safety rules, safety equipment and institutional safety training using five-point Likert-scale items. A semi-structured interview guide was used with administrators to obtain information about policies, inspection routines, equipment maintenance, training and institutional constraints. A workshop observation checklist assessed the physical environment, PPE, fire extinguishers, emergency switches, signage, tools, maintenance records and safety practices. The combination of instruments enabled methodological triangulation.

The instruments were reviewed by experts in education, safety management and research methodology for relevance, clarity and coverage. A pilot study was conducted in a TVET institution outside Nyeri County. Reliability was assessed using Cronbach's alpha. The overall 20-item scale had $\alpha = .965$. Subscale coefficients were .871 for guideline adequacy, .881 for compliance with safety rules, .876 for safety equipment and .874 for safety training, indicating high internal consistency.

After obtaining the required institutional and research permissions, questionnaires were administered to trainees and trainers, interviews were conducted with administrators and workshops were inspected using the checklist. Quantitative data were coded and analysed using SPSS Version 28. Frequencies, percentages, means and standard deviations summarized the data. Chi-square analysis tested associations between categorical safety training and compliance levels. Independent-samples t-tests compared trainees and trainers, one-way ANOVA compared programmes, and multiple linear regression examined predictors of compliance. Statistical significance was assessed at $\alpha = .05$. Interview and open-ended responses were coded thematically, and observation findings were used to triangulate the quantitative results.

**Table 1: Target Population Distribution**

| S/no | Name Institution | Electrical Trainees’ | Electrical Trainers | Institutional Administrators | Total |
|---|---|---|---|---|---|
| 1. | Nyeri National Polytechnic | 180 | 20 | 4 | 204 |
| 2. | Mathenge Technical Training Institute | 90 | 12 | 3 | 105 |
| 3. | Mukurwe-ini Technical Training Institute | 80 | 10 | 2 | 92 |
| 4. | Mathira Technical & Vocational College | 65 | 8 | 2 | 75 |
| 5. | Kieni Technical & Vocational College | 55 | 8 | 2 | 65 |
| 6. | Tetu Technical & Vocational College | 50 | 7 | 2 | 59 |
| | **Total** | **520** | **65** | **15** | **600** |

Source: Field Survey, 2026

# 4. Results and Discussion

## 4.1 Response Rate and Respondent Profile

Of the 302 intended questionnaire responses, 290 were valid for analysis, representing a usable response rate of 96.02%. Twelve questionnaire cases were excluded because of incomplete data. Six of the planned administrator interviews were completed, representing 50.0%, while all six workshop observation checklists were completed.

Among trainees, 143 (49.31%) were from Electrical Installation, 85 (29.31%) from Electrical and Electronics

Engineering and 62 (21.38%) from Renewable Energy. Trainees were distributed across Years One to Three. Trainers were represented across different levels of teaching experience, providing perspectives from both relatively new and more experienced staff.

**Table 2 Distribution of Survey Respondents by Category**

| Respondent Category | *n* | % |
|---|---|---|
| Trainees | 234 | 80.7 |
| Trainers | 56 | 19.3 |
| **Total** | **290** | **100.0** |

Source: Field Survey, 2026

### 4.1.1 Descriptive Findings

**Table 3: Overall Means and Standard Deviations across Safety Dimensions**

| Dimension | *M* | *SD* | Level |
|---|---|---|---|
| Guideline adequacy | 3.12 | 0.96 | Moderate |
| Compliance with safety rules | 3.09 | 0.95 | Moderate |
| Safety equipment | 3.14 | 0.95 | Moderate |
| Safety training | 3.11 | 0.94 | Moderate |
| **Overall safety score** | 3.11 | 0.91 | Moderate |

Source: Field Survey, 2026
*Note.* N = 290. Mean scores based on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree).

All four dimensions were within the moderate range. Guideline adequacy had a mean of 3.12, indicating that respondents generally recognized the existence of safety guidelines but also identified weaknesses in accessibility, updating and communication. Compliance with safety rules recorded 3.09, suggesting that safe practices were present but not consistently enforced. Safety equipment recorded the highest mean at 3.14, although qualitative findings indicated that physical availability did not always imply functional readiness. Safety training recorded 3.11, with respondents particularly identifying a need for more practical and repeated drills.

### 4.1.2 Categorized Compliance Levels

**Table 4: Distribution of Overall Electrical Safety Compliance Levels**

| Compliance Category | *f* | % |
|---|---|---|
| Low | 71 | 24.5 |
| Moderate | 150 | 51.7 |
| High | 69 | 23.8 |
| **Total** | **290** | **100.0** |

Source: Field Survey, 2026

Overall, 51.7% of respondents fell in the moderate compliance category, 24.5% in the low category and 23.8% in the high category. The results therefore indicate that electrical safety compliance had not reached a consistently high level across the selected institutions.

### 4.1.3 Inferential Analyses

A chi-square test of association was conducted because both compliance level and safety training category were categorical. The analysis showed a statistically significant association between safety training and compliance, $\chi^2(4, N = 290) = 232.811$, $p < .001$. Cramer's V was .634, indicating a strong association. The cross-tabulation showed that respondents in the low-training category were concentrated in the low-compliance category, while respondents in the high-training category were concentrated in the high-compliance category.

This result indicates that stronger institutional safety training is associated with higher compliance. The finding does not by itself establish causation, but it provides strong empirical evidence that training and compliance are closely related in the study context.

### 4.1.4 Comparison by Respondent Category

Independent-samples t-tests showed no statistically significant difference between trainees and trainers on the overall safety score. Trainees recorded M = 3.104 (SD = .910), while trainers recorded M = 3.148 (SD = .893), with $t(288) = -0.329$, $p = .742$. Similar non-significant patterns were observed for guideline adequacy, rule compliance, safety equipment and safety training. This suggests that the moderate compliance assessment was shared broadly by both respondent groups rather than being confined to trainees or trainers.

### 4.1.5 Comparison Across Programmes

A one-way ANOVA showed no statistically significant difference in overall safety scores across Electrical Installation, Electrical and Electronics Engineering and Renewable Energy programmes, $F(2, 287) = 0.175$, $p = .839$, $\eta^2 = .001$. Mean scores were 3.08, 3.15 and 3.14 respectively. The finding indicates that the compliance challenges are not restricted to a single programme and therefore support institution-wide safety interventions.

### 4.1.6 Predictors of Electrical Safety Compliance

Multiple linear regression was conducted with overall compliance as the dependent variable and guideline adequacy, safety equipment and safety training as predictors. The model was statistically significant, $F(3, 286) = 527.885$, $p < .001$. The model produced $R = .920$, $R^2 = .847$ and adjusted $R^2 = .845$, indicating that the three predictors jointly explained 84.7% of the variance in compliance.

Safety equipment was the strongest predictor ($\beta = .370$), followed by safety training ($\beta = .305$) and guideline adequacy ($\beta = .289$). All three predictors were statistically significant. The results indicate that better compliance is associated with the combined presence of adequate guidelines, functional safety equipment and effective safety training.

**Table 5: Multiple Regression Coefficients for Predictors of Overall Safety Compliance**

| Predictor | *B* | *β* | *t* | *p* |
|---|---|---|---|---|
| Guideline adequacy | .289 | .289 | 5.577 | < .001 |
| Safety equipment | .370 | .370 | 6.967 | < .001 |
| Safety training | .308 | .305 | 5.882 | < .001 |

Source: Field Survey, 2026

*Note.* N = 290. B = unstandardized regression coefficient; β = standardized beta coefficient; t = t-test statistic; p = probability value.

### 4.1.7 Open-Ended Findings

Respondents identified several practical safety challenges. The most frequently reported specific hazards included loose extension cables on walking paths (13.1%), inadequate illumination at circuit assembly workbenches (12.8%), sharing of specialized safety goggles (12.4%), bridging blown glass fuses with unrated copper wire (10.3%), malfunctioning emergency cut-off buttons (9.7%) and inadequately stocked first aid kits (9.3%).

The most frequently recommended improvements were replacement of ageing sockets with certified safety variants (20.7%), visible symbolic safety signs near high-voltage units (20.7%), rearrangement of bench layouts to reduce congestion (16.9%) and routine replenishment of first aid supplies (13.1%).

Training needs were strongly practical: specialized training on safe sizing and insulation testing was requested by 30.3% of respondents, hands-on LOTO simulation by 29.0%, arc-flash fire-response demonstrations by 16.9%, hazard-identification walkthroughs by 13.1%, and electric-shock response and cardiopulmonary rescue drills by 10.7%.

#### 4.1.8 Workshop Observation Findings

The observation checklist showed high visible compliance, with 102 of 108 items marked compliant (94.4%). However, several recurring gaps were identified, including guidelines that were not regularly updated and emergency stop switches that were absent, blocked or non-functional in some institutions. The contrast between the high visible observation score and the moderate questionnaire score suggests that visible compliance and functional or behavioural compliance are not necessarily identical.

#### 4.1.9 Administrator Interview Findings and Triangulation

Administrator interviews identified six recurring themes: outdated or generic safety policies; weak routine inspection systems; equipment serviceability gaps; irregular and mainly verbal safety training; supervision and overcrowding challenges; and budgetary or institutional constraints. These themes helped explain the moderate questionnaire results. Safety documents could exist without being customized to electrical workshops, equipment could be physically present without being fully serviceable, and trainers could face difficulties providing close supervision in crowded practical sessions.

The convergence of questionnaire, observation and interview findings demonstrates the value of triangulation. The quantitative data showed moderate compliance, the observation data showed strong visible safety features, and the qualitative data identified latent operational weaknesses. Together, these sources suggest that the main challenge is not simply the absence of safety structures, but the consistency, accessibility, functionality and enforcement of those structures.

## 4.2 Discussion of Findings

#### 4.2.1 Guideline Adequacy and Administrative Integration

The moderate guideline score (M = 3.12) shows that while formal safety rules exist across the workshops, they rarely translate into clear, everyday practice. This reflects a common challenge in vocational education where safety policies remain filed away as administrative documents rather than serving as active operational guides (Babalola et al., 2021; Simiyu, 2020). As Hughes and Ferrett (2020) observed, rules often become passive 'dead documents' meant for accreditation audits rather than practical tools posted at the workstation.

Interview responses highlighted that safety guidelines were mostly generic documents stored in main offices. This matches findings by Wachter and Yorio (2014), who showed that safety management fails when written procedures do not match daily workshop tasks. In technical training, practical safety standards like the IET Wiring Regulations (BS 7671) and Kenya's Occupational Safety and Health Act (OSHA, 2007) must be visibly integrated directly into the work environment.

Looking at this through Systems Theory (Checkland, 1999), guidelines form just one piece of the safety system. Written policies only work when they connect directly with equipment maintenance, practical instruction, and active supervision. When safety rules are invisible or unclear at the workbench, students and trainers cannot rely on them to guide real-time technical decisions (Reason, 2016).

#### 4.2.2 Overall Electrical Safety Compliance Levels

With an overall mean compliance score of 3.11 and 51.7% of participants scoring in the moderate range, safety practices across the workshops are inconsistent. This indicates that while safety rules are understood, they are not applied reliably enough to build a resilient safety culture (Fullerton et al., 2022).

Importantly, the data showed no statistically significant difference in compliance between trainees and trainers ($t = 0.412$, $p = .681$). This shows that safety gaps are not caused by individual carelessness among students, but by systemic challenges within the institutions. As Okello (2021) and Zohar (2010) pointed out, overall safety climate depends far more on leadership, resource supply, and institutional oversight than on individual blame. Solutions must therefore focus on improving workshop infrastructure and administrative support.

Participant feedback also revealed how physical working conditions drive risky behavior. Missing protective gear, poor lighting, cramped work areas, and faulty emergency switches force trainees to take shortcuts just to complete their tasks (Geller, 2018). Heinrich's (1931) Domino Theory helps explain this dynamic: when an institution permits unsafe physical conditions, it creates an environment where human error easily turns into severe workplace accidents.

#### 4.2.3 Availability and Condition of Safety Equipment

Safety equipment recorded the highest average score (M = 3.14) and emerged as the strongest predictor of overall compliance ($\beta = .370$, $p < .001$). This proves that having functional, accessible equipment is the single most critical factor in encouraging safe work habits, directly supporting Behavior-Based Safety principles (Choudhry & Fang, 2008).

In practice, students cannot follow safety rules if basic protective equipment is damaged, missing, or ill-fitting (Kemei et al., 2022). Likewise, emergency preparedness breaks down when crucial devices such as Earth Leakage Circuit Breakers (ELCBs), emergency stop buttons, and fire extinguishers are unserviced or faulty (Ogunyemi & Alamu, 2019).

Workshop observations and interviews made it clear that institutions must distinguish between simply owning safety gear and keeping it functionally ready. This supports findings by Kanchana et al. (2015), who stressed that equipment inventories are useless without continuous maintenance, regular inspection dates, and functional testing.

#### 4.2.4 Influence of Safety Training on Compliance

Safety training had a moderate mean of 3.11 and showed a strong, significant link to compliance ($\chi^2 = 232.811$, $p < .001$; Cramer's $V = .634$). This confirms what vocational research consistently shows: hands-on, practical safety instruction directly builds safe habits (Vinodkumar & Bhasi, 2010; Burke et al., 2006).

Rather than generic safety lectures, participants explicitly requested hands-on training tailored to real electrical hazards such as Insulation resistance and continuity testing, Lockout/Tagout (LOTO) isolation procedures, Arc-flash safety and boundary awareness, Hazard identification and risk assessment (HIRA), Electric-shock rescue and CPR response

This emphasis on practical skill over theoretical lectures aligns with Bandura's (1986) Social Cognitive Theory, which shows that confidence and behavioral mastery develop through direct practice and guided feedback. From an instructional perspective, safety should not be taught as a standalone orientation lecture. Instead, it must be embedded directly into everyday technical practical sessions (Nwanoruo et al., 2020). Repeated demonstrations and continuous assessment help trainees turn safe practices into natural routines.

#### 4.2.5 Integrated Regression Model and Systems Analysis

The regression model accounted for 84.7% of the total variance in compliance ($R^2 = .847$, $F(3, 286) = 527.14$, $p < .001$), demonstrating that guidelines, equipment, and training work together as a single system. This outcome validates a core premise of Systems Theory: electrical safety is created through the combined interaction of hardware, policy, and human skill (Reason, 2000; Rasmussen, 1997).

Isolated safety efforts are rarely effective. Purchasing PPE without practical training, drafting policies without displaying SOPs at workbenches, or running one-time inductions without follow-up drills leaves major safety gaps open (Aneziris et al., 2017). Because equipment availability had the highest influence ($\beta = .370$), followed by training ($\beta = .305$) and guidelines ($\beta = .289$), institutions should prioritize functional safety tools while simultaneously reinforcing hands-on instruction.

#### 4.2.6 The Compliance Gap: Visible Indicators vs. Workshop Practices

A key insight came from comparing high visible observation compliance (94.4%) with moderate questionnaire scores ($M = 3.11$). This gap points to a common challenge known as 'surface compliance' (Dekker, 2014; Hopkins, 2011).

Institutions often score high on visible surface checks like hanging fire extinguishers or placing safety signs because these items are easy to show during external audits. However, daily behavioral practices like routine insulation testing, active LOTO protocol execution, and systematic hazard reporting remain far less consistent.

Systems Theory explains that visible outputs do not guarantee functional reliability across the whole organization (Skyttner, 2005). Furthermore, Heinrich's (1931) theory illustrates how unseen hazards (such as ungrounded machinery or worn cable insulation) combine with daily routines to trigger unexpected accidents. Bridging this gap requires proactive safety management built around regular equipment servicing, clear workstation instructions, practical risk assessments, and steady supervisory support.

## 5. Conclusions and Recommendations

### 5.1 Conclusions

The study concludes that electrical safety compliance in the selected TVET institutions in Nyeri County is moderate. Although institutional safety guidelines, equipment and training programmes exist, their implementation is not sufficiently consistent, accessible, functional or practical to produce uniformly high compliance. Guideline adequacy, safety equipment and safety training were all significant predictors of compliance and jointly explained 84.7% of its variance.

Safety equipment emerged as the strongest predictor, indicating the importance of a physical environment that supports safe behaviour. Safety training was strongly associated with compliance, emphasizing the need for continuous practical drills rather than one-time orientation. The lack of significant differences between trainees and trainers and across programmes further suggests that the identified gaps are institutional and system-wide rather than restricted to a particular respondent category.

Overall, the evidence indicates that improving electrical safety in TVET institutions requires an integrated approach in which workshop-specific rules, functional equipment, continuous practical training, inspection, supervision and management support operate together.

### 5.2 Recommendations

1. TVET institutions should develop, regularly update and visibly display workshop-specific electrical safety guidelines covering PPE, live

testing, isolation, LOTO, fire response, first aid, modern electrical tools, solar PV systems and emergency reporting.

2. Institutions should establish routine inspection and maintenance schedules for PPE, fire extinguishers, emergency stop switches, ELCBs, grounding systems, first aid kits, sockets and electrical tools, with records maintained for accountability.
3. Safety training should be practical and continuous. Institutions should conduct regular demonstrations and drills on insulation testing, LOTO, hazard identification, arc-flash response, electric-shock rescue, CPR and emergency shutdown.
4. Safety competence should be integrated into practical CBET assessment, and trainees should demonstrate required safety procedures before undertaking high-risk practical tasks.
5. Workshop supervision should be strengthened by reducing overcrowding during high-risk practicals, improving bench layout and ensuring trainers have adequate time and authority to enforce safety procedures.
6. TVET managers should institute internal daily or weekly safety inspections and periodic comprehensive audits, with corrective action plans for identified gaps.
7. TVETA, the Ministry of Education and institutional management should support safety improvement through adequate budgeting, technical guidance, monitoring and enforcement of practical electrical workshop safety standards.

## 5.3 Limitations and Areas for Further Research

The study was limited to selected TVET institutions in Nyeri County, which may constrain generalization to other counties. The cross-sectional design permits assessment of associations but does not establish causal relationships. Questionnaire data may also be affected by self-report bias, although interviews and observations were used to strengthen the evidence through triangulation.

Future studies should examine electrical safety compliance across multiple counties and include direct accident, near-miss and incident records as outcome measures. Longitudinal or quasi-experimental studies could evaluate the effect of specific interventions such as LOTO training, emergency-response drills or equipment-maintenance programmes. Further research should also examine the relationship between safety compliance and practical skills performance among electrical trainees, as well as the budgeting and financing of safety systems in TVET institutions.

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