The Text Emphasises the Importance of Implementing Safety Measures and Effectively Managing Risks in Electronic and Electrical Laboratories to Prevent Accidents

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ABSTRACT
The study examines the consequences of accidents in electrical and electronics engineering laboratories at eight polytechnics in Nigeria from September 2022 to January 2023. The research, conducted by students and departmental staff, uses a survey-based method combining qualitative and quantitative tools. Data is collected through questionnaires and analysed using descriptive statistics. The outcome of the investigation revealed that the mean responses and standard deviations of respondents on approaches for controlling measures to be adopted in laboratories to minimise accident occurrences and guarantee learners to comply with safety regulations and legislation. All of the controlled measures required approval by the participants, according to the mean findings.

Key Words*: lab accidents, safety measures, managing risks, polytechnic electrical and electronics Engineering*

INTRODUCTION

1.0 The Study's Background

Polytechnic education is a blended learning process that integrates technology and science with practical training preparing individuals for jobs and higher education. It focuses on applied sciences engineering and industrial arts preparing adults for the workforce and laying the groundwork for technology-related higher education. (Umar F.K. 2017).
A laboratory is a type of study environment that supports conducting experiments practice and peer observation in order to produce goods that are used by organisations and businesses.
Laboratory experiments are essential in electrical learning because they teach students skills like observation classification measurement communication interpretation and conclusion-

making. They improve the classroom experience foster cognitive abilities and guide curriculum creation. Laboratory work can help students develop academic and social skills by teaching them to value different points of view convey ideas and collaborate. (Gunawan G. 2017).

Engineering laboratory skills include sampling testing measuring documenting and analysing data as you study electronics measurement and instrumentation power and machines electrical repair and maintenance and electrical installation. These abilities are used in enterprises government agencies and educational institutions and are critical to the advancement of modern scientific and technical advancements. Technicians' laboratory abilities help teachers' lecturers and engineering students. (Umar F.K. 2017).

The engineers must be able to deal with unpredictability unresolved information contradictory objectives institutional and technological advances business realities and regulatory implication.

The programme created to educate the learner to enter the workforce with a grasp of the rules of science and technology as they relate to the creation and building of modern technology is considered technical education by the common working definition. It places a focus on the engineering parts of mechanics learning including electrical and electronic mechanical and automotive trades. It does after all call upon a comprehension of and use of the fundamental ideas in maths and science (Pritchard A. 2017).

Technical colleges and polytechnics are educational institutions aimed at producing the manpower for a country's economic growth and development. Yekinni in Abdulrauf (2012) viewed polytechnic as an institution where specific knowledge and practical skills are required for specific causes employment or professional practice. It is to produce craftsmen technicians' technologists' scientists or similar levels in business are imparted or taught. Polytechnic aims to provide functional skills to technician's technologists and also provide engineering skills knowledge and attitudes which individuals need to gain entry to and progress in their selected occupation.

Prospective operations like academic study practical investigations and measurement tasks frequently call for the use of reactive materials prone procedures and complex equipment configurations. Depending on the situation laboratory personnel and facilities may be exposed to a variety of risk factors including electrical and electronic ergonomic physical chemical biological and radiological dangers (Hallman M.G. and McCullough M.A. 2022).

Accidents are anxiety driven sudden and unexpected events or situations without forewarning that can result in loss of materials injury and even death. According to Yekinni at Tuuli (2016) it is the result of a series of unfortunate circumstances. Electrical accidents according to Tuuli are incidents involving electrical installations that could cause burns electrical shock from a source in excess of electronics and electrical labs personnel action or equipment malfunction. There are various types of electronics and electrical labs and workshops. general laboratory accidents.

Thus due to the occurrence of accidents in institutional laboratories a series of preventive measures were prescribed by experts technicians technologists engineers and researchers to be implemented the prescriptions range from taking necessary precautions while working in the laboratories and workshops keeping laboratories and workshops safe working with healthy machines and using appropriate safety equipment while working with machines among others.

1.1 Problem of the study

This study aims to emphasise the importance of implementing safety measures and effectively managing risks in electronic and electrical laboratories to prevent accidents in Nigeria's north-east polytechnics, increase student enrolment, and support technological and economic growth. It emphasises the need for staff and students to be aware of potential hazards and take necessary precautions.

1.2 Study aim's and purposes

The purpose of the study is to determine and emphasise the importance of implementing safety measures and effectively managing risks in electronic and electrical laboratories to prevent accidents at the Polytechnic of Nigeria. Specifically, the study seeks to find out the consequences of accidents that frequently occur in electronics and electrical engineering laboratories.

1.3 Study Questions

The study question is to find out what emphasises the importance of implementing safety measures and effectively managing risks in electronic and electrical laboratories to prevent accidents.

1.4 Significance of the study

The study aims to educate staff and students on accidents in electronics and electrical engineering labs in Nigerian polytechnics a region with high accidents incidences worldwide.

1.5 Scope of the study

This study examines common accidents in Nigerian polytechnics' electronics and electrical engineering laboratories focusing on the implication of these accidents.

LITERATURE REVIEW

2.0 Introduction

This chapter provides a comprehensive understanding of the subject through a comprehensive cognitive explanation theoretical context and research review.

2.1 Intellectual Clarification

The study highlights the need for a safety culture in communities particularly among electricity-related employees construction workers and schoolchildren to decrease accidents.

Yekinni (2016) reported about the management of electrical and electronics engineering workshop accidents in technical colleges in Oyo and Ogun states Nigeria.

The population for the study was sixty-six (66) comprised of forty-two (42) electrical and electronics teachers from polytechnics in Ogun State and twenty-four (24) electrical and electronics teachers from technical colleges in Oyo State.

The findings of the study revealed that: nine accidents do occur at least once in a month in electrical and electronics workshops; accidents in electrical and electronics engineering workshops are caused by failure to de-energise or isolate the electrical energy source prior to maintenance activities; accidents in school workshops can result in a reduction in students' enrolment.

The findings of the study revealed that electrical and electronics workshop accidents can be managed by providing well-stocked first aid boxes to the workshop and giving adequate training to teachers and workshop attendants on the method of administering them.

2.3 Implications of accidents

Cargo activities on tanker vessels provide serious risks to the marine environment and crew including the possibility of fires and explosions. Explosions can be caused by electric arcs flammable materials static electricity and risky procedures. Explosions caused by static electricity and fire mishaps rank highest in a bow-tie construction. Hazardous practises including intentional human error combustible environments operational and technical breakdowns and unsafe practises are examples of intermediate occurrences. (Elidolu G. 2022)

Hybrid method risks assessments look at the connection operability and storage of EES systems. According to the results synthetic oil has the highest accident implication whereas cryogenic liquid systems have the fewest. The functioning of a safer EES system is hampered by harsh working circumstances intricate heat exchanger networks and intermittency. (Qi M. 2021)

2.4 Electrical Accidents

Inadequate wiring in electrical systems can cause accidents resulting in considerable monetary damage. Technicians must take safety procedures perform regular maintenance and be aware of threats to avoid burns and eye infections.

The results from investigating the causes of electrical accidents emphasised the necessity of developing a culture of safety in communities especially among employees who are engaged in occupations related to electricity construction workers and schoolchildren to reduce the rate of such accidents.

Yekinni (2016) reported about the management of electrical and electronics engineering workshop accidents in technical colleges in Oyo and Ogun states Nigeria.

The population for the study was sixty-six (66) comprised of forty-two (42) electrical and electronics teachers from polytechnics in Ogun State and twenty-four (24) electrical and electronics teachers from technical colleges in Oyo State.

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maintenance activities; accidents in school workshops can result in a reduction in students' enrolment.

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2.5 Virtual Laboratory Enhances Students' Problem-Solving Skills.

The study shows that students' ability to solve problems related to electricity concepts is improved via virtual labs. Compared to the control group the experimental group was better at planning and executing solutions and they also demonstrated superior problem-solving skills. Overall the problem-solving skills of the two classes were comparable.

2.6 Standards for Electrical-Laboratory Interface Risk Management

Guidelines for Risk Management of Electrical-Laboratory Interfaces Standards for lowering risks at medical device electrical-laboratory interfaces include ISO 14971 and ISO 13485. All manufacturers and suppliers are subject to ISO 13485:2003, but ISO 9001:2008 creates a hierarchy. Additional standards include EN 45502-1, IEC 62304, and IEC 60601-1. Industry-specific recommendations are available from the US Food and Drug Administration for 21 CFR 820, Subchapter H—Medical Devices. (Jawd, S.M., 2023)

2.7 Preventing electrical hazards in work environments

To reduce electrical dangers in the workplace, extension cables and wires must be periodically inspected, outside sheaths must be securely fastened, and cable connections and couplers must be installed correctly. Power outages, regular expert installation and maintenance, and designated switch locations for stationary equipment are also crucial. Connecting wires in double-insulated mobile equipment, using specialist equipment in areas where explosive ingredients are present, and avoiding high electrical loads are also crucial. (F.R. Spellman and R.M. Bieber, 2011)

2.8 The measures to minimize electrical hazards in laboratory equipment.

The following actions should be taken to prevent electrical dangers in laboratory equipment:
i. To secure circuits near water sources, use ground circuit breakers; make sure lamps have enough electricity; turn off appliances when not in use; keep kids away from appliances; avoid plugging in too many devices at once; disconnect unused appliances; check the integrity of the heater; and ensure efficiency.

ii. Because they can start fires, stay away from using electric heaters that emit light. Water heaters should be used as light-producing heaters since temperatures above 600°C may ignite flammable objects. (S.M. Jwad and M.A.H. Shallal, 2021).

2.9 Laboratory-Electrical Equipment Maintenance

In order to prevent mistakes brought on by a range of hazards, including high voltages, pressures, temperatures, corrosive chemicals, smells, radiation, fire, explosions, and biological dangers, maintaining laboratory electrical equipment demands intense attention to detail and ongoing awareness. Safety education, policy approval, experimental design inspections, the use of personal protection equipment, and buddy systems are some of the strategies used to prevent accidents. Health and safety regulations oversee laboratory operations, and routine inspections help spot damaged wires and guard against electrical burns and short circuits. (N.M. Aljamali, 2021)

2.10 Engineering Device Failure Prevention

Electrical appliances like electricity distribution centres and temporary lighting could be dangerous. Electrocution could occur from improper grounding or using the wrong tools. Steer clear of connecting cables near entrances or in crowded areas. To reduce the risk of an unexpected failure, have more sockets installed by experts, make sure the devices have been approved by local testers, and turn off the equipment when not in use. (J. Dawson and R. Thomson, 2018)

Dawson, J. and Thomson, R., 2018. The future cybersecurity workforce: Going beyond technical skills for successful cyber performance. *Frontiers in psychology*, *9*, p.744.

2.11 Management of electrical/electronic workshop accident

The goal of the project was to enhance how Nigerian technical institutes handled electrical and electronic workshop mishaps. Using 66 instructors from the states of Oyo and Ogun, a descriptive survey methodology was used. The results show that nine accidents occur each month, which reduces the number of students enrolled. Well-stocked first-aid kits and appropriate training for instructors and attendants were recommended as solutions to these accidents. In order to effectively oversee student activities, it was also recommended that technicians or workshop participants be hired and kept up-to-date. (Y.S. Afeez, 2016).

Electrical and electronics workshop accident prevention methodology

In Nigerian technical colleges, the study aimed to determine the methodological needs for electrical and electronic workshop accident prevention. Using 66 instructors from the states of Ogun and Oyo, a descriptive survey methodology was used. The results show that de-energised or isolated electrical energy sources and protective glass covering hazardous electric cables can prevent accidents in workshops. In order to ensure adequate monitoring, the study also recommended that technicians or workshop participants be updated and recruited. (Y.S. Afeez, 2023)

METHODS

3.1 Introduction

This chapter discusses a study on preventing mishaps in Nigerian technical colleges' electrical and electronics workshops using a descriptive survey methodology. Results suggest using protective glass, de-energized energy sources, and recruiting technicians for proper monitoring to prevent accidents. (Toyin L.B. 2017)

3.2 Study Planning

The study uses a descriptive survey research methodology to gather data on the current state of electrical and electronics engineering lab accidents in Nigerian technical schools. Utilized by Nwankwo I.N. (2020).

3.3 Study Populations

The study investigates common characteristics in eight Nigerian polytechnics' electrical and electronics engineering laboratories, including academic personnel and students, to draw conclusions. (A.D. Sherbinin 2007

3.4 Study Population Size

The study examines common characteristics in eight Nigerian polytechnics' electrical and electronics engineering laboratories, including academic personnel and students. The research sample includes all employees. The NBTE recommends more HND lecturers and teaching personnel for diverse streams. In 2023, around 1200 people and students will be in the ND and HND departments.

3.5 The study area

Study Area Overview

i. Geographical location of study: Northeast Nigeria, including Adamawa, Bauchi, Borno, Gombe, Taraba, and Yobe states.
ii. Area spans 272451 km2.
iii. Research based on eight Nigerian polytechnics' electrical and electronics engineering laboratories.
iv. Location: N 9° 4' 55.1964" E 8° 40' 30.9972"

3. 6 Sampling procedures

A representative selection of electrical engineering professionals and students from the research area

3.7 Data Assembly

The study utilized a questionnaire to demonstrate a systematic data collection process from all electrical engineering departments at Northeast Polytechnics, supporting research aims and incident assessment. L. Vaughan (2001)

3.8 Evaluation

Descriptive statistics are a statistical approach that researchers use to assess and analyse data in order to generate pertinent findings trustworthy conclusions and assistance for making decisions.

3.8.1 Simplicity

There is a broad range of statistical competency levels accessible for easily understood descriptive statistics. They provide a brief summary of the information without necessitating complex presumptions. L. Vaughan (2001)

3.8.2 Information Study

When looking at figures for the first time they are really beneficial. By employing descriptive statistical approaches researchers can rapidly understand the dataset's central tendencies (such as mean median and standard deviation) and variance (such as standard deviation) before moving on to more sophisticated studies. (2010) Zuur A.F. Ieno E.N. and Elphick C.S.

3.8.3 Facts Study

Through the identification of outliers data inconsistencies and other issues within a dataset summary information enables quality control and data cleansing.

Ilyas I.F. and Chu X. (2019).

3.8.4 **Information Presentation**

By transforming survey data into percentages descriptive statistics efficiently summarise and present data to both technical and non-technical audiences using graphic representations such histograms box plots and bar charts. (Hardy I. Clutterbuck J. and Creagh S. 2023).

RESULTS AND DISCUSSIONS

4.1 Introduction

This chapter contains the results and discussion of the findings.

4.2 Results

120 assessments were returned from 150 allocated, including 60 staff, 54 students, and 6 others. Inductive and descriptive statistics were used for conclusions, aligning with the investigation's objectives.

Q3. What are the necessary techniques for managing accidents in electronics and electrical engineering laboratories?

Table 1: implication of accidents that frequently occur in electrical engineering laboratories

The techniques for controlling accidents	electronics engineering laboratories								Mean		Remark
	$\bar{X}1$	$\bar{X}2$	$\bar{X}3$	$\bar{X}4$	$\bar{X}5$	$\bar{X}6$	$\bar{X}7$	$\bar{X}8$	$\bar{X}$	σ	
Thorough auditing of all accidents	2.00,	2.50,	2.00,	3.00,	2.50,	2.00,	2.90,	2.80,	2.48	0.38	Agree
The person is in charge of taking care of any diseases or injuries they have incurred at work.	3.00,	2.90,	3.00,	3.00,	2.70,	2.80,	2.50,	3.00,	2.83	0.19	Agree
Having fully-equipped first-aid kits	2.00,	2.50,	3.00,	2.00,	2.50,	2.50,	2.50,	2.50,	2.47	0.31	Agree
The allocation of resources should be made to the appropriate labs for implementation.	3.00,	2.50,	3.00,	3.00,	2.50,	2.50,	2.50,	2.50,	2.68	0.24	Agree
Correct reporting of any incidents	3.00,	2.00,	2.00,	2.50,	2.50,	2.00,	2.50,	3.00,	2.46	0.38	Agree
Guidelines for carrying out regular inspections in the labs	3.00,	2.90,	3.00,	3.00,	3.00,	2.80,	2.50,	3.00,	2.91	0.15	Agree
Conducting an accurate investigation to prevent future incidents	3.00,	2.80,	2.50,	2.70,	2.40,	2.60,	2.30,	3.50	2.70	0.35	Agree
Specialists in health care have received	3.00,	3.00,	3.00,	3.00,	3.00,	2.00,	3.50,	3.00,	2.97	0.38	Agree

health and safety training.											
Staff and student are given first aid training and policies.	2.80,	2.60,	2.50,	2.50,	2.10,	2.20,	2.20,	3.20,	2.47	0.30	Agree
Applying accident guidelines and safeguarding labs prevents	2.30	1.20	2.40	3.10	1.50	2.70	3.80	3.00	2.56	0.79	Agree
The training initiatives in labs are being implemented.	3.00,	3.50,	3.00,	3.00,	3.00,	3.00,	3.50,	3.00,	3.14	0.22	Agree
Avoid oily areas that are moist or wet.	2.30	1.20	2.40	3.10	1.50	2.70	3.80	3.00	2.56	0.79	Agree
Use the proper connection.	3.00,	2.00,	2.00,	2.50,	2.50,	2.00,	2.50,	3.00,	2.46	0.38	Agree
Use and maintain tools regularly	2.50,	2.50,	2.50,	2.50,	3.00,	2.00,	2.50,	3.00,	2.47	0.31	Agree
Wearing overalls, hand gloves, safety boots, etc	3.00,	2.00,	2.00,	2.50,	2.50,	2.00,	2.50,	3.00,	2.46	0.38	Agree
All									39.62	5.92	Agree

Table 3:00 shows the mean responses and standard deviations of respondents on approaches for controlling measures to be adopted in laboratories to minimise accident occurrences and guarantee learners to comply with safety regulations and legislation. All of the controlled measures required approval by the participants, according to the mean findings.

Researcher fieldwork-2023 the implication of accidents that frequently occur

Keys: X=Mean σ= Standard Deviation

Respondents agreed on all implications of electrical accidents, except for institutional closure, staff termination, student ratings, suspension, injury, withdrawal, reputation loss, and potential legal action.

4.3 Analysis and Findings

The study investigated accident exercises in Nigeria's polytechnic electrical engineering laboratories, revealing that students and staff did not strictly adhere to safety management procedures, despite increased awareness of accidents at home and in the lab. Monthly accidents

in Nigeria's technical institutes reduce enrolment, requiring well-stocked first-aid kits, appropriate teacher training, and current technologies to prevent tragedies.

Accidents in Electronic and Electrical Labs in Nigeria

i. Negative Impacts of Accidents in Vocational/Technical Education
ii. Job loss, student dropout, property damage, costly investigations, and student expulsions.
iii. Nichols' 2005 report confirms 24000 US vocational/technical students experience accidents annually.
iv. Osang Obi and Ewona (2013) argue excessive lab deaths due to research.
v. Monthly accidents in northeast Nigerian polytechnics, with 13 implications per polytechnic.

4.3 Discussion of Findings

The discussion of the findings of this research

4.3.1 Accidents' Implication

Accidents in electronic and electrical labs can result in job losses, student dropout rates, damage to property, harm to the polytechnic's image, costly investigations, expulsions, lower attendance, illness, and behavioral changes.

i. US Vocational/Technical Students' Accidents
ii. Nichols' 2005 report: 24000 US students experience accidents causing property damage and loss of education.
iii. Osang Obi and Ewona (2013): Over 24000 deaths in workshops/laboratories due to research.

4.3.2 Summary of Findings

Northeast Nigerian polytechnic institutions experience monthly accidents in electronics and electrical labs, with four incidents per semester, and 13 penalties for each incident.

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter consist of recommendations and conclusions of the research.

5.2 Conclusions

Accidents in Nigerian electronic and electrical labs can lead to job loss, student dropout rates, property damage, and damage to polytechnics' image. To prevent these, attentiveness, safety equipment, and proper training are crucial.

5. 3 Recommendations

The study's findings suggest a comprehensive approach to handling employee mishaps and damage.

i. Worker Safety Measures:
ii. Handling worker dangers and accidents
iii. Availability of lab space
iv. Annual surveillance for disease detection and work-related accidents
v. Comprehensive healthcare professional training

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