SAFETY SKILLS REQUIRED BY TECHNICAL COLLEGE ELECTRICAL INSTALLATION STUDENTS IN HANDLING EQUIPMENT IN PLATEAU AND KADUNA STATES

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DEPARTMENT OF VOCATIONAL TEACHER EDUCATION

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MAY, 2015

APPROVAL PAGE

Safety Skills Required By Technical College Electrical Installation Students in Handling Equipment in Plateau and Kaduna States.

This Project has been approved for the Degree of Masters in Industrial Technical Education by the Department of Vocational Teacher Education, University of Nigeria, Nsukka.

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Dung, Choji Joseph a Post-graduate Student of the Department of Vocational Teacher Education, Faculty of Education, University of Nigeria, Nsukka with the registration number PG/M.Ed/12/61400 has successfully completed the requirements for the course and research work for the master degree in Industrial Technical Education as embodied in this project. This study is original and has not been submitted in part or in full for any diploma or degree of this or any other university.

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DEDICATION

This research work is humbly dedicated to God Almighty, most merciful creator for his perfect control of all that was involve from the beginning to the last stage of this work.

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I wish to express my profound gratitude to God Almighty who has blessed me and brought me thus far. I sincerely appreciate my supervisor, Prof. E.O. Ede whose guidance assistance and encouragement led to the success of this work. I also wish to thank my readers Dr. E.A. Anaele, Dr. (Mrs.) E.O. Ajala, and Dr. N. Ugwuoke for their suggestions during and after proposal which contributed immensely towards improving the quality of this work.

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ABSTRACT

The study sought to determine the safety skills required by technical college electrical installation students in handling equipment. The study was carried out in Plateau and Kaduna States. A survey research design was employed for the study. The population for the study was 80 comprising of 39 electrical installation teachers and 41 electrical installation workers in the field. The entire population was used for the study. A structured questionnaire item was used for collecting data from the respondent. Four research questions were developed to guide the study and four null hypotheses were formulated and tested at 0.05 level of significance. Mean and standard deviation were used to analyze the data for answering research questions while t-test for independent samples was used to test the null hypothesis of no significant difference at 0.05 level of significance. It was found out that all the safety skills identified in handling hand tools, operating machine tools, workshop safety and the personal protective equipment are required by electrical installation students in technical colleges for effective functioning in the workshop. It was recommended that all the safety skills identified should be integrated into the curriculum of electrical installation trade at technical college level.

CHAPTER I

INTRODUCTION

Background of the Study

Occupational safety is of paramount concern to both workers and students. Students and even parents are much more interested in the level of safety provided in a particular occupation. Graduates who possess required safety skills would always fair better in an occupation, especially technical occupations. The knowledge of safety practice skills by electrical installation students in technical colleges is an essential prerequisite for effective use of tools and machines in the workshop. Skilled electrical worker is not just someone who can perform any electrical job correctly but a worker who can complete every job safely (Oranu, Nwoke and Ogwo 2002). Safety has become a major determinant for effective and successful performance in a job.

In the view of Olaitan, Nwachukwu, Igbo, Onyeamaechi and Ekon (1999), safety is the art of taking precaution for the avoidance or reduction of accidents in order to protect people and property. Oranu, Nkowe and Ogwo (2002) further view safety as the ability to perform every simple task involved in a job without causing damage to tools, equipment or materials used in performing the task. Safety practice is the ability to perform a task with necessary precautionary measures exhibited for the purpose of preventing accidents. Practice means doing something repeatedly in order to improve performance. For students to perform a task with little or no record of accidents in electrical workshop, certain related skills are required by them.

However, Okorie (2000) defined skill as a manual dexterity through repetitive performance of an operation. Skill is a well-established habit of doing something and it involves the acquisition of performance capabilities (Osinem 2008). This implies that skill involves well-established habit of doing things. In this study, skill is the

ability of electrical installation students in Technical colleges to establish good habit performance in the workshop by acting, thinking, and behaving well in order to prevent minor and major accidents that is involving in any operation or job that is related to electrical installation and maintenance work.

Electrical installation is one of the trades in technical colleges. It is made up of the following components, domestic and industrial installation; cable joining; battery charging and repairs and winding of electrical machines (NBTE, 2014). In the view of Nwachukwu, Bakare and Jika (2011), electrical installation trade is a vocational course offered by students in technical colleges in order to produce electrical craftsmen and technicians. Electrical installation student is a person who is taking vocational course offered in technical colleges in order to become electrical craftsman. Nwachukwu (2006), opined that electrical installation students learn the basic skills required to operate, maintain, install and repair electrical installation equipment and appliances in technical colleges.

Technical Colleges according to Okoro (2009), are principal vocational institutions in Nigeria which are designed to prepare the individuals to acquire practical skills, knowledge and attitude at sub-professional level, they are also established to train craftsmen in various occupations. Okorie (2001) also saw Technical College as institutions where craftsmen are trained up to obtain the craft certificate of West African Examination Council and advanced craft certificate. Students who have completed the first three years of secondary school education are eligible for admission into Technical Colleges. Technical Colleges are therefore, schools or training institutions where trades are being taught. It is imperative for technical colleges to take into cognizance the safety skills necessary in handling electrical equipment by students to achieve the set objectives of the program.

However in this study, technical college is formal place of learning where theory and practical skills are learned by students from the teacher and instructor who give the instruction.

A teacher is a person who had acquired knowledge and had undergone formal training that equipped him/her with required pedagogy for effective transmission of knowledge to the students, Federal Republic of Nigeria (FRN, 2002), defined a teacher as a person who had undergone approved professional training in education at the appropriate level and who is capable of imparting knowledge, attitude and skills to the learner. In the context of this study, teacher is a person who is well trained with the required knowledge, skills and pedagogy needed to teach in technical college as a technical teacher. Technical teacher is an individual who had acquired scientific and technological knowledge and skills through formal training on how to impart knowledge to the students. Technical teacher, according to FRN (2004) and Teachers Registration Council of Nigeria (TRCN, 2002) is a person who is trained in science, industrial technology and pedagogy for imparting knowledge, technical skills and attitudes to the learners. TRCN further explained that qualified technical teachers who are to teach in Nigeria technical colleges must possess a Bachelorôs degree in Industrial Technology Education B.ED (Tech). Ogbaunya and Osoro (2009) stated that technical teachers are those who obtained technical training/theories and practice of education that are related to the advancement of knowledge, skills and attitudes among youths, who will later use the knowledge and skills acquired to improve and solve environmental problems. Technical teacher in this study refers to a person who possesses the knowledge, skills and attitudes needed to teach electrical subjects to the students.

According to Hornby (2000), an electrical installation worker is a person who is highly skilled in repair and installation electrical devices. Therefore, electrical installation worker in this study is a person who is highly skilled in repairing, installing and maintaining electrical devices to meet the changing taste or need of the society. Electrical installation worker must possess at least a minimum of National Technical Certificate (NTC) or its equivalent. Electrical installation worker must possess sound knowledge on safety skills for economic gain in any organization, school or industry through the use of equipment, tools as well as machines.

In the view of Simpson (2001), equipment is physical item or tool that can be used to achieve a goal especially if the item is not consumable in the process. Electrical equipment is set of tools and machines used in electrical work. Nwachukwu (2006) described tools as all portable and handy instruments or mechanical devices useful for performing special operations. A tool is a piece of equipment which is used with hands to make or repair something. This can be hand tool or machine tool.

Hand tool is any tool or implement designed for manual operation. Also, it is a tool operated with hand without electricity or other source of power. Chao and Henshaw (2002), opined that hand tools are used manually. They further stated that, hand tools include anything from axes to wrenches. The greatest hazards posed by hand tools result from misuse and improper maintenance. Olaitan, Nwachukwu, Igbo, Onyemachi, and Ekong (1999) viewed hand tools as instruments or devices that can be handled easily while carrying out special operation as well as instructional and learning activities. Therefore, hand tools in this study refer to instruments or devices used to carry out electrical operations manually in the absence of machine tools.

A machine tool is a device consisting of fixed and moving parts that modifies mechanical energy and transmits it in a more useful form (Olusegun, 2003). Machine

in the view of Mukta (2007) is an apparatus with moving parts for converting mechanical into electrical energy or vice versa such as generator or motor, acting either on electromagnetic or electrostatic principles, but not including stationary apparatus such as transformers. Machines are therefore, mechanical or electrical devices for vocational technical operations. Operating simply means to control the way a system or device works. In this study machine tool operation simply means the activities carried out on a machine to do a work in the workshop.

Work is any mental or physical activity directed towards the achievement of a goal (Okoro, 2006). Working in electrical workshop involves all the activities carried out in the workshop in order to achieve learning outcome or set objective of the program. Kadiri (2006) suggested that, these activities include: workshop management and maintenance, organization and environmental safety and the use of personal protective equipment when carrying out any task in the workshop using personal protective equipment (PPE).

Personal Protective Equipment (PPE) are items and assets intended to eliminate or reduce the consequences of equipment failure or human error in the work place (Mukta, 2007). The use of personal protective equipment in electrical workshop cannot be over emphasized as it provides safety for both students and teachers in the workshop. Electrical teachers must have safety knowledge in order to teach students how to use equipment in the performance of a task.

However, Federal Ministry of Education (2005) while addressing key issues and challenges in vocational and technical education noted that the implication of the National Policy on Education would be to make as many students in the nation as possible to be technologically literate. FME further stated that virtually at all levels, vocational/technical education is not adequately backed up with enough human and

equipment safety. That is precisely why as many as half of all the equipment are non-functional and students sustain injuries. Hence, the need for the study on safety skills required by technical college electrical installation students in handling equipment in Plateau and Kaduna States.

Statement of the Problem

Due to loss of tools and machines as well as incessant occurrence of accidents that lead to sustenance of injuries and electric shock, many students have been skeptical to participate in practical activities in electrical workshop and as such, shy away from participation. Yakubu (2004), confirmed that students in Technical Colleges often absent themselves from school during practical lessons. This, according to Yakubu, was attributed to the accidents the students experience in the workshops. Similarly, damages to tools and machines as well as accidents occurring in electrical workshop in Technical Colleges in Plateau and Kaduna States seem to have instilled fear into the students which has made them to be absent during practical work. The enrolment level into electrical installation trade in the technical colleges is also on decline because parents and students are apprehensive of the frequent accident rate occurring in the colleges. The safety practice skills required by electrical installation students in Technical Colleges in Plateau and Kaduna State which could reduce the occurrence of accident and damages to tools and machines may be lacking.

Most of the tools, equipment and machines damaged due to lack of safety skills by electrical students and some of the machines are imported ones, the parts are costly and not easy to purchase or replace. The magnitude of damaged tools results in the non-performance of many tools, equipment and machines, and the increase in the rate of accidents in the workshops of technical colleges is still alarming and as such, students tend to shy away from electrical installation practical because of fear of

accident. Therefore the problem that this study intends to tackle is the decline in enrolments and the avoidance of practical activities in electrical workshops by students due to fear of electrical accidents. This gave the researcher a great concern to find out the safety skills required by technical college electrical installation students in handling equipment.

Purpose of the Study

The main purpose of this study is to determine the safety skills required by technical college electrical installation students in handling equipment in Plateau and Kaduna states. Specifically, the study seeks to determine:

1. The Safety skills required by electrical installation students in handling hand tools in technical colleges in Plateau and Kaduna States.
2. The Safety skills required by electrical installation students for operating machine tools in technical colleges in Plateau and Kaduna States.
3. The workshop Safety skills required by electrical installation students in Plateau and Kaduna States.
4. The personal protective equipment and materials required by students for work in electrical installation workshop in technical colleges in Plateau and Kaduna States.

Significance of the Study

The findings of the study will be of benefit to the electrical installation Teachers, Students, Government, Curriculum planners, Workshop Personnel/electrical workers, National Board for Technical Education (NBTE), the society/parents and the researchers.

Electrical installations teachers in technical colleges shall from the findings of this study, when published, see the need to improve the teaching of safety skills and to identify the materials needed for safety practice in electrical installation workshop. The findings will also benefit the teacher to pass across instruction with ease and make it meaningful to the students.

The students will benefit from the findings of this study by receiving standard training on safety skills and the use of safety equipment which will in turn improve their safety and academic performance. The awareness from the findings of the study will help the students to identify the personal safety equipment and making good use of them. The findings would assist the students in their everyday handling and operation of equipment and tools in and outside the workshops.

These findings will benefit the Government through Ministry of Education and Ministry of Science and Technology by using the information provided to come up with measures that will ensure effective supply of safety equipment and recruitment of qualified teachers. The Curriculum planners shall from the findings of this study, when published, discover the need to introduce safety skills practices in the curriculum, so that the studentsô of this programme shall possess the consciousness and skill in managing electrical equipment. The finding of the study would assist in the curriculum review and updates in areas that lack safety skills.

The result of the study would help the workshop personnel/electrical workers to effectively guide themselves and the students when working on machine or making use of tools during practical works. Understanding of the result of the study would also help the workshop personnel and workers to take adequate care of tools and equipment in the workshop by keeping them clean and placing them in their proper position in the work area.

The findings of this study could be used by National Board for Technical Education (NBTE) as a quality control body to incorporate suitable programme that can enhance safety practice competencies in electrical electronics profession.

The findings of the study will be of benefit to the society/parents at large, when competent electrical installation students practice safety in handling electrical equipment both at home and in the community. The findings shall benefit the society when skilled graduates of electrical installation practice and educate the public on safety measures to be taken when handling electrical equipment.

The information that would emanate from this study will stimulate similar research efforts in other states of the federation on the practice of safety skills required in their institutions. The results may have far reaching implications for national development in general as new concepts would be discovered on safety skills. The findings of the study would provide information to researchers that may wish to carry out similar research in other field in the future.

Research Questions

The following research questions are formulated to guide this study:

1. What are the Safety skills required of electrical installation students in handling hand tools in technical collegesô workshops in Plateau and Kaduna States?
2. What are the Safety skills required of electrical installation students for operating machines tool in technical collegesô workshops in Plateau and Kaduna States?
3. What are the workshop Safety skills required of electrical installation students in technical colleges in Plateau and Kaduna States?
4. What are the personal protective equipment and materials required by students for work in electrical installation workshop in technical colleges in Plateau and Kaduna States?

Hypotheses

The following null hypotheses formulated for the study will be tested at 0.05 level of significance:

H_{01}: There is no significant difference between the mean responses of the electrical installation teachers and electrical installation workers on safety skills required by electrical installation students in handling hand tools in technical colleges in Plateau and Kaduna States.

H_{02}: There is no significant difference between the mean responses of electrical installation teachers and electrical installation workers on safety skills required by electrical installation students for operating machine tools in technical colleges in Plateau and Kaduna States.

H_{03}: There is no significant difference between the mean responses of electrical installation teachers and electrical installation workers on workshop safety skills required by electrical installation students in technical colleges in Plateau and Kaduna States.

H_{04}: There is no significant difference between the mean responses of electrical installation teachers and electrical installation workers on the personal protective equipment and materials required by students for work in electrical installation workshops in technical colleges in Plateau and Kaduna States.

Scope of the Study

This study is delimitated to safety skills required of electrical installation students in handling equipment in technical colleges in Plateau and Kaduna States. This specifically covered the safety skills required for handling tools, operating machine tools, workshops safety skills and the personal protective equipment required by students for effectiveness in electrical installation work. The study was carried out in all the technical colleges in Plateau and Kaduna States.

CHAPTER II

REVIEW OF RELATED LITERATURE

The review of related literature is organized under the following sub-headings:

Conceptual Framework

- Technical College Education
- Electrical installation Trade in Technical Colleges
- Electrical Installation Student
- Tools and Equipment
- Safety Skills
- Approaches to Safety Skills Determination
- Safety Skills in Handling Hand Tools
- Safety Skills in Machines Tools Operation
- Workshop Safety Skills in technical colleges
- Personal Protective Equipment and Materials

Theoretical Framework

- ✓ Human Versus Machine Safety Theory
- ✓ Need Assessment Theory
- ✓ Job Training Theory

Related Empirical Studies

Summary of the Literature Reviewed

Conceptual Framework

Eric, (2009) define a concept as an idea, thought or devolution of abstract system of thought by which science investigation interprets and understands particular segment of reality or phenomena. It is a tool for identifying what researcher would observe, how the researcher would observe and what interpretation the researcher would place on various possible observation.

Technical College Education

Technical college education is an aspect of education that deals with acquisition of practical skills in an attempt to produce technical man-power which can lead to self-reliance from the acquired skills in technical colleges. Federal Government of Nigeria, (FRN, 2004) indicates that technology education is a programme through which practical and applied skill is acquired or obtained starting from technical college. Technical colleges are institutions that provide students with knowledge on skills manipulation to enable them use their brain and hands to produce objects.

In the view of Okoro (2006), technical college is a principal vocational institution in Nigeria, which is designed to prepare individuals to acquire practical skills, knowledge and attitude required of technicians at sub-professional level. Ogbuanya and Osoro, (2009) sees technical education as special training which help to qualify a person to engage in branches of productive industry. Ogbuanya and Osoro, (2009) further stated that the specialized education may consist of the explanation of the processes in production or of instruction in art and science in its relation to industry but it may also include the acquisition of the manual skills which production necessitates.

In a related view Ogbuanya and Osoro (2009) defined vocational technical education and training as those learning activities designed to facilitate the acquisition of practical and applied skills and attitudes, which contribute to successful economic performance. Also Samuel (2009) viewed vocational and technical education as a multidisciplinary and pragmatic field of study, which is aimed at equipping the individuals with requisite vocational and technical education skills, which will enhance their relevance and functionality in the society.

Technical Education may also be considered as a kind of education, knowledge or training which is available and accessible in technical colleges. Makama (2005) noted that the courses run by technical colleges are departmentalized to ensure that students are given training in specific trades for effective performance. Some of the trades in these colleges include electrical installation, electronics, metal work technology, auto-mechanic technology, etc. which are practically oriented.

FRN, (2004) highlighted some electrical engineering trades being offered in technical colleges to include: electrical installation and maintenance work, radio, television and electrical work and appliances repairs. These trades/courses are being offered in order to produce technological minded individuals, who can use their brains and hands to manipulate things for meaningful development in the world of technology.

According to Umunadi (2009) Technical Colleges are principal vocational institutions in Nigeria which are designed to prepare the individuals to acquire practical skills, knowledge and attitudes at sub-professional level, primarily established to train craftsmen in various occupations. Okorie (2001) also sees Technical Colleges as institutions where craftsmen are trained up to the National Technical certificate (NTC) level issued by the National Business and Technical

Examination Board (NABTEB). Students who have completed the junior secondary schools education and the successful products of the vocational training centers are legible for admission to Technical Colleges. Technical Colleges are therefore, schools or training institutions where trades are being taught. Technical colleges train craftsmen in several areas which include: Metal work practice; Fabrication and welding; electrical installation, Block laying and Concreting, Carpentry and joinery; and Furniture making. These activities are done in the workshops.

Workshops play very important roles in technical colleges and workshop safety is of very serious concern to Technical Colleges. Practical works in the workshops require tools and techniques that are inherently dangerous. When working in the workshop it is important to protect the eyes, ears, and lungs, and to take great care when using hand and machine tools.

Electrical Installation Trade in Technical College

Electrical installation and maintenance work is one of the technical trades taught in years 1, 2, and 3 in technical colleges as stated in the National Policy on Education (FGN, 2004). The component included in the curriculum as stated by the Nigerian Educational Research and Development Council (NERDC, 2007) and National Board for Technical Education (NBTE, 2014) includes: domestic and industrial installation, cable joining battery charging and repair, and winding of electrical machines. Electrical installation is a vocational course offered in technical colleges in order to produce electrical craftsmen and technicians. According to Nwachukwu (2006), electrical and electronics students learn the basic skills required to operate, maintain, install and repair electrical and electronics equipment and appliances. The objectives, according to NBTE (2014), include the following:

- To draw and interpret electrical installation winding diagram for domestic and industrial buildings
- To carry out surface and concealed wiring in domestic and industrial building.
- To carryout inspections and testing of completed building.
- To identify, install, maintain and repair various type of electrical equipment and machine.
- To join, terminate, solder and braze different types of cables.
- To charge, maintain, and repair batteries.

Electrical Installation Student

Electrical installation student is a person who is learning vocational course offered in technical colleges in order to become electrical craftsman and technicians. In his view, Nwachukwu (2006) stated that electrical installation students learn the basic skills required to operate, maintain, install and repair electrical and electronics equipment and appliances. Anaemena (2000) said that electrical installation students may study the properties and behaviors of electrons under all conditions especially with reference to technical and industrial applications. At technical college level, electrical installation students need to learn the safety practice skills required in handling tools and equipment in order to be safety conscious when carrying out a task in the workshop and workplace after graduation.

Tools and Equipment

A tool is a piece of equipment which is used with hands to make or repair something: power tools or machine tools. Tools are instruments held in hand and used to form, shape, fasten, add to, or change something by cutting, hitting, boring etc.

Nwachukwu (2006) described tools as all portable and handy instrument or mechanical devices useful for performing special operations in a vocational institution and teaching-learning environments.

Equipment is the set of necessary tools, clothing, etc. for a particular purpose: electrical equipment. Simpson (2001) define equipment as items that last a minimum number of years or cost more than a certain amount, and stated that they are essential for the attainment of educational objectives.

Safety Skills in Electrical Installation

Safety is the freedom from dangers of both human and material resources. Okparaeke (2004) viewed safety as the avoidance of accident which may lead to injury to persons, wastage of materials and damage of tools, equipment or machines in the work site through adherence with compliance to precautionary measures. Olaitan, Nwachukwu, Igbo, Onyemachi and Ekong (1999) said that safety is an art of inculcating the necessity of taking precautions for the avoidance or reduction of accidents in order to protect people and properties. Safety practice is the repeated exercise with appropriate precautionary measures or caution aimed at preventing accidents when one is performing occupational tasks. Also Umoumoh (2003) holds the view that safety movement is an evolution, moving from injury prevention to accident control and fatal environment control.

Accident and damages to tools, equipment and machines cannot be prevented in any field through repeated observance of precautionary measures but only when skills are involved in such exercises. Skill is the ability to do something well. Skill, according to Hull in Amoyedo (2006), is the well-established habits of doing things by the people. Okorie (2000) said that skill is a manual dexterity through repetitive performance of an operation. Skill is a well-established habit of doing something

which is obtained through training and involves repetitive performance (Okoro, 2000).

Skill can be acquired through experience and training. Safety skills are required by the students of electrical installation at technical college level. This is necessary in order to save the students from both minor and major accidents in the workshop. Safety skills in this study might be seen as special abilities, habit and capabilities, skillfulness and tactfulness in handling and using electrical tools, machines, and operating equipment or materials consciously. It equally involves following sequences of operations with caution when performing a task. Safety practice skills no doubt constitute a vital framework in the prevention of accidents in the workshops.

Safety skills in this study might be seen as special abilities, habit and capabilities, skillfulness and tactfulness in handling and using electrical tools or materials, and operating equipment or machines consciously. It equally involve following sequences of operations with caution when performing a task. Okorie (2001) considers safety skill as the bedrock of modern educational practices needed to fit individuals into the world of work, education for living (life skills) and self-reliance. This implies that acquired skills enable individuals to develop their intellectual, physical, social, emotional and economic capacities.

Workshop is a room or place where machines, tools or equipment are kept for production of new components as well as for maintenance and repair (Samuel and David, 1999). A workshop is defined as a place where the leaner may experiment, test, construct, dismantle, repair, design, create, imagine, and study (Okorie, 2001). Going by this definition, a workshop is an essential facility for the study and practice of Technical/ Vocational Education. As a matter of facts, various types of workshops

are in use, some of which are the single unit, General unit and Mobile shop. Workshop is a place where tools and power machines are kept for practical and production in technical colleges.

Approaches to Safety Skills Determination

There are numbers of approaches suitable for determination of safety practice skills for tasks in occupations or vocational subjects. The following will be considered for the purpose of this study.

- The process approach
- The audit safety system approach
- The system analysis approach

- **Process Approach**

Bakare (2010) observed that the safety skills of a worker could be identified or determined through the observance of the task performance sequence followed and the display or application of safety skills in carrying out task in an occupation or trade. Bakare observed that the competencies of workers will be displayed by their ability to follow the right work process and safety rule sequentially. Bakare, emphasized that, in identifying safety skills, each process of work, should be monitored and examined carefully.

- **Audit Safety System Approach**

Audit safety system, according to Bakere (2010), is a management tool used to evaluate the ñstate-of-the-artò of safety program. He stressed that, it is most useful when performance is low and efforts are required to stimulate additional ones. He further maintained that, audit system involves the use of supervisory methods, which identify hazardous situations such as physical items like faulty tools,

equipment or machines, and non- physical items like working methods, lack of discipline, lack of training, or use of incorrect equipment and so on.

This approach is relevant and could be useful for training and practice during operation in the workshop.

- **The System Analysis Approach**

  Similarly, Yakubu (2014), observed that the principal method of analyzing potential failure of equipment is to trace from the system and determine or detect the ultimate effect on the task being performed. He also stated that, accidents result from deficiencies in human operations, faults or defects in tools, equipment and environmental influences. He further stated that usually, failures are compound and these include mechanical or electrical failures, defective materials and environmental conditions such as extreme heat or noise levels inhibiting inter-communication. These could assist in tracing failures on machines or equipment. Training in detecting faults on tools, machines or equipment and materials could reduce occurrence of accident and promote safety in electrical workshop.

The system analysis approach suggested the following instructions that could assist to determine situations or errors that could lead to occurrence of injury or accident. They include:

- Be attentive to sudden stop of a machine
- Check materials before machining
- Observe excessive heat from machine
- Inspect machines before operating it

This implies that, regular observation and inspection of machines could assist to determine abnormality such as irrational sound or sudden stoppage of machine

which is an indicator of improper condition or unfit of such machine. This also implies that, electrical students need to be safety conscious towards conditions that may arise as a result of unfit machines.

According to Nwachukwu (2006), safety in the workshop requires careful planning, and that planning involves:

- Developing a detailed guide sheet of instruction for students which should contain safety observances and precautions in the workshop
- Prepare a list of tools, equipment and materials in use in the workshop and identifying their storage location
- Classifying the tools, equipment and materials according to usage
- Identifying these tools, equipment and materials in operational stages.
- Ensuring that list of workshop safety rules and observance are readily available at various ends of the workshop.
- In the event of introducing new activities in the workshop, the teacher should ensure that he carefully demonstrates the new activities to acquaint students with necessary operations and procedures using the right tools and equipment at the right time.

Similarly, Aladeyehan (2001), stated that there is nothing more important in school workshop/laboratory teaching situation than safety. He further stated that, it is impossible to list all the safety precautions which should be enforced for school workshop purpose. The nature of the workshop, the kind of instructional activities, and other factors determine the specific kind of safety regulations that are necessary. Since safety practice is regarded as the activities involved in ensuring that accidents are prevented from occurring. Therefore, safety practice skill is the ability to engage on repeated activities that could lead to avoidance of accident.

Accident, according to Kadiri (2006), is unexpected, unplanned occurrence which can involve injury and damage to property. In the view of Kwurmi and Gupta (2004), an accident is a mishap which can cause some injuries to a person, damage to machines, tools and equipment and may result in loss of production. Kwurmi and Gupta further stated that, accident may be due to workerôs own fault which may be prevented by their own precautions or may be due to employerôs fault for not making safe working environment. Thus, electrical students and workers need to be familiar with the causes of accident and be sure that precautions required to prevent the occurrence are adequately adhered to.

Safety Skill in Handling Hand Tools

In common with other areas of electrical work operations in the workshop, using of hand tools create hazards which, if not identified, constitute a threat to the safety of both the students, staff and to the tools. A hand tool is any tool or implement designed for manual operation. Also, it is a tool held in the hand and operated without electricity or other source of power. In the view of Chao and Henshaw (2002), Hand tools are tools that are powered manually. Hand tools include anything from axes to wrenches. The greatest hazards posed by hand tools result from misuse and improper maintenance. Ahmed (2011) define hand tools as the instrument or devices that can be handled easily while carrying out special operation as well as instructional and learning activities. Electrical hand tools are commonly utilized in transmitting knowledge in the workshop or field to the learners. They are used in demonstrations, practices for learning of skills and for skills testing in specified vocational and technical areas. Handling electrical hand tools simply means to operate or control such tool. According to Yakubu (2004), hand tools do not usually cause accidents if they are in good working order, used correctly, carried carefully and stored safely. In

support of proper selection of tools and usage, Nwachukwu (2006), said that, available tools should be classified according to usage and equipment properly serviced before embarking on new jobs. Oranu, Nwoke and Ogwo (2002), classified hand tools into the following section:

- Marking out tools (scribers, punches, divides)
- Cutting tools (hacksaw, chisels, files)
- Measuring tools (steel rules, veneer caliper, try square and micrometer screw gauge).
- Driving tools (hammers, screw drivers)
- Holding tools or devices (pliers, clamps)

Below are some of the hazards of hand tools as cited by Chao and Henshaw (2002):

- If a chisel is used as a screwdriver, the tip of the chisel may break and fly off, hitting the user or other employees.
- If a wooden handle on a tool, such as a hammer or an axe, is loose, splintered, or cracked, the head of the tool may fly off and strike the user or other employees.
- If the jaws of a wrench are sprung, the wrench might slip. If impact tools such as chisels, wedges, or drift pins have mushroomed heads, the heads might shatter on impact, sending sharp fragments flying toward the user or other employees.

They stressed on safety practices relevant and peculiar to each category of tools. Such safety practices are outline as follows:

- Never carry a scriber, divider trammel or odd-leg caliper in pocket. The sharp point of the tool will pierce the skin.

- Always cover the sharp point of a tool with cork when the tool is not in use
- Wear goggles when grinding sharp pointed tools such as scissors or center punches

Characteristics of Hand Tools

1. They are handy
2. The parts are simple and most commonly made of wood and rubber.
3. Technically they are moveable with ease.
4. They may be large or small tools.
5. The energy expenditure by users is less.
6. Little or no skills are required in manipulating tools by users.
7. Tools are easy to maintain.
8. Spare parts are easily found and cheap.
9. The worn out or damaged parts are easily replaceable and
10. Tools can be used in operation with or without supporting devices (Nwachukwu, 2006).

However, some hand tools used in electrical installation workshop in technical college as cited by Nigerian Educational Research and Development council (NERDC, 2007) are stated below:

Screw drivers, Allen keys, Spanners, Pliers, Hacksaw and blade, Mallet, Files, Chisels, Bow through, Jim let, Saws, Rawl plug tool, Hammers, Center punch, Scraper, Plastic hammer, Knives, Fish wire, and manual drilling machine among others.

Safety Skills in Machine Tools Operation

In electrical industries and school workshops, there are machines with large number of moving parts and other dangerous projections which may cause accidents, fatal injuries if proper measures are not taken for safe guarding against them.

An electrical Machine is a device consisting of fixed and moving parts that modifies mechanical energy and transmits it in a more useful form. In their view Olaitan, Nwachukwu, Igbo, Onyemachi, and Ekong (1999) see machines as heavy mechanical or electrical devices for vocational technical operations in the laboratory, workshop or field. Machine is more sophisticated than tools. The sophistication of the machine necessitates special skills to operate them. Machine, in the view of Mukta (2007), is an apparatus with moving parts for converting mechanical into electrical energy or vice versa such as a generator, or a motor, acting either on electromagnetic or electrostatic principles, but not including stationary apparatus such as transformers. Machine tool can be referred to as a power driven machine which can be used to carry out operations such as cutting, generating, drilling, milling, facing, conversion of energy and so on (Bakare, 2010). Electrical machines are those devices used in generating or conversion of one form of energy or the other. i.e AC to DC or DC to AC. Operating simply means to control the way a system or device woks. Operating electrical machine involve all the activities carried out on the machine such as on and off, repairs, production and maintenance. As an electrical worker, there is need to be acquainted with likely accidents that may occur during the operation of machines. Kadiri (2006), buttressed this fact and said that, if one does not give sufficient thought to the need for protection, one will eventually learn of that need in a hard way causing discomfort and injury to himself or herself. He further stressed that, the most

important element of occupational safety programme is an effective system to identify and control hazards that may result from operating machines.

In contribution to the need for safety consciousness and careful operation of machines in electrical workshops, Kwurmi and Gupta (2004), suggested that, moving parts of machines must be properly guarded to maintain safety. They also emphasized that the type of guard should be selected with regard to the nature of the machine, purpose and mode of operation. They therefore outlined the following safety instructions for the operation of machines:

- Before operating any machine the work and tool should be clamped securely.
- The machine should be operated only by a skilled workman
- The machine should not be left in running position while going for an emergency or urgent call
- When the machine is running, the operator should not indulge in any mischief with other operators.
- The proper lighting or ventilation should be provided in machine working environment.

In the view of Ahmed (2011) most accidents that occur while operating machines are caused by carelessness, horse play, practical jokes or silly strikes. He opined that there is no place for this type of behavior in the work place. ITF (2011) outlined safety precaution that must be observed while operating machines as follows:

- Protect hands with gloves and wear safety shoes when operating machines.
- Wear approved eye protector when operating a power tool.
- Keep your concentration while the machine is in motion
- Never leave your machine unattended to while it is in motion

- Take care not to distract other machine operators
- Never clean a machine while in motion-always isolate it from the power supply first
- Keep your hair short or under a cap or hairnet, it can become tangled in drills or rotating shafts
- Avoid loose clothing.
- Do not wear rings, chains or watches at work
- Do not allow unguarded bar to protrude beyond the end of a machine, e.g. in Centre lathe
- Always ensure that all guards are correctly fitted round in position.

Some of this machines used in electrical installation workshops in technical college as cited by NERDC, (2007) are stated below:

D.C motor, A.C motor (single phase and three phase), D.C Generator, A.C Generator (single phase and three phase), Three phase starters: Direct on line, Star-Delta, Auto transformer, D.C Starter. (Face plate), Inductors(choke)., Transformers (step up and step down), Inverter, Converter, Bench vice, power drilling machine, Conduit bending springs, Conduit bending machine.

Characteristic of Machines

1. They are not handy.
2. The handling of machines requires some efforts.
3. Some skills are required in handling machines for operation.
4. Maintenance of machines is not always easy.
5. Replacement of damaged machines need technical experience, know-how to maintain and therefore not easy to replace (Nwachukwu, 2006).

Electrical Equipment

Other equipment and materials have been classified by NERDC, (2007) as follows:

Measuring Equipment: Meter rule, Micro meter screw gauge, Standard wire gauge, D.C Volt meter, D.C Ammeter, Ohm meter, Insulation resistance tester (mega ohm meter), Multi meter, Oscilloscope, Watt meter, Clamp on ammeter, Wheat stone bridge, Potentiometer, Tachometer, Neon tester (voltage tester), Bell and battery set, Spirit level, Cathode ray oscilloscope, and Signal generator among others.

Non- Measuring Equipment: D.C motor, A.C motor (single phase and three phase), D.C Generator, A.C Generator (single phase and three phase), Three phase starters: Direct on line, Star-Delta, Auto transformer, D.C Starter. (Face plate), Inductors(choke)., Transformers (step up and step down), Inverter, Converter, Work bench, Wiring boards, Bench vice, Power drilling machine, Manual drilling machine, Conduit bending springs, Conduit bending machine, Circuit breaker, Switch gear, Switches, Fuses, Contactors, Gas lamp, Blow lamp, Soldering iron, Ladder, Stock and dies, Rheostat, Capacitors, Thermostat, Relays, Safety belt, Hand gloves, First aid box, Fire extinguisher, Safety posters.

Consumables: Ceiling rose, Lamp holders, Lamps, Plugs, Joint boxes, Switches, Socket outlets, Clips, Wiring nails, Conduit pipes (PVC), Conduit pipes (Galvanized), Soldering, Flux, Florescent fittings, Cables (various sizes), Sealing wax, Knock out boxes, Patrex boxes, Conduit accessories, Screw nails, Wooden blocks, Insulation tape

All the above mentioned equipment and materials should always be stored, maintained and be kept in good condition so as to achieve the durability. National Power Training Institute of Nigeria (NAPTIN, 2010) advised that equipment should

be kept in a locked room or locked in cabinets. The teacher may control the key and in most cases they give out the supply as needed by individual students. Cabinets and storages areas should be kept opened during the time the classes are in session. The advantage of this is that, students are free to use material needed without permission.

In addition, workshop maintenance of electrical, machine installation should be carried out by a trained electrician. Power points or outlets switch etc be properly earthed, this should not be tampered with or repaired except by a competent electrician.

However, because of potential hazards, associated with most vocational and technical education activities, the design of its facilities should take into consideration the safety of students, instructors and equipment. Ahmed (2011), observed that while the teacher is the prime ingredient in a school safety programme, it is very difficult for even safety conscious instructors to maintain a safety programme in an unsafe facility. He recommended that, all workshop using gasoline, paints and other inflammable liquid should be protected against electrical sparks and other fire hazards. All electrical installations should adhere to both state and federal safety codes.

However, ITF (2011) opined that, workers should walk around the workshop and locate all the fire extinguishers, the fire exit and fire alarm. This will help you during an emergency. Always try to prevent a fire, store gasoline and oily rags in safety cans wipe off spilled gasoline and oil immediately. Okorie (2000) enumerated the following as machine, tools and equipment safety requirements:

Machine safe working loads should be known and expected.

- Do not work on machine with loose foundation.
- Do not congest machine bed with tools, equipment or jobs which may obstruct tool- post movement.

- Switch on and off the electric control switch to ensure normal function.
- Use correct tools for appropriate jobs.
- Grind mushroom head of chisel and other cutting tools.
- Do not carry pointed tools in apron.
- Keep away unwanted tools and equipment, from the work bench.
- Guards (and tool supports) provided on the machines should be well adjusted, cleaned and tightened.
- Clean machines and tools after each dayôs work.
- Carryout regular maintenance exercise on machines before they get damaged.

Frequent Nature of Accident in Electrical Workshop and their Control

According to NAPTIN (2010), frequent nature of accident in the workshop is very paramount, virtually every day a large number of accidents occur in the factories, schools, technical colleges and elsewhere in the country which sometimes results in death, sometimes in permanent disability. Even if an accident does not render the victim unfit or makes him liable for infection, and shock, statistics gathered in the accidents shows, in general that every three accidents which occur, two are caused by personal element of the victim and one by means beyond his control (ITF, 2011). To put it briefly, it may be said that two out of three are the victims of own fault, and third was his employers or teachers fault for not making safe working conditions. Therefore, administrators and teachers of workshop based courses should not only be concerned about the consequences of studentôs injury. While it is understood that no phase of education is completely free from accidents, the incident of accidents is higher in laboratory and workshop courses due to the nature of activities learned or carried out.

It is the responsibility of the teachers to provide supervision and instruction. Besides, the teacher is responsible for accident prevention since he is in a position to train pupils to observe rules. Okorie (2000) in his explanation opined that most accidents which could have otherwise been avoided or prevented, are caused by human actions or in actions. It was explained that such accidents could arise from radiations, noise, vibration, poor lighting, pollutants, acids and alkalis, heat, fire, machinery, materials and handling. These causes itemized above could be categorized into three areas: the technical equipment, the working environment and the worker. In the area of the technical equipment, lack of adequate safety devices in the design of machines or non-provision of safety equipment create hazards which can lead to accidents. Likewise, a highly polluted environment which may be either noisy, hot, electrically charged or fume polluted, constitute hazards in the environment. The worker himself is the major contributory factor. He needs to receive adequate training.

To support the above statements, NAPTIN (2010) stated that accidents are caused by either unsafe practices or acts and unsafe conditions: unsafe practices on the part of the worker which may result from ignorance of operating producers, by not wearing correct dressing or clothing, by not obeying safety rules e.g. not wearing goggles when operating grinding machines, by using worn out or unsuitable tools for correct work, or by not maintaining his tools. Secondly, unsafe conditions by employer or teacher by means of installing dangerous machinery without adequate guide, by allowing the floor of his factory/workshop become slippery with oil, by not allowing time and money for the proper maintenance of machines and equipment and also by inadequate ventilation, lighting, toilet and washing facilities (environmental conditions). In another study on causes of accident, it was discovered that accidents

caused by unsafe acts stand at 78%, by unsafe conditions 20% and natural occurrences 2% (NAPTIN, 2010).

In the light of the above, Ahmed (2011) stated that in every eight hour shift nearly 1,000 workers are the victims of industrial accidents in the world. Many of these will be blinded for life or confined to hospital bed for months. Ahmed further explained that the number of accidents reported in industries have increased over the years. Discussions with workers have revealed that more emphasis should be given to safety education and training. Ahmed opined that, recent records shows that 17,000 workers are killed every year, over 2,000,000 workers are injured and 300,000 are permanently impaired. But Sunday (2002) disagreed that it is of course impossible to quantify satisfactorily how much some permanent impairment will reduce workers future earnings. The country at large suffers a loss in human resources when injuries occur. Labour once lost is never recovered. Sunday (2002) stated that:

> On the recent time, specifically 17th September, 2002, the Super Engineering Limited at Plot 68 Ikorodu had a vital experience of losing about hundred working staff, material and equipment in a fire outbreak that engulfed the company. This accident was a result of lack of observation of safety regulations by the management of the company as there was no fire extinguisher and no emergency exit which could have reduced the casualty. (p. 44).

However, if school shop accidents are to be reduced to a minimum, identification and elimination of accidents hazards in the shop environment are two of most essential activities in which the shop teacher must engage in. It is a known fact that the use of machines, tools, and materials in shop environment will present some hazards which may result in personal injuries. Black (1999) opined that ñsome degree of hazards is associated with every form of activity; therefore, the highest degree of injury elimination can only be achieved by careful, and painstaking attention to safety in every form of activityò. In view of the above points, it becomes pertinent that all

technical teachers should have the knowledge of workshop rules and be familiar with their legal responsibility so as to protect themselves and students from litigation. Pupils must be properly instructed in the principle of safety.

Safety Skills for Working in the Workshop

Work, according to Okoro (2006), is any mental or physical activity directed towards the achievement of a goal. Work is not necessarily unpleasant or unsatisfying but the real motivation for working is the purpose to be achieved.

When working in electrical workshop in technical colleges, the management and maintenance of tools, machine and equipment should be given much degree of consideration for the span of tool, equipment, machines and personnel. Effective techniques for workshop management is the involvement of workshop staff in planning, directing and controlling training facilities for the purpose of learning skills in various occupational and in meeting with colleges and institutionôs work objective. In every occupational workshop, tools and machines are needed to. They should also be in constant use and be kept in good condition and control. The control and maintenance of machines and tools form a complex management function. A well-managed tool and machine in any occupation will provide effective learning but challenging and exciting to all the users of workshop. In essence, there shall be equipment for acquiring skills and to maintain consumable materials to be purchased, distributed for practice and utilization and kept in order. When a laboratory is clean and bright, with tools and machines located at their appropriate places, it will give an impressive look to facilitate instruction and effectiveness in learning. In planning for tool management system. Olaitan (1999) recommended that the following principles should be adopted.

1. Equipment and tools should be organized in sequence like uses, size, colour for ease of reference and accountability.
2. Proximity to uses should be of high priority. This will afford free access to them.
3. Lost or damaged tools should be replaced for continuity of programmes.
4. Tools should be organized and arranged so that supervisor can inspect and identify immediately worn-out, broken and costly ones.
5. Hazardous substance or materials subject to abuse must not only be stored securely but should also be under control.
6. Careless loss of tools and materials due to pilfering or vandalism must be constantly checked.
7. Waste must be minimized.

It is a desirable technique to make college workshops and institutionôs laboratories similar to occupational standards and actual industrial settings and conditions. This will prepare learners for various occupations and minimize the adjustment needed to enter into industries or world of work.

However, in most learning and work situations, appropriate maintenance procedure is known to have prolonged the lifespan of equipment in all aspects of technological endeavors. In electrical installation technology workshop, for instance, the drilling machine bit can easily be broken or lost out. In this case, therefore, a maintenance procedure undertaken should be by changing the broken bit, and tying it strong can reactivate machine and restore it to its operational standard.

In view of the above points, maintenance can be defined by way of checking or taking care of equipment and machine on daily basis and from time to time to prolong the life (lifespan) of equipment and machines at all levels. ITF (2011) supported that maintenance is the means of taking specific approved steps and

precautions to care for a piece of equipment, machinery or facility, and to ensure that it attains its specific maximum functional self. Similarly, there are three common types of maintenance practices which include: preventive maintenance, predictive maintenance and corrective maintenance. The preventive maintenance type or maintenance involves inspection, lubrication, cleaning and testing of an equipment or facility used in a factory, laboratory and workshop. This type of maintenance does not wait until the machine, infrastructure or equipment has collapse or broken down before being attended to. The effect is rather to prevent a breakdown; preventive maintenance is mostly concerned with the application of useful strategies to forestall a breakdown when danger signals are observed. In this circumstance, it means that when danger signals are observed in the operation of equipment, machinery or infrastructure, an immediate action or measure is taken to arrest the situation and to prevent equipment from breaking down. The degree and accuracy with which the maintenance intervention is carried out determines the extent to which a breakdown of the machine is forestalled.

Corrective maintenance involves approaches and effort to rectify an already damaged or broken-down equipment, machinery and infrastructure. Steps to be taken for the replacement of already damaged parts or repair and servicing. In all the cases, the effort is to ensure continuity within the operational and production framework. Generally, maintenance can be done in two ways that is, routine maintenance and preventive maintenance. Akinseinde (2003) reported that:

> Routines maintenance is repetitive and on one-day-to-day basis with the intention to keep the equipment clean and in good operating condition. This involves a general clean up, disposal of scraps, oiling of machines and minor repairs due to breakdown. Preventive maintenance is an orderly, continuous and scheduled procedure to prevent breakdown of equipment and prolong its life. Its purpose is to discover the evidence of wear and tear before it develops to

> damaging effects. It involves periodic over hauling of equipment, close inspection of machine after a specific period and using the findings as basis for repairs and replacement of component parts. (p.72).

There must be regular and systematic check on tools, machinery and materials. All hand and machine tools must be kept sharp, clean and in safe working condition. The teacher should forbid the use of any defective tools machines or equipment. As a general rule, tools with broken/cracked handles or mushroomed head should not be used. Maintenance of equipment ensures maximum operation of equipment at a minimum cost and assist in a safe working environment for students and teachers. Poor maintenance of tools and machines may cause injuries to students or damage to equipment (Everett and Jenkins, 2001). In addition, maintenance activities in the laboratories and workshops require prompt and continuous attention. It is required in this way because the efficiency of any equipment or instrument very much depends on the day-to-day care they receive. This care is provided by the operational staff in the laboratories and workshop (human resources) who operate these equipment most often and whose production rate and efficiency rate much depend on the reliability of the equipment (materials resource). It becomes necessary, therefore, that these operational staff becomes very familiar with the equipment and machinery within their work environment.

There are many factors militating against effectiveness of maintenance and repair of tools and equipment. Olateju (2002) highlighted the following factors as:

1. Lack of maintenance skill and poor appreciation of dynamics of maintenance. This prevents the application of sound engineering approach to maintenance activities.
2. Poor appreciation of the need for staff training and retraining establishment that deemphasize training, retraining establishment and continuing education can hardly process an effective maintenance programme.

3. Unavailability of funds to process spare parts or finance maintenance facilities limits the potentials of an establishment for maintenance activities.
4. Unavailability of spare parts and unsuccessful efforts to procure spare parts often bring frustration when the fund is not available.
5. Lack of data and poor information on the equipment is a handicap for effective maintenance.
6. Absence of efficient inventory often results in frequent shortage of materials and spare parts.
7. Indiscipline and ignorance on the part of the users of equipment often lead to persistent equipment breakdown. This makes maintenance problematic.
8. Reluctance on the part of the engineers in some establishment who often have the erroneous conception of maintenance as a task for technicians alone. As a result of these, engineers who possess expert knowledge and skill often consider themselves too big for maintenance job.
9. Deficiency in the quality of management. The quality of management is an establishment responsible for taking decision relating to day-to-day running of facilities and equipment are often deficient.

Workshop Organization and Environmental Safety

In the view of Chao and Henshaw (2002), designing a workshop depends very much on what it is meant for. This is usually determined by the type of tools, equipment, materials and the number of participants required there at a time. Specific professional practices require different specific workshop designs. Different technical practices like electrical, carpentry, metal working, plumbing, building construction, mechanical and even foundering, spray painting, motor-vehicle body building depends on certain specific designsò.

Consequently, for whatever decision or workshop or laboratory ranging from simple, open air carving workshops to a sophisticated electrical workshop, it is necessary that they are well planned and arranged to make students carry out their duties with ease and comfort, as well as in safety. This is on one hand while safe-keeping, preparation and utilization of materials, equipment and tools can be assured with ease on another hand.

Safety strategies in the workshop are the art of planning for a safety conscious workshop environment conducive for teaching, learning and research. In planning, designing, and organizing the workshop, ITF (2011) opined that due consideration must be given to the following areas;

1. Work spaces
2. Placement of equipment,
3. Selection of machine and hand tools
4. Light and ventilation
5. Traffic flow
6. House keeping

However, in the area of environmental safety, environment can be seen as all the surrounding conditions which influence growth and development of works, environment. A typical work environment is often characterized by the presence of man, light, water, air facilities. Among the aforementioned, man stands out as the chief actor with the responsibility of organizing the rest of the factors to achieve a good atmosphere. Work environment is a system where work can be carried out effectively. It is therefore imperative that the work environment must be protected from risk and hazard.

In order to enhance better productivity of workers in any establishment, the management always consider suitable environment to accomplish such work. A more conducive environment for work usually motivates the workers to perform their activities with little or no accidents (Sunday, 2002).

An unsafe working environment is a threat to the life of a worker and potentially a liability to an employer. Unsafe physical conditions may prevail in the work situation as a result of the following:

(i) Inadequate illumination and ventilation

(ii) Poorly constructed stairs, slippery floors or poorly installed machines

(iii) Lack of or inadequate emergency exits in the building

(iv) Inadequate work area

(v) Defective tools, equipment or materials

(vi) Poor housekeeping, improper pilling and storing of tools and materials, tools not put away in their racks, boxes or cabinets, congestion of tools and materials in the work area.

(vii) No well designed aisle, materials stacked carelessly so that they protrude into the aisle.

(viii) Ineffective guarding, guards on machines not affording adequate protection or not allowing for proper use of machines, machines not guarded at all.

(ix) Some process produces various dusts, vapours and fumes. These by-products constitute health hazards unless adequate control measures are taken to prevent their circulation (Okorie, 2001).

Some positive caution inscription should be designed in a workshop that carries elements of advice or warning against undue optimism. Such inscription may be in form of:

DANGEROUS EXPLOSIVES KEEP OFF

NO SMOKING HERE

ENTRY IS PROHIBITED

DONõT SWALLOW POISON

NAKED WIRE

DONõT TOUCH

In line with some of the above mentioned inscriptions, Okorie (2001) in his study highlighted the following as environmental safety requirements.

(a) Mount firefighting equipment (extinguisher and sand) as conspicuous and accessible intervals.

(b) Always mop-up traces of oil and water on the floor

(c) Indicate danger zones with conspicuous red marks

(d) Maintain adequate ventilation or install air conditioners where ventilation is lacking

(e) Keep gauge away free from obstructions

(f) Install dust ducts and turbo fans to conduct harmful particles to safety

(g) Exhaust gases from plants should be conducted always for safety

(h) Canteen and beverage bar should be provided for the workers service (depending on the environment);

(i) First-aid facilities should be maintained within the environment,

(j) Recreational facilities should be available (depend on the type and size of environment)

(k) Automatic speed control designs like lumps, zebra crossing, speed limit warning sign should be conspicuously put in place;

(l) Out of bounds sign should be marked on the entrance of hazardous compartments; and

(m) Prohibitory sign like: No smoking, No horns, etc. should be displayed in the areas of interest.

In order to achieve a favorable atmosphere in a workshop, it is important to consider environmental influence that brings about or develop a safe workshop such as: constant supply of heater and water; availability of light or electricity, abundant ventilation; provision of storage facilities; layout of the machines in order of use; creation of passage way for traffic with machine or; sealing all inflammable in container; and provision for automatic press button switches within the workshop; provision for fire extinguishers; reducing draft and spillage in pesticide application and finally, applying chemicals in accordance with recommended dosage (Anaele, 2003).

Similarly, fire safety is also one of the most paramount areas of workshop environmental safety. Fire as it is known is a phenomenon in which combustible materials, especially organic materials containing carbon react chemically with oxygen in the air to produce heat. Flame arises from the combustion of volatile liquids and gases involved can spread the fire. Causes of industrial or workshop fire among others may include; electrical faults, smoking arson, friction, poor housekeeping, like electrical wires in contact with water, faulty electrical equipment and installations; welding and cutting, burners, and open flame etc. NAPTIN (2010) postulated the following as general electrical safety rules.

- Keep gang ways clear and provide free access to every part of the workshop.
- Remove all loose cables from the flow of the workshop.
- Keep the floor off grease, oil or any liquid

- All electrical connection must be secure, loose wires or connections can arc.
- A fuse of correct rating must be fitted. This is to safeguard if a fault develops, never use makeshift fuse such as pieces of wire.
- Any external metal parts must be earthed so that if a fault develops, the fuse will blow and interrupt the supply.
- Never run power tools from lamp sockets.
- Connection between the plug and equipment should be made with the correct cable suited to the correct rating of the equipment.
- Walk carefully in the workshop.
- Equipment should always be disconnected from the main supply before making any adjustment, even when changing a lamp.
- Do not under any circumstances, interfere with any electrical equipment or attempt to repair it yourself. All electrical work should be done by a qualified electrician.
- Make use of the recommended fire extinguisher in the workshop in case of fire outbreak. A little knowledge is often sufficient to make electrical equipment function but a much higher level of knowledge and expertise is usually needed to ensure safety.

Personal Protective Equipment in Electrical Workshop

It is a known fact that with adequate and available equipment in a workshop without human resources, the production will be deficient. Therefore, human resources should be given high degree of consideration by means of protection, because accidents and injuries reduce the effectiveness of the work force and may result in expensive medical bills and law suits.

Safety is of prime importance in the operation of the power tools in workshop. One of the major problems affecting the management of workshop is lack of safety precaution in the workshop. The remote causes of accident in the workshops are as a result of not observing the workshop rules and regulation. These include safety rules, workshop safety habits, hand tools safety and machine safety rules.

However, in any society, rules and regulations must be devised for the guidance and benefit of all concerned, the workshop is no exception. These rules are necessary to make a workshop a safe, efficient and healthy place in which to work. A clean and well- ordered shop is also much more attractive to customers, in line with not obeying workshop rules, accidents claim for too many victims, and these accidents are caused by either neglect or carelessness on the part of the workman or circumstance beyond the employer control. Many accidents can be prevented if the causes are recognized and dealt with before hand. Mudd (1999) opined that a large number of accidents occur in factories and garages every day. About two-thirds of these are fault of the individual employee, who may or may not be injured. More often than not such luck is the result of ignorance, lack of care and over confidence.

Most of the time the worker is responsible for the accidents that is encountered at work, and the worker is supposed to take reasonable care for his/her own health and safety and that of others who may be affected by what they do or donôt do. A large number of accident cases arising from the human factors are caused by unsafe acts or practices of the worker.

The PPE is defined as all equipment which is intended to be worn or held to protect against risk to health and safety. According to Everett and Jenkins (2001) such safety equipment includes:

Eyes: wear safety eye glasses and goggles at all time in the shop, but especially for all machines operations, safety glasses and goggle to prevent chips from striking the eyes.

Some goggles protect the eyes from bright, damaging light, splashes from chemical or molten metal, liquid droplets, crust, gases and welding filters, face shield and hoods.

Ear: loud continuous noise may damage hearing, when working under those conditions, wear ear protectors, which allows voices to be heard but not noise.

Hand and fingers: keep your hands and fingers clear of all blades and cutting tools at all times. Gloves of various designs provide protection against a range of hazards including electric shock, cuts and abrasions, extremes of temperature (hot and cold), skin irritation and dermatitis and contact with toxic or corrosive liquids.

Hair: long hair can get caught in moving parts of machines. Tie the hair back or wear a protective net cap. Head can also be protected by industrial safety helmets to protect against falling objects or impact with fixed object.

Clothing: loose clothing, long sleeves, ties and short tails can get caught in machines. Types of clothing used for body protection includes: overalls and aprons to protect against chemical and other hazardous substances, outfits to protect against cold, heat and bad weather, and clothing to protect against machinery.

Jewelry: necklace, bracelet, watches and rings can get caught in machines. They should be removed before working with machines.

Mouth: placing object such as nails in the mouth is dangerous. They can be swallowed easily.

Back: use caution when handling large or heavy materials. When lifting, bend your knees not your back.

Feet: often there are sharp objects and scraps on the floor. Protect your feet all the time with safety boots or shoes with steel toe caps, which are heat resistant and designed to keep out molten metal, wellington boots to protect against water and wet conditions and anti- static footwear to prevent the buildup of static electricity on the wearer.

In line with personal protective equipment (PPE), rules and regulations are made to maintain standards and order in the use of laboratories and workshops. These rules and regulation should be made known to all concerned for strict adherence. For this to be effective, the authority should pause periodically and examine how well the rules and regulations are observed. This is done in view of the fact that it is one thing to paste these rules at strategic positions and it is another thing for them to be obeyed. Ensuring that they are obeyed is the sole responsibility of teacher and technicians.

General Safety Rulles

The following general safety rules sited by ITF (2011) are to be observed in the workshop or on the job site:

- Always walk ð do not run
- Never talk to or interrupt anyone who is working on a machine
- Remove power plug or turn off power supply to a machine when changing cutter or blades.
- Never leave tool or pieces to stock lying on the table surfaces of a machine being used.
- When furnished with a machine, turn off all the power and wait until the blade or cutter has come to complete stop before leaving.
- Always carefully check stock for knots, split, meal objects, and other defects before machining.

- Any tool with a sharp cutting edge can cause serious injury if mishandled.
- It should be understood that using guards does not necessarily prevent accidents. Guards must be used correctly if they are to provide fullest protection. Also, it is impossible to do some operations, especially on the circular saw, with the regular guard in place. Therefore, there are times when special guards should be used.
- Keep the floor around the machine clean. The danger from falling or slipping is always great.
- Always use a brush to clean the table surface.
- Always keep your eyes focused on where the cutting action is taking place.
- When using tools for set-up works on a machine (1) select the right tool for the job (2) keep it in safe condition (3) keep it at a safe place.
- Report strange noises or faulty operation of machine to the instructor. Also the following are recommended by ITF (2011) as safety equipment: safety goggles, fire extinguishers, safety helmet, sand bucket, waste bin, work area, dust duct and turbo fan, protective hand gloves and boot etc.

However, first aids box is one of the most important personal protective equipment in the workshop. Minor injuries occur in the workshops which had often led to serious disabilities to the worker and few cases led to death. These minor injuries could have been prevented or promptly attended to. It is therefore, imperative that workmen, students, their instructors and supervisors are equipped with adequate knowledge of first aid delivery. A first-aid box that contains simple requirements to handle minor accidents like burns, cuts, scalds and bruises, some analgesic for the treatment of common ailments like headaches and other pains should be kept in the box. The following items are recommended by Oladimeji (1999).

i. A handbook on basic first-aid treatment

ii. Scissors

iii. Assorted sizes of adhesive plastic dressing

iv. Safety pins

v. Tweezers

vi. Cotton wool

vii. A clinical thermometer

viii. Iodine

ix. Razor blade

x. Packet of gauge

xi. Tissues, eye-bath

xii. Antiseptic cream lotion

xiii. Disinfectants

xiv. Crepe bandage

xv. Cotton bandage

xvi. Embrocation

xvii. A bottle of hydrogen peroxide

xviii. Analgesic tablets aspirin

xix. Soap.

Safety Environment and Equipment in Electrical Workshop

Equipment and materials are commonly utilized in transmitting knowledge in the workshop or on the field and laboratory to the learner; they are used in demonstrations, practices for learning of skill and for skill testing in specified vocation and technical areas of teaching and learning. Machines and tools are combined for the purpose of this heading to be referred to as equipment and may be used interchangeably.

Therefore, equipment is those teaching and learning machines that are mostly operated mechanically or manually with oil, gas electricity, battery or solar powers among others in the workshop. Oladimeji stated that equipment are also often regarded as large or heavy equipment. Some of them include the lathe machine, kiln, pug mill, sewing machines, chain saws, tractors, circular saws, weaving looms, screen printing machines, electric or gas cookers. Everett and Jekins (2001) commented that equipment are devices that help a person to do work. Everett and Jekins maintained that with equipment works can be done faster, better and more safely. They added that equipment used in manufacturing products and installation are classified as hand tools, portable power tools, power machine and equipment and finally, industrial machine and equipment etc.

While materials are referred to as objects used to sharpen out, construct or work upon for the production of an item. In other words, it is that substances from which items or things can be made from (solid or liquid materials). These materials include wood, plastic, glass, metal, Plaster of Paris (POP) clay, fabric, leather and rubber etc. Robicca (2001) supported the above statement that our world is made up of a great variety of materials with steel, glass, nylon, aluminum and wood as just a few of materials from which products are made. These materials are called industrial; industrial materials can be classified as natural or synthetic. Natural materials are those that can be found in nature wood and metal are example while materials that are made by people are called synthetic e.g. plastics because they are manmade.

However, it is an obvious fact that the realization of the objective of technical education depends to a large extent on the availability of equipment and materials and their safety teaching and learning about equipment and materials is of great importance for the purpose of practical implementation in the workshop. The success

of curriculum is not lying at the feet of the teachers only, but to conducive environment in form of workshop, laboratory and equipment. Ama (1999) noted that one of the major problems facing technical education in the Federation is inadequacy of safety equipment. In Plateau and Kaduna State technical colleges, the situation is the same. Ama added that, poor maintenance of equipment and materials constitutes a serious drawback to the development of technical educational. Everett and Jekins (2001) emphasized that technical teachers should be competent in handling machines, equipment and tools effectively in teaching and learning by means of demonstration and ability to organize practical work. The acquisition of manipulation skills effectively by means of instructional methods such as demonstration and project method will go a long way in helping the study to improve in their practical skills.

The role workshop equipment and materials can play in technology education institutions in the training of electrical students for the acquisition of practical skills to become self-reliant economically cannot be over emphasized. Where equipment and materials are available for use in the school workshop, it enables the students to use both hands and brains in learning. This places them in a better position with adequate skills to produce materials or items by themselves through project, for example spanners, relays, amplifier and models. Equipment and machines in the school workshop promote the students desire to be creative in producing models and other samples that could be sold for revenue for the schools concerned, national develop and a good technological know-how. This of course has to be achieved if the learners are equipped with tools to work and to practice. With this workshop equipment and materials supplied, the learners will work and practice with great confidence.

A skilled student as a result of adequate utilization of workshop equipment and material would be engaged in repairs and maintenance of broken-down tools and

equipment which are common in our technology education (electrical) workshop. This would promote facility management and reduce wastage.

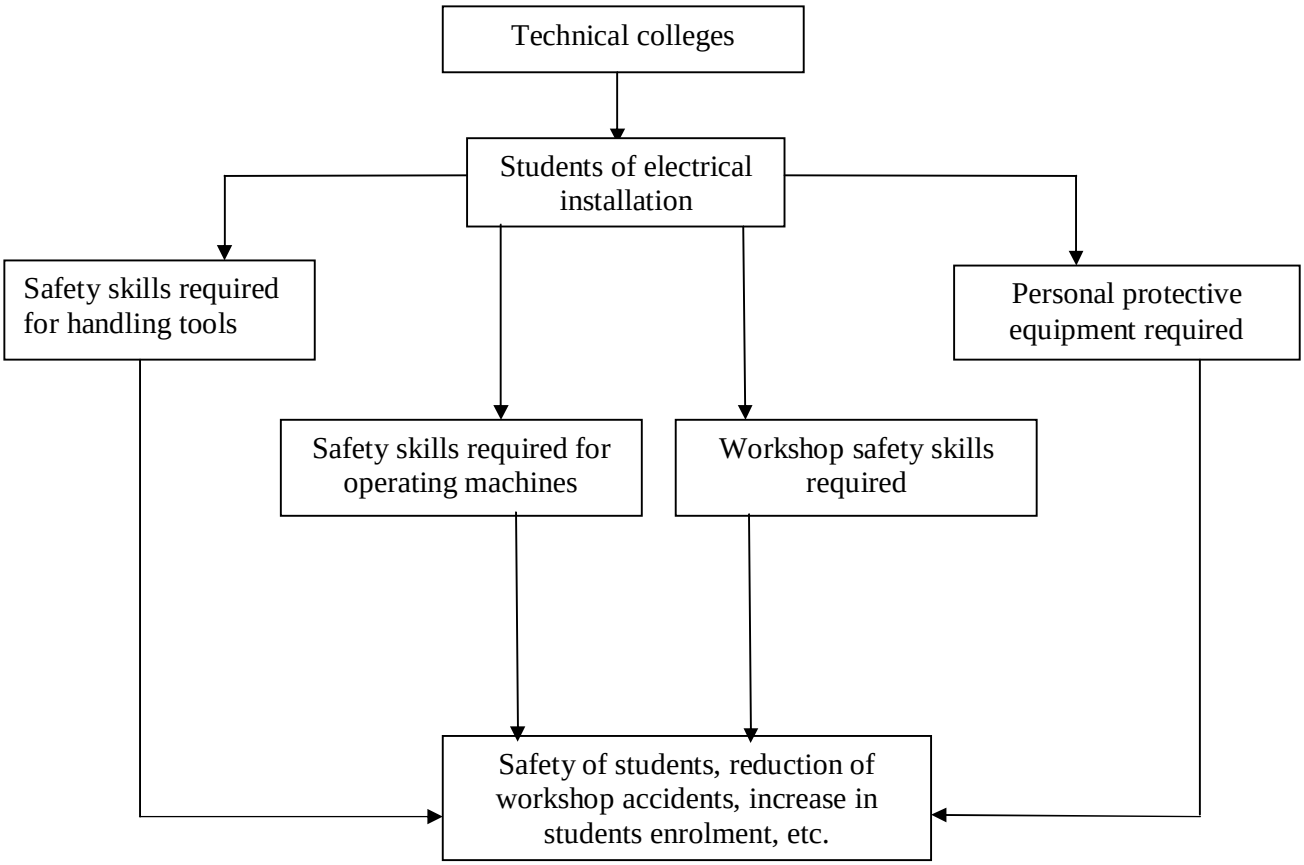

Fig. 1: Schema of Safety Skills Required by Electrical Students in Handling Electrical Equipment

Source: produced by the researcher, 2014.

Description of Schema

Technical colleges in plateau and Kaduna states offer electrical installation trade, made up of the following components: Domestic and industrial installation, cable jointing/battery charging and repairs as well as winding of electrical machine. Students of electrical installation trade are to carry out practical activities in each of the aforementioned. To achieve that with little or no record of accident, safety skills are required by the students in handling hand tools, for machine tool operation,

workshop safety and the use of personal protective equipment (PPE). When these safety measures are properly observed, there will be a reduction in workshop accident, increase in student enrolment into the trade and studentôs performance ability will increase.

Theoretical Framework

In an attempt to identify and develop safety consciousness in students, there is need to review a safety theory that will be relevant to the study. A theory is a representative of a system of believes upon human aspirations or a conjecture, a speculation, an opinion, or hypothesis. It is therefore not necessarily based on facts and it does not have to tally truly with the descriptions of reality. Ezeji (2001) described theory as consisting of statements or prepositions which are made in order to explain natural phenomena. Olaitan (2003) sees a theory as systematically related set of statements including some laws like generalization that is empirically testable. According to James (2009), a number of safety theories have been developed based on the idea of ñif we can get technology right we can control the risk whilst others feel that we must get peopleôs attitudes rightsò.

óHuman versus Machine Safety Theory

Heinrich, Peter and Roos propounded the safety theory which they referred to as óHuman Versus Machine Safety Theory in 1980 which state that the elimination of unsafe acts of workers, the use of mechanical guarding and correction of environmental, mechanical or physical hazards are fundamentals and first requirement of a complete safety programme. Emphasizing further, they said that safety begin with the use of correct tools, machines work process and materials in safe environment.

They added that the dangerous nature of machines can be attributed to either the designers or users technical incapability. This is because the incorrect use and abuse of machines, which create danger, are blamed on people. The tarrying degree of workers failure is fully portrayed by its direct result in loss of limb or money. They remarked that the misunderstanding of instructions, recklessness, violent temper and lack of knowledge or training results in unsafe acts which cause personnel injuries or property damage.

The above theory had provided a good framework on which the study will be based. This is because of the relevance of the theory to the study, especially in the area of using tools, materials and operating equipment and machines in electrical workshop environment with the associated hazards or accidents and the solutions, which the theory indicated will be based on improvement of unsafe acts.

Need Assessment Theory

Abraham Maslaw developed a theory of personality that has influenced a number of different fields, including education. This wide influence is due in part to the high level of practicality of maslowôs theory. This theory accurately described many realities of personal experiences. In 1954, Maslow first published motivation and personality, which introduced his theory about how people satisfy various personal needs. He theorized that a person could not recognize or pursue the next higher need in the hierarchy until her or his currently recognized need was substantially or completely satisfied, a concept called prepotency. It is often illustrated as a pyramid with the survival need at the broad-based bottom and the self-actualization need at the narrow top. They are as follows:

Maslow's hierarchy of needs

1. Physiological	Thirst, sex, hunger
2. Safety	Security, stability, protection
3. Love and belongingness	To escape loneliness, love and be loved, and gain a sense of belonging
4. Esteem	Self-respect, the respect for others
5. Self-actualization	To fulfill oneôs potentialities

The hierarchy theory is often represented as a pyramid, with the larger, lower levels representing the lower needs, and the upper point representing the need for self-actualization. Maslow believes that the only reason that people would not move well in direction of self-actualization is because of hindrances placed in their way by society. He further stated that education is one of these hindrances and recommends ways education can switch from its usual person-stunting tactics to person-growing approaches. Maslow states that educators should respond to the potential an individual has for growing into a self-actualizing person of his/her own kind. Ten points that educators should address as stated by James (2009) are listed below:

1. We should teach people to be authentic, to be aware of their inner selves and to hear their inner-feeling voices.
2. We should teach people to transcend their cultural conditioning and become world citizens
3. We should help people discover their vocation in life, their calling, fate or destiny. This is especially focused on finding the right career and the right mate.
4. We should teach people that life is precious, that there is joy to be experienced in life, and if people are open to seeing the good and joyous in all kinds of situations, it makes life worth living.

5. We must accept the person as he or she is and help the person learn their inner nature from real knowledge of aptitudes and limitations we can know what to build upon, what potentials are really there.
6. We must see that the personôs basic needs are satisfied. This includes safety, belongingness, and esteem needs.
7. We should refresh consciousness, teaching the person to appreciate beauty and the other good things in nature and in living.
8. We should teach people that controls are good and abandonment is bad. It takes control to improve the quality of life in all areas
9. We should teach people to transcend the problems and grapple with the serious problems in life. These include the problems of injustice of pain, suffering and death.
10. We must teach people to be good choosers. They must be given practice in making good choices.

The theory is relevant to this study because, it helps to understand the need for training students and employees in electrical work discipline of the skill needs in safety practice which will give them the required experience that further practical skills will be based.

Job Training Theory

Prosser and Quigley promulgated job training theory in (1949) as training in an operation where the entire purpose is to develop skills and give an opportunity to apply technical knowledge. The theory stipulates that effective establishment of process habits in any learner will be secured in proportion as the training is given on actual job and not exercises or pseudo jobs. The theory is further oriented towards the acquisition of practical skills, and stipulates that training should be given on the real

jobs and not on pseudo jobs. The theory proposes that adequate job training would improve the productivity and the safety of the worker.

This theory is related to this study because it is directed on the training which will provide skills especially safety skills for the work or the student which this study aims at.

Related Empirical Studies

Several research studies have been carried out on safety and general accidents. The literature on skill required in safety practice in electrical installation seems to be uncommon or scanty despite the importance of this aspect to electrical profession.

In a related study on safety skills in technical college workshops, Yakubu (2004) conducted a research on safety practice skills needed by the Woodwork Students of Technical College in Kaduna State with five research questions. The study aimed at determining safety practice skills needed by the students in using hands tools, operating power tools and operating machines. A survey design was used, the population was 108 and a structured questionnaire was used in data collection, the findings revealed that students needed safety in using woodwork hand tools, operating woodwork portable power tools, operating woodwork machines and handling wood materials. The two studies are related because they centered on safety practices skills. Although the two studies differ because the previous study is on safety practice skills needed by the wood work students while the present study is on safety skills required by electrical installation students.

Also, Okpharaeke (2004) conducted a research on Safety Practice Skills Needed by Trainees and Employers of Block laying and Concreting in the Building Industry in Imo State to determine the safety practice skills needed in block molding, use of equipment and machines, preliminary site operations, block wall construction

among others. A survey design was used with a population of 152 and six research questions. A structured questionnaire was used in data collection and the major findings among others include: the trainees needed more safety in block molding, use of equipment and machines, preliminary site operations, use of equipment and machines for wall construction and finishing. The two studies are related because they focus on safety practice skills need for work. However, while the previous study was on block laying and concreting, the present study is on electrical installation.

Similarly, Amiseh (2008) conducted a study on Strategies for Enhancing Electrical Safety Practices and Awareness in Small and Medium Scale Industries in Benue State with four research questions to determine the problems involved in the use of electricity, precautionary measures to be taken, remedial measures and sensitization mode for workers. A survey design was used with a population of 1938 and 896 sample through random sampling: a structured questionnaire was used for data collection. The two studies are related because they centered on safety practices. Although the two studies differ because the previous study is on strategies for enhancement while the present study is on safety skills required.

However, Abimbola (2007) carried out a research on Skill Improvement Needs of Technical Teachers for Maintenance of Woodwork Equipment in Secondary Schools in Ogun State with four research questions. The study aimed at determining skills acquired and those needed, a survey design was used and the population was 72. A structured questionnaire was used for data collection. The findings includes: woodwork teachers do not possess the competencies required by them to effectively maintain woodwork equipment. The present study is related to the previous study because both of them have skills needed as an objective. However, the previous study

differs from the present study because the previous study was on skill improvement need while the present is on safety skills required.

Also, Omozokpia (1994) investigated the status of safety education programme in workshops of technical education programmes in Niger State. Questionnaire was used to collect relevant data from stratified sample of 195 teachers randomly selected from a total population of 305 teachers. Percentage and frequency counts were used to answer the research equations, while Friedmanôs Two-way Analysis of Variance was used to test the hypothesis at 0.05 level of probability. The study among other things revealed that teachersô use of various teaching methods and evaluation for safety education depends on teachersô qualification, teaching and industrial experience. The two studies are related because they centered on acquisition of safety skills. The two studies differ because the previous study is on investigation on the status of safety education while the present study is on safety skills required.

Summary of the Review of Related Literature

The related literature was reviewed on technical education, electrical installation trade, equipment and tools, approaches to safety skills determination, safety skills in handling hand tools, safety skills in machine tools operation, safety skills required for work in the workshop and personal protective equipment required.

The Human versus Machine Safety Theory by Heinrich, Peter, and Roos (1980), Need Assessment Theory by Abraham Maslaw and Job Training Theory postulated by Prosser, and Quigley (1949) were used for the study.

In related empirical studies, a study on safety practice skills needed by the woodwork students of technical college in Kaduna State by Yakubu (2014) was reviewed. The author found out that woodwork students have little or no safety skills

in using woodwork hand tools, potable tools, and operating woodwork machines. A study on safety practice skills needed by trainees and employers of block laying and concreting in the building industries in Imo State by Okpharaeke (2004) was conducted. Also a study on strategies for enhancing electrical safety practice and awareness in small and medium scale industries in Benue State by Amiseh (2008) was carried out. Another study was conducted on skill improvement needs of technical teachers for maintenance of woodwork equipment in secondary schools in Ogun State by Abimbola (2007) and a study on the status of safety education programme in workshops of technical education programme in Niger State by Omozokpia (1994) was investigated. The study revealed that teachers teaching method on safety is not encouraging due to their qualification and lack of industrial experience.

From the literature reviewed, it seems clear that no study was carried out on safety skills required in handling electrical equipment and none of the study was carried out in Plateau and Kaduna State. This is the gap the study is set to fill by treating ñsafety skills required by technical college electrical installation students in handling equipment in Plateau and Kaduna Statesò.

CHAPTER III

METHODOLOGY

This chapter presents the procedure to be adopted for the study under the following sub-headings: design of the study, area of the study, population for the study, instrument for data collection, validation of the instrument, reliability of the instrument, method of data collection and method of data analysis.

Design of the Study

The study used descriptive survey research design. Descriptive survey research design, according to Ali (2006), is one in which a group is studied by collecting and analyzing data from a sample considered to be representative of the population or the entire population when it is not too large to be managed and comparing what is obtained with the predetermined standards. This design is suitable for the study since information was solicited from the respondents (the teachers) through questionnaire on issues relating to the objectives of the study.

Area of the Study

The area of the study was Plateau and Kaduna states. There are seven technical colleges in these states. They are: Government Science and Technical College, Bukuru; Government Technical College, Malali; Government Technical College, Soba; Government Technical College, Kajuru; Government Technical College, Fadanchawe; Government Technical College, Abet and Federal Science and Technical College, Kafanchan. Each technical college has electrical installation as a trade or program. The area of the study was chosen because poor habit of safety practice in electrical installation workshops is on the increase in the technical colleges in the states.

Population for the Study

The population for the study is 80. This consists of 39 electrical installation teachers and 41 electrical installation workers in Plateau and Kaduna States. (See appendix D for population distribution).

Sample and Sampling Technique

The entire population was used for the study because it is of manageable size. Thus there was no sampling.

Instrument for Data Collection

The instrument for data collection is a structured questionnaire. The questionnaire was developed by the researcher from the available literature on electrical installation and safety practice skills. The title of the questionnaire is safety skills in electrical installation (SSEI). The questionnaire is divided into 5 sections (A-E), section A sought information on personal data of the respondent. Section B sought information on safety skills required for handling tools and it has 10 items. Section C dealt with the safety skills required for operating machine tools and it has 25 items. Section D sought information on safety skills required for work in the workshop and it comprises of 10 items. Section E is on the personal protective equipment required and it has a total of 20 items. The response options to the items based on a four-point scale rating, with numerical value of 4, 3, 2 and 1 are as follows:

Highly Required (HR) = 4

Required (R) = 3

Slightly Required (SR) = 2

Not Required (NR) = 1

Validation of the Instrument

The instrument was subjected to face-validation by three lecturers. Two from the Department of Vocational Teacher Education, University of Nigeria, Nsukka, and one from the Department of Science and Technical Education, University of Jos. This approach is in consonance with Bakare (2010), who pointed out that face- validation is to ensure that the questionnaire items elicit the desired responses in the research questions. The validates were required to assess the questionnaire in terms of clarity, appropriateness, and relevance in addressing the problem of the study. Their suggestions and recommendations were taken into consideration in the final draft of the instrument.

Reliability of the Instrument

The cronbach Alpha coefficient method was used to determine the internal consistency of the instrument. It was obtained by administering 5 copies of the questionnaire to electrical installation teachers and 15 copies to electrical installation workers in Nasarawa State. The data obtained was analyzed using mean and standard deviation while the cronbach reliability technique was applied to obtain the reliability coefficients for each cluster and for the entire instrument.

Method of Data Collection

The instruments were administered on the respondents by the researcher through personal contacts and with the help of four research assistants. The research assistants were trained by the researcher on procedures in administering the instruments so as to ensure proper administration, safe handling and return of the instrument. This technique helps the researcher and increases the return-rate of all the 80 questionnaires administered. Some of the questionnaires were retrieved by the

researcher directly from the respondents while others were done through the research assistants.

Method of Data Analysis

For analyzing the data, mean and standard deviation were used. The research questions were answered using mean while the hypotheses were tested using t-test statistics. Therefore any item on safety skill required that had a mean score of 2.50 and above was regarded as required whereas any item with a mean score below 2.50 was regarded as not required. The hypotheses were tested using the t-test at 0.05 level of significant.

The decision of testing the hypotheses was based on comparing the critical values obtained from statistical tables with the values of the statistical tool used (t-test) at 0.05 level of significance. A null hypothesis is accepted when the critical value is greater than the calculated value of the statistics, otherwise the null hypothesis was rejected and the alternative accepted.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

This chapter presents the analysis of data collected in the study. The presentation and analysis is organized in Tables according to the research questions and hypotheses formulated for the study.

RESEARCH QUESTION 1:

What are the safety skills required of electrical installation students in handling hand tools?

The data for answering the above research question are presented in Table one below:

Table 1:

Means and Standard Deviations of Responses of Electrical Installation Teachers and Electrical Installation Workers on the Safety Skills Required of Electrical Installation Students in Handling Hand Tools.

s/n	Safety skills required in handling hand tools in electrical installation workshops are ability to:	Mean	SD	Decision
1	Select right tools for the job	3.69	0.49	R
2	Use tools with a good handle always	3.53	0.59	R
3	Avoid using tools without handles	3.35	0.64	R
4	Check the sharpness of hack saw blades, scribers, punch and screwdrivers before use.	3.21	0.52	R
5	Use appropriate tools for a specific job or operation	3.55	0.53	R
6	Know the capacity of any tool before using it for any work.	3.54	0.59	R
7	Use insulated hand tools for electrical work	3.60	0.56	R
8	Put finger behind the tip of the screwdriver while screwing	3.23	0.89	R
9	Use correct size of screwdrivers for work.	3.38	0.66	R
10	Give a tool to colleague through the handle.	3.19	0.78	R
	Grand Mean	**3.43**		

Key: NR= Not Required; R= Required

The data presented in Table 1 showed that item 1 to 10 had their Means ranging from 3.19 to 3.69 which were above the cut-off point of 2.50. This implies that all the 10 safety skills listed in the Table were required by electrical installation students for using hand tools.

RESEARCH QUESTION 2:

What are the safety skills required of electrical installation students for operating machine tool in technical college workshop?

The data for answering the above research question are presented in Table two below:

Table 2:

Means and Standard Deviations of Responses of Electrical Installation Teachers and Electrical Installation Workers on Safety Skill Required of Electrical Installation Students for Operating Machine Tool.

s/n	Safety skills required for operating machines tools in electrical workshop are ability to:	Mean	SD	Decision
11	Protect hands with gloves and wear safety shoes when operating portable tools and machines	3.63	0.54	R
12	Wear approved eye protector when operating a power tool.	3.49	0.55	R
13	Stop power tools or machines before cleaning activities or making any adjustment.	3.54	0.57	R
14	Switch off the socket outlet before power tools or machine is connected.	3.48	0.64	R
15	Disconnect the power tools or machine immediately the work is done.	3.41	0.49	R
16	Disconnect the power tool or machine immediately a strange sound is noticed.	3.54	0.53	R
17	Remove the plug of the power tool or machine before making any adjustment.	3.48	0.57	R
18	Test the power tool or machine for functionality before use.	3.35	0.68	R
19	Keep the body away from the rotating part of the power tool/machine	3.53	0.57	R
20	Never put the whole body weight on portable drill while drilling	3.40	0.61	R
21	Never adjust any power tool or machine while running	3.39	0.67	R
22	Check faults in the power tool or machines before re-use.	3.33	0.63	R
23	Use brush to remove chips from drilling machine	3.21	0.71	R
24	Remove all hand tools from power tools or machines table.	3.27	0.53	R
25	Switch off the machine or power tool after use.	3.47	0.50	R
26	Remove power tools and machines from the power source after use.	3.39	0.62	R
27	Check and tighten drill bit before use	3.50	0.62	R
28	Concentrate on work while using power tool or machine.	3.53	0.62	R
29	Keep fingers away from cutting edge of power tool or machine.	3.66	0.48	R
30	Maintain safety margin specified for a machine	3.51	0.64	R
31	Use apron or overall while operating any power tool or machine.	3.38	0.62	R
32	Report to the instructor any strange noise from the power tool or machine	3.53	0.53	R
33	Stop operating power tool or machine if job is boring or when you get tired.	3.41	0.61	R
34	Remove coat and jacket, tie and roll up loose sleeves before operating any machine.	3.46	0.59	R
35	Turn off the power machine and wait until the motor stops.	3.25	0.65	R
	Grand Mean	**3.45**		

Key: NR= Not Required; R= Required

The data presented in Table 2 showed that item 11 to 35 had their Mean ranged from 3.21 to 3.66, which were above the cutoff point of 2.50. This implies that all the 25 safety skill listed in the Table were required by electrical installation students for operating machine tools.

RESEARCH QUESTION 3:

What are the workshop safety skills required of electrical installation students in technical colleges?

The data for answering the above research question are presented in Table two below:

Table 3:

Means and Standard Deviations of Responses of Electrical Installation Teachers and Electrical Installation Workers on Workshop Safety Skills Required of Electrical Installation Students.

s/n	The workshop Safety skills required of electrical installation students are ability to:	Mean	SD	Decision
36	Keep gang ways clear and provide free access to every part of the workshop.	3.56	0.59	R
37	Remove all loose cables from the floor of the workshop.	3.48	0.55	R
38	Work in a very bright workshop.	3.38	0.60	R
39	Keep the floor off grease, oil or any liquid.	3.34	0.62	R
40	Remove all rings, brackets and similar metal item.	3.23	0.55	R
41	Wear hand gloves when working in the workshop.	3.34	0.57	R
42	Keep all tools in the workshop in their boxes.	3.21	0.54	R
43	Never throw any hand tool to colleague in the workshop.	3.46	0.57	R
44	Walk carefully in the workshop.	3.38	0.60	R
45	Make use of the recommended fire extinguisher in the workshop in case of fire outbreak.	3.38	0.66	R
	Grand Mean	**3.38**		

Key: NR= Not Required; R= Required

The data presented in Table 3 showed that item 36 to 45 had their Mean ranged from 3.21 to 3.47, which were above the cutoff point of 2.50. This implies that all the 10 workshop safety skills listed in the Table were required by electrical installation students for workshop safety.

RESEARCH QUESTION 4:

What are the personal protective equipment and materials required by students for work in electrical installation workshop?

The data for answering the above research question are presented in Table two below:

Table 4:

Means and Standard Deviations of Responses of Electrical Installation Teachers and Electrical Installation Workers on Personal Protective Equipment and Materials Required by Students for Work in Electrical Installation Workshop.

s/n	The personal protective equipment and materials required by students in electrical workshops are:	Mean	SD	Decision
46	Safety goggles	3.54	0.59	R
47	Fire extinguishers	3.55	0.55	R
48	Functional first aid box	3.53	0.57	R
49	Safety helmet	3.46	0.59	R
50	Written safety precautions signs	3.33	0.69	R
51	Sand bucket	3.26	0.63	R
52	Emergency exit	3.44	0.61	R
53	Machine guard	3.36	0.64	R
54	Protective hand gloves and boot	3.38	0.56	R
55	Overall/aprons	3.29	0.64	R
56	Zebra crossing warning sign	3.00	0.91	R
57	Waste bin	3.03	0.73	R
58	Traffic flow	2.99	0.82	R
59	Machine speed warning sign	3.18	0.64	R
60	Out of bound sign on entrance of hazardous components	3.21	0.69	R
61	Prohibitory sign e.g. no smoking	3.24	0.73	R
62	Tools cabinet/rack	3.10	0.69	R
63	Work area	3.21	0.71	R
64	Dust duct and turbo fans	3.14	0.74	R
65	Protective foot wear	3.35	0.58	R
	Grand Mean	**3.28**		

Key: NR= Not Required; R= Required

The data presented in Table 4 showed that item 46 to 65 had their Mean ranged from 3.00 to 3.99, which were above the cutoff point of 2.50. This indicates that all the 20 personal protective equipment and materials listed in the Table were required by students for work in electrical installation workshop.

Hypotheses 1:

There is no significant difference between the mean responses of electrical installation teachers and workers on the safety skills required of electrical installation students in handling hand tools.

Table 5:

Summary of t-test Analysis of Mean Responses of Electrical Installation Teachers and Electrical Installation Workers on the Safety Skills Required by Students in Handling Hand Tools

s/n	Safety skills required in handling hand tools in electrical installation workshops include ability to:	Electrical Teachers n = 39		Electrical Workers n =41		df	t-test	Sig.(2-tailed)	Decision
		X_1	$S.D_1$	X_2	$S.D_2$				
1	Select right tools for the job	3.59	0.55	3.78	0.42	78	-1.75	0.08	NS
2	Use tools with a good handle always	3.41	0.68	3.63	0.49	78	-1.70	0.09	NS
3	Avoid using tools without handles	3.31	0.73	3.39	0.54	78	-0.58	0.57	NS
4	Check the sharpness of hack saw blades, scribers, punch and screwdrivers before use.	3.26	0.55	3.17	0.49	78	0.73	0.47	NS
5	Use appropriate tools for a specific job or operation	3.62	0.54	3.49	0.51	78	1.09	0.28	NS
6	Know the capacity of any tool before using it for any work.	3.54	0.68	3.54	0.50	78	0.01	0.99	NS
7	Use insulated hand tools for electrical work	3.67	0.62	3.54	0.50	78	1.03	0.31	NS
8	Put finger behind the tip of the screwdriver while screwing	3.10	1.07	3.34	0.69	78	-1.19	0.24	NS
9	Use correct size of screwdrivers for work.	3.33	0.700	3.41	0.63	78	-0.55	0.59	NS
10	Give a tool to colleague through the handle.	3.13	0.98	3.24	0.54	78	-0.66	0.51	NS

Key: NS= Not Significant; S= Significant; df= Degree of freedom; t cal= calculated values of t-test SPSS; SD= Standard Deviation; X_1= Mean of Electrical Teachers; X_2= Mean of Electrical Workers;n_1=Number of Electrical Installation Teachers; n_2=Number of Electrical Installation Workers; Level of Significance=0.05

Table 5 showed that all the 10 safety skills had their computed probability (sig. 2-tailed) values ranged from 0.08 to 0.99. These values are greater than 0.05 criterion level of significance. This indicates that there is no significant difference in the Mean responses of the respondents (electrical installation teachers and workers) on the items. Therefore, the hypothesis of no significant difference (H_o1) was accepted.

Hypotheses 2:

There is no significant difference between the mean responses of electrical installation teachers and workers on the safety skills required of electrical installation students for operating machine tools.

Table 6:

Summary of t-test Analysis of Mean Responses of Electrical Installation Teachers and Electrical Installation Workers on the Safety Skills Required by Students in operating machine Tools

s/n	Safety skills required for operating machines tools include ability to:	Electrical Teachers n = 39		Electrical Workers n =41		df	t-test	Sig.(2-tailed)	Decision
		X_1	$S.D_1$	X_2	$S.D_2$				
11	Protect hands with gloves and wear safety shoes when operating portable tools and machines	3.67	0.53	3.59	0.55	78	0.68	0.50	NS
12	Wear approved eye protector when operating a power tool.	3.46	0.55	3.51	0.55	78	-0.41	0.68	NS
13	Stop power tools or machines before cleaning activities or making any adjustment.	3.49	0.60	3.59	0.55	78	-0.77	0.45	NS
14	Switch off the socket outlet before power tools or machine is connected.	3.49	0.64	3.46	0.64	78	0.17	0.87	NS
15	Disconnect the power tools or machine immediately the work is done.	3.51	0.51	3.32	0.47	78	1.79	0.08	NS
16	Disconnect the power tool or machine immediately a strange sound is noticed.	3.56	0.50	3.51	0.55	78	0.44	0.66	NS
17	Remove the plug of the power tool or machine before making any adjustment.	3.49	0.60	3.46	0.55	78	0.18	0.85	NS
18	Test the power tool or machine for functionality before use.	3.31	0.79	3.40	0.55	77	-0.60	0.55	NS
19	Keep the body away from the rotating part of the power tool/machine	3.64	0.58	3.43	0.55	77	1.69	0.09	NS
20	Never put the whole body weight on portable drill while drilling	3.59	0.55	3.22	0.61	78	2.84	0.01	S
21	Never adjust any power tool or machine while running	3.44	0.79	3.34	0.53	78	0.63	0.53	NS
22	Check faults in the power tool or machines before re-use.	3.36	0.71	3.29	0.56	78	0.47	0.64	NS
23	Use brush to remove chips from drilling machine	3.03	0.82	3.38	0.54	75	-2.26	0.03	S
24	Remove all hand tools from power tools or machines table.	3.26	0.60	3.28	0.46	75	-0.16	0.88	NS
25	Switch off the machine or power tool after use.	3.55	0.50	3.39	0.49	78	1.45	0.15	NS
26	Remove power tools and machines from the power source after use.	3.44	0.75	3.32	0.47	78	0.85	0.39	NS
27	Check and tighten drill bit before use	3.56	0.68	3.44	0.55	78	0.91	0.37	NS
28	Concentrate on work while using power tool or machine.	3.49	0.72	3.56	0.50	78	-0.53	0.59	NS
29	Keep fingers away from cutting edge of power tool or machine.	3.67	0.48	3.66	0.48	78	0.08	0.94	NS
30	Maintain safety margin specified for a machine	3.42	0.72	3.59	0.55	77	-1.15	0.26	NS
31	Use apron or overall while operating any power tool or machine.	3.36	0.67	3.39	0.59	78	-0.22	0.82	NS
32	Report to the instructor any strange noise from the power tool or machine	3.59	0.49	3.46	0.55	78	1.07	0.29	NS
33	Stop operating power tool or machine if job is boring or when you get tired.	3.49	0.68	3.34	0.53	78	1.07	0.29	NS
34	Remove coat and jacket, tie and roll up loose sleeves before operating any machine.	3.44	0.59	3.49	0.59	78	-0.39	0.69	NS
35	Turn off the power machine and wait until the motor stops.	3.28	0.65	3.23	0.65	78	0.43	0.67	NS

Key: NS= Not Significant; S= Significant; df= Degree of freedom; t cal= calculated values of t-test SPSS; SD= Standard Deviation; X_1= Mean of Electrical Teachers; X_2= Mean of Electrical Workers; n_1=Number of Electrical Teacher Installation Teachers; n_2= Number of Electrical installation workers; Level of Significance=0.05

The data in Table 6 reveals that items 11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22, 24 to35 had their computed probability (sig. 2- tailed) values ranged from 0.08 to 0.94 which is greater than 0.05 criterion level of significance. This indicates that there is no significant difference in the Mean responses of the respondents (electrical installation teachers and workers) on those items. The null hypothesis was accepted for those items. However, item 20 and 23 had their computed probability values to be less than 0.05 (0.01 and 0.03). Therefore, there is significant difference in the responses of the respondents to those items. The null hypothesis was therefore rejected for the two items (20 and 23).

Hypotheses 3:

There is no significant difference between the mean responses of electrical installation teachers and workers on workshop safety skills required of electrical installation students in technical colleges.

Table 7:

Summary of t-test Analysis of Mean Responses of Electrical Installation Teachers and Electrical Installation Workers on the Workshop Safety Skills Required by Students in the workshop

s/n	The workshop Safety skills required of electrical students are ability to:	Electrical Teachers n = 39 X_1	$S.D_1$	Electrical Workers n =41 X_2	$S.D_2$	Df	t-test	Sig.(2-tailed)	Decision
36	Keep gang ways clear and provide free access to every part of the workshop.	3.53	0.61	3.59	0.59	73	-0.45	0.66	NS
37	Remove all loose cables from the floor of the workshop.	3.51	0.56	3.44	0.55	78	0.59	0.55	NS
38	Work in a very bright workshop.	3.38	0.63	3.37	0.58	78	0.14	0.89	NS
39	Keep the floor off grease, oil or any liquid.	3.45	0.72	3.24	0.49	77	1.47	0.15	NS
40	Remove all rings, brackets and similar metal item.	3.26	0.64	3.19	0.46	78	0.49	0.62	NS
41	Wear hand gloves when working in the workshop.	3.31	0.66	3.37	0.49	78	-0.45	0.65	NS
42	Keep all tools in the workshop in their boxes.	3.15	0.63	3.27	0.45	78	-0.94	0.35	NS
43	Never throw any hand tool to colleague in the workshop.	3.44	0.64	3.49	0.51	78	-0.40	0.69	NS
44	Walk carefully in the workshop.	3.31	0.66	3.44	0.55	78	-0.97	0.33	NS
45	Make use of the recommended fire extinguisher in the workshop in case of fire outbreak.	3.36	0.67	3.39	0.67	78	-0.21	0.84	NS

Key: NS= Not Significant; S= Significant; df= Degree of freedom; t cal= calculated values of t-test SPSS; SD= Standard Deviation; X_1= Mean of Electrical Teachers; X_2= Mean of Electrical Workers;n_1=Number of Electrical Installation Teachers; n_2=Number of Electrical Installation Workers; Level of Significance=0.05

Table 7 showed that all the 10 safety skill items had their computed probability (sig. 2- tailed) values ranged from 0.15 to 0.89. These values are greater than 0.05 criterion significance value, which indicates that there is no significant difference in the Mean responses of the respondents (electrical installation teachers and workers) on the items. Therefore, the hypotheses of no significant difference in the mean ratings of the two groups of respondents on the 10 safety skills were not rejected.

Hypotheses 4:

There is no significant difference between the mean responses of the electrical installation teachers and workers on personal protective equipment and materials required in electrical installation workshop.

Table 8:

Summary of t-test Analysis of Mean Responses of Electrical Installation Teachers and Electrical Installation Workers on the Personal Protective Equipment and materials Required in Electrical Workshop

s/n	The personal protective equipment and materials required in electrical workshops are:	Electrical Teachers n = 39 X_1	$S.D_1$	Electrical Workers n =41 X_2	$S.D_2$	df	t-test	Sig.(2-tailed)	Decision
46	Safety goggles	3.51	0.56	3.56	0.63	78	-0.36	0.72	NS
47	Fire extinguishers	3.54	0.51	3.56	0.59	78	-0.18	0.86	NS
48	Functional first aid box	3.54	0.60	3.51	0.55	78	0.20	0.84	NS
49	Safety helmet	3.46	0.60	3.46	0.59	78	-0.01	0.99	NS
50	Written safety precautions signs	3.33	0.70	3.32	0.69	78	0.11	0.92	NS
51	Sand bucket	3.31	0.69	3.22	0.57	78	0.62	0.54	NS
52	Emergency exit	3.36	0.71	3.53	0.51	77	-1.20	0.23	NS
53	Machine guard	3.31	0.69	3.41	0.59	78	-0.74	0.46	NS
54	Protective hand gloves and boot	3.38	0.54	3.37	0.58	78	0.15	0.88	NS
55	Overall/aprons	3.36	0.63	3.22	0.65	78	0.97	0.33	NS
56	Zebra crossing warning sign	2.79	1.12	3.20	0.61	76	-2.03	0.05	S
57	Waste bin	3.03	0.84	3.02	0.61	78	0.01	0.99	NS
58	Traffic flow	2.85	0.93	3.12	0.68	78	-1.52	0.13	NS
59	Machine speed warning sign	3.26	0.72	3.13	0.56	77	0.91	0.37	NS
60	Out of bound sign on entrance of hazardous components	3.38	0.75	3.05	0.59	78	2.24	0.03	S
61	Prohibitory sign e.g. no smoking	3.38	0.75	3.09	0.70	78	1.77	0.08	NS
62	Tools cabinet/rack	3.16	0.79	3.05	0.59	77	0.69	0.49	NS
63	Work area	3.36	0.71	3.07	0.69	78	1.84	0.07	NS
64	Dust duct and turbo fans	3.21	0.80	3.07	0.69	78	0.79	0.43	NS
65	Protective foot wear	3.49	0.64	3.22	0.47	78	2.12	0.04	S

Key: NS= Not Significant; S= Significant; df= Degree of freedom; t cal= calculated values of t-test SPSS; SD= Standard Deviation; X_1= Mean of Electrical Teachers; X_2= Mean of Electrical Workers;n_1=Number of Electrical Installation Teachers; n_2=Number of Electrical Installation Workers; Level of Significance=0.05

The data in Table 8 reveals that items 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 57, 58, 59, 61, 62, 63 and 64 had their computed probability (sig. 2- tailed) values to be greater than 0.05 criterion level of significance (0.070 to 0.994), which indicates that there is no significant difference in the Mean responses of the respondents on those items. However, items 56, 60 and 65 had their computed probability values to be less than 0.05 (0.028 and 0.046), which indicates that there is significant difference in the mean responses of the respondents to the items. The null hypotheses for the three items (56, 60 and 65) were rejected.

Major Findings of the Study

The following findings emerged from the study with respect to the research questions and hypotheses tested:

1. **Many safety skills required of electrical installation students in handling hand tools were established from the study.** Some of the safety skills include the ability to:
   i. Select right tools for the job,
   ii. Use tools with a good handle always,
   iii. Avoid using tools without handles,
   iv. Check the sharpness of hack saw blades, scribers, punch and screwdrivers before use,
   v. Use appropriate tools for a specific job or operation,
   vi. Know the capacity of any tool before using it for any work,
   vii. Use insulated hand tools for electrical work,

viii. Put finger behind the tip of the screwdriver while screwing,

ix. Use correct size of screwdrivers for work and

x. Give a tool to colleague through the handle.

2. **Other findings of the study are safety skills required of electrical installation students for operating machine tools.** The skills include:

i. Protect hands with gloves and wear safety shoes when operating portable tools and machines,

ii. Wear approved eye protector when operating a power tool,

iii. Stop power tools or machines before cleaning activities or making any adjustment,

iv. Switch off the socket outlet before power tools or machine is connected,

v. Disconnect the power tools or machine immediately the work is done,

vi. Disconnect the power tool or machine immediately a strange sound is noticed,

vii. Remove the plug of the power tool or machine before making any adjustment,

viii. Test the power tool or machine for functionality before use,

ix. Keep the body away from the rotating part of the power tool/machine,

x. Never adjust any power tool or machine while running,

xi. Check faults in the power tool or machines before re-use and

xii. Remove all hand tools from power tools or machines table.

3. **It was also found from the study that many workshop Safety skills are required by electrical installation students.** Some of the workshop safety skills are:

i. Keep gang ways clear and provide free access to every part of the workshop,

ii. Remove all loose cables from the floor of the workshop,

iii. Work in a very bright workshop,

iv. Keep the floor off grease, oil or any liquid,

v. Remove all rings, brackets and similar metal item,

vi. Wear hand gloves when working in the workshop,

vii. Keep all tools in the workshop in their boxes,

viii. Never throw any hand tool to colleague in the workshop,

ix. Walk carefully in the workshop and

x. Make use of the recommended fire extinguisher in the workshop in case of fire outbreak.

4. **Also in the findings of the study is that many personal protective equipment and materials were found to be required by electrical installation students.** The personal protective equipment and materials required by electrical students include:

i. Safety goggles,

ii. Fire extinguishers,

iii. Functional first aid box,

iv. Safety helmet,

v. Written safety precautions signs,

vi. Sand bucket,

vii. Emergency exit,

viii. Machine guard,

ix. Protective hand gloves and boot,

x. Overall/aprons,

xi. Waste bin,

xii. Traffic flow,

xiii. Machine speed warning sign,

xiv. Prohibitory sign e.g. no smoking,

xv. Tools cabinet/rack,

xvi. Work area and

xvii. Dust duct and turbo fans.

5. It was also found that there was no significant difference in the mean responses of electrical installation teachers and electrical installation workers on the safety skills required of electrical installation students in handling hand tools and most of operating machine tools.
6. Furthermore, it was found that there was no significant difference in the mean responses of electrical installation teachers and electrical installation workers on the workshop safety skills, and most of the personal protective equipment and materials required of electrical installation students.
7. However, significant difference was found in the mean responses of electrical installation teachers and workers on two of operating machine tools. The significant difference existed on never put the whole body weight on portable drill while drilling and use brush to remove chips from drilling machine. Also, significant difference was found in the mean responses of electrical installation teachers and workers on three of the protective equipment and material required by electrical installation students. The significant difference also existed on the mean responses of respondents on zebra crossing warning signs, out of bound sign on entrance of hazardous component and protective food wear.

Discussion of the Findings

The findings of the study were organized and discussed under the following sub-headings: safety skills required in handling hand tools, safety skills required for operating machine tools, workshop safety skills and personal protective equipment and materials required by the students.

Safety Skills Required by the Students in Handling Hand Tools

The result of the study revealed that many safety skills are required by students in handling hand tools in electrical installation. These skills include ability to: Select right tools for the job; Use tools with a good handle always; Avoid using tools without handles; Check the sharpness of hack saw blades, scribers, punch and screwdrivers before use; Use appropriate tools for a specific job or operation; Know the capacity of any tool before using it for any work; Use insulated hand tools for electrical work; Put finger behind the tip of the screwdriver while screwing; Use correct size of screwdrivers for work; and Give a tool to colleague through the handle. This finding is in line with the work of Yakubu (2004) who stated that hand tools do not usually cause accidents if they are in working order, used correctly, carried carefully and stored safely. The findings also were in consonance with the opinion of Nwachukwu (2006) who said that, available tools should be classified according to usage and they should be properly serviced before embarking on a new job. It is necessary therefore for electrical installation students to take adequate measures while carrying out any activity in the workshop.

The result of the analysis of hypothesis revealed that there was no significant difference in the mean responses of electrical installation teachers and electrical installation workers on the safety skills required of electrical installation students in

handling hand tools. This result implies that those safety skills are generally accepted as the required safety skills for handling hand tools in electrical installation work.

Safety Skills Required for Operating Machine Tools

The result of the study also showed many safety skills that are required for operating machine tools in electrical installation which are also in line with the view of ITF (2011). These include ability to: Protect hands with gloves and wear safety shoes when operating portable tools and machines; Wear approved eye protector when operating a power tool; Stop power tools or machines before cleaning activities or making any adjustment; Switch off the socket outlet before power tools or machine is connected; Disconnect the power tools or machine immediately the work is done; Disconnect the power tool or machine immediately a strange sound is noticed; Remove the plug of the power tool or machine before making any adjustment; Test the power tool or machine for functionality before use; Keep the body away from the rotating part of the power tool/machine; Never adjust any power tool or machine while running; Check faults in the power tool or machines before re-use; Remove all hand tools from power tools or machines table; Switch off the machine or power tool after use; Remove power tools and machines from the power source after use; Check and tighten drill bit before use; Concentrate on work while using power tool or machine; Keep fingers away from cutting edge of power tool or machine; Maintain safety margin specified for a machine; Use apron or overall while operating any power tool or machine; Report to the instructor any strange noise from the power tool or machine; Stop operating power tool or machine if job is boring or when you get tired; Remove coat and jacket, tie and roll up loose sleeves before operating any machine; and Turn off the power machine and wait until the motor stops. The result is

in line with Oranu, Nwoke and Ogwo (2002) that the users or operators of power machines and tools should always wear eye goggles when drilling machines. The result is also in agreement with Bakare (2010) that operators should always wear face shield when using drilling machines and make sure that the switch is off before connecting drilling machine to source. It is therefore important that students of electrical installation should wear and use certain materials to play safe in electrical installation workshop.

The result of the study also showed that there was no significant difference in the mean responses of electrical installation teachers and electrical installation workers most of the safety skills required for operating machine tools. However, significant difference existed in the mean responses of electrical installation teachers and electrical installation workers on few of the safety skills. The significance difference where found in such skills as; never put the whole body weight on portable drill while drilling and use brush to remove chips from drilling machine.

Workshop Safety Skills Required in Electrical Work

Another outcome of the study which is in agreement with Bakare (2010) and NAPTIN (2010) was that workshop safety skills required in electrical installation include: gang ways should be kept clear and provide free access to every part of the workshop; loose cables should be removed from the floor of the workshop and students should work in a very bright workshop as well as keep the floor off grease. It was found that all rings, brackets and similar metal item should be removed and that wear hand gloves when working in the workshop and should keep all tools in the workshop in their boxes. The student should never throw any hand tool to colleagues in the workshop but Walk carefully in the workshop and make use of the recommended fire extinguisher in the workshop in case of fire outbreak. When

students perform carefully and avoid carelessness in the workshop, there will be less or no injuries.

The result of the study on the analysis of hypothesis showed that there was no significant difference in the mean responses of electrical installation teachers and electrical installation workers on workshop safety skills required of students. This is because the workshop safety skills are important to every student for effective electrical installation work and safety.

Personal Protective Equipment and Materials Required in Electrical Workshop

The study revealed the personal protective equipment and material required by students in electrical installation workshop which are in agreement with Everett and Jenkins (2001) and ITF (2011) that such equipment include: Safety goggles; Fire extinguishers; Functional first aid box; Safety helmet; Written safety precautions signs; Sand bucket; Emergency exit; Machine guard; Protective hand gloves; Overall/aprons; Waste bin; Traffic flow; Machine speed warning sign; Prohibitory sign e.g. no smoking; Tools cabinet/rack; Work area; and Dust duct and turbo fans are very important for safety in electrical installation work. There should be a safety belt and dry stick in the workshop.

From the test of hypothesis, no significant difference in the mean responses of electrical installation teachers and electrical installation workers on personal protective equipment and materials required by students was found on most of the items. However, significant difference existed in only few items such as zebra crossing warning sign, out of bound on entrance of hazardous components and protective food wear.

CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This Chapter contains re-statement of the problem, summary of procedure used, summary of findings of the study, conclusion, implications of the study, recommendations and suggestions for further studies.

Re-statement of the Problem

Students of electrical installation in technical colleges are trained to acquire adequate skill to be employable. This goal can only be achieved if the students are safe and available for training. In a situation where their health is jeopardized because of electric shock and other related workshop accidents, the dream for skill acquisition becomes a mirage. Therefore, in consideration for all other important aspects of the training programme, safety should be a top priority since all others depend solely on the health of both teachers and students as well as the courage of student to handle electrical equipment and accessories without fear.

Safety as an issue in electrical workshop is meant to curb or avert workshop accidents. Workshop accidents have negative effect on both the interest of the students in the course as well as their lives and health, even that of their teachers. It has been established that many students and even teachers and instructors shy away from workshop practices for the fear of falling victims of accidents in the workshop. Such scenario is neither in the interest of the programme nor the achievement of the programme goals. Fear of accident is the last thing that should be allowed to befall electrical installation programme. It is through this programme in the technical college that much needed craftsmen are trained to service both electrical and allied industries in Nigeria. Electricity is the pillar of economic development in any country, including Nigeria. Therefore, trainees in electrical installation should not be allowed

to either be afraid of electrical accident or gloss over safety issues in electrical installation workshop; rather they should be informed in every aspect of safety in the workshop. Therefore, the problem of this study was the decline in enrolment and the avoidance of practical activities in electrical workshops by students due to fear of electrical accident. Hence, the necessity to determine the safety skills required by technical college electrical installation students in handling equipment in the states.

Summary of Procedure Used

The study adopted descriptive survey research design. The study was aimed at determining the safety skills required by technical college electrical installation students in Plateau and Kaduna States. Specifically the objectives of the study were to determine the safety skills required in: handling hand tools, operating machine tools, workshop safety skills and personal protective equipment (PPE).

To achieve these objectives, four research questions and four null hypotheses were formulated. The population for the study was 80 which consisted of 39 electrical installation teachers in 7 Technical Colleges in Plateau and Kaduna states as well as 41 qualified electrical installation workers. The entire population was used for the study. Questionnaire was the instrument used for data collection which consists of 65 items developed by the researcher from the reviewed literature. The instrument was validated by three experts: Two from the Department of Vocational Teacher Education, University of Nigeria, Nsukka and one from the Department of Science and Technical Education, University of Jos. Data was collected by the researcher with the help of four research assistants. The data collected were analyzed using mean, while t-test for independent sample was used to test the null hypothesis of no significant difference in the mean responses of electrical installation teachers and electrical installation workers at 0.05 level of significance.

Summary of Findings

A summary of the major findings of this study is as follows:

1. Many safety skills required by students of electrical installation in handling hand tools were found from the study. Some of the safety skills are: Select right tools for the job, use tools with a good handle always, avoid using tools without handles, check the sharpness of hack saw blades, scribers, punch and screwdrivers before use and use appropriate tools for a specific job or operation
2. The study also found many safety skills required by the students in operating machine tools. The skills include the ability to: protect hands with gloves and wear safety shoes when operating portable tools and machines, wear approved eye protector when operating a power tool, stop power tools or machines before cleaning activities or making any adjustment, switch off the socket outlet before power tools or machine is connected and disconnect the power tools or machine immediately the work is done.
3. Similarly, the study identified the workshop safety skills required by electrical installation students. The workshop safety skills include: keep gang ways clear and provide free access to every part of the workshop, remove all loose cables from the floor of the workshop, work in a very bright workshop, keep the floor off grease, oil or any liquid and remove all rings, brackets and similar metal item.
4. It was also found that many personal protective equipment (PPE) and materials are required by students. Such equipment and materials include: safety goggles, fire extinguishers, functional first aid box, safety helmet, written safety precautions signs sand bucket, and emergency exit.
5. Furthermore, no significant difference was found between the mean responses of electrical installation teachers and electrical installation workers on safety skills

required by the students in handling hand tools and operating machine tools as well as on workshop safety skills and personal protective equipment and materials required by electrical installation students.

Conclusion

Teaching and learning of electrical installation is heavily dependent on the good health, interest and availability of students. Training/instruction cannot be carried out in atmosphere of fear and uncertainly. To achieve success in training students in electrical installation, safety has to be given adequate consideration. The study therefore, found that in order to avoid accidents and waste of materials while working with electrical equipment, in the workshop, there is need for students to acquire safety skills in handling hand tools, operating machine tool, workshop safety skills and to possess the Personal Protective Equipment (PPE) and materials required for work. Many safety skills required by electrical installation students were identified by this study. Some of the skills are: use tools with a good handle, wear approved eye protector when operating any power tool, gang ways should be kept clear to provide free access to every part of the workshop and written safety precautions signs should be made available.

Implications of the Study

The findings of this study have implications for the electrical installation teachers, students, Government, curriculum planners, workshop personnel/electrical workers, National Board for Technical Education (NBTE), society/parents and the academic researchers.

Based on the findings on safety skill required in handling hand tool; operating machine tool; workshop safety skills and personal protective equipment (PPE)

electrical installation, the teachers should adopt the findings identified in teaching their students on safety skills required for successful electrical installation work. These skills will also serve as vital basic and background skill and knowledge for other electrical installation services. Master electrical worker should also widen their scope to these basic skills and knowledge so as to be proficient in their services and also produce adequately electrical installation workers.

The findings of the study would also help the curriculum planners to develop appropriate curriculum that will make provision for electrical installation teachers to teach safety skills as course of study in electrical technology. The students will benefit from the findings by understanding the skills to apply when doing work, likewise the workshop personnel /electrical workers. Also, the society and parent will benefit when the students transfer the knowledge gain into the community. The curriculum planners would through the findings of the study select the necessary pedagogy and technics that will be useful in the teaching of the safety skills. The study also has implication to academic researchers as it will serve as good literature for their further research aimed at solving problems in the society.

Limitation of the Study

Although the researcher and the research assistants explained to the respondents listed above the objectives of the study and how to fill the questionnaire, the respondents may not have completed the questionnaire objectively which can affect the generalization of the result of the study. The result of this study may also be affected by the respondentsô mood and bias at the time of filling the questionnaire. Furthermore, since the questionnaire is not a commonly used or validated instrument but developed by the researcher, it may not have elicited the full answers to the objectives of the study.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Safety skills should be included in the curriculum of electrical installation at technical college level.
2. Workshop/seminars should be regularly organized for electrical installation teachers to acquaint them with the safety skills required by students for safe workshop practice and in electrical installation work.
3. The National Board for Technical Education (NBTE) should incorporate safety skill in the electrical installation curriculum as well as in the regulatory or quality assurance programme.
4. Safety skills should be taught as a separate course or subject in electrical installation trade in technical colleges in Nigeria to give it the prime importance it deserves.

Suggestions for Further Research

The following suggestions were made for further research.

1. Development and validation of safety skills modules in electrical installation trade should be carried out.
2. Effect of safety skills on studentsô interest and performance in electrical installation in technical colleges in Nigeria should be conducted.

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APPENDICES

APPENDIX 'A'

Department of Vocational Teacher Education,

Faculty of Education,

University of Nigeria Nsukka,

29th May, 2014.

Dear Sir,

Request for Validation of Instrument

I am a post graduate student of Industrial Technical Education Unit in the department of Vocational Teacher Education; I am carrying out a project research titled: Safety Skills Required by Technical College Electrical Installation Students in Handling Equipment in Plateau and Kaduna States.

I humbly request you to critically examine the instrument in terms of relevance of the content and clarity of the statement.

Thank you for your cooperation.

Yours faithfully,

Dung Choji Joseph

APPENDIX 'B'

Department of Vocational Teacher Education,
Faculty of Education,
University of Nigeria Nsukka,
Enugu State,
28 May, 2014.

Dear Sir/Madam,

Safety Skills Required by Technical College Electrical Installation Students in Handling Equipment in Plateau and Kaduna States.

I am a post graduate student of the above university, currently carrying out a study on the topic stated above.

You have been identified as one who could provide useful information needed to the successful conduct of this study. It will be appreciated if you will complete this questionnaire and return it to the bearer.

The information provided by you will be treated with utmost confidence and will be used strictly for the intended purpose.

Thank you for your anticipated cooperation.

Yours faithfully

Dund Choji Joseph.

APPENDIX 'C'

SECTION A

QUESTIONNAIRE

DEPARTMENT OF VOCATIONAL TEACHER EDUCATION
FACULTY OF EDUCATION
UNIVERSITY OF NIGERIA, NSUKKA

SAFETY SKILLS REQUIRED BY TECHNICAL COLLEGE ELECTRICAL INSTALLATION STUDENTS IN PLATEAU AND KADUNA STATES

SECTION A: Personal Data

Instruction: check (✓) against the box or fill the gap-as applicable to you.

i. Name of College: é é é é é é é é é ..

ii Status: Electrical Teacher ( ) Instructor ( )

Instruction: please provide the information requested using a check (✓) in the appropriate column or space provided, be assured that information provided are for research purpose only and will be treated with strict confidence.

KEY:

Highly Required (HR)

Required (R)

Slightly Required (SR)

Not Required (NR)

SECTION "B"

Research Question 1: What are the safety skills required of electrical installation students in handling hand tools in the workshops of Technical Colleges in Plateau and Kaduna States?

S/No	Safety skills required in handling hand tools in electrical installation workshops:	HR	R	SR	NR	
1.	Select right tools for the job					
2.	Use tools with a good handle always					
3.	Avoid using tools without handles					
4.	Check the sharpness of hack saw blades, scribers, punch and screwdrivers before use.					
5.	Use appropriate tools for a specific job or operation					
6.	Know the capacity of any tool before using it for any work.					
7.	Use insulated hand tools for electrical work					
8.	Put finger behind the tip of the screwdriver while screwing					
9.	Use correct size of screwdrivers for work.					
10.	Give a tool to colleague through the handle.					

SECTION "C"

Research Question 2: What are the safety skills required of electrical installation students for operating machines tool in the workshops of technical colleges in Plateau and Kaduna States?

S/No	Safety skills required in operating machines for electrical workshop:	HR	R	SR	NR	
11	Protect hands with gloves and wear safety shoes when operating portable tools and machines					
12	Wear approved eye protector when operating a power tool.					
13	Stop power tools or machines before cleaning activities or making any adjustment.					
14	Switch off the socket outlet before power tools or machine is connected.					
15	Disconnect the power tools or machine immediately the work is done.					
16	Disconnect the power tool or machine immediately a strange sound is noticed.					
17	Remove the plug of the power tool or machine before making any adjustment.					
18	Test the power tool or machine for functionality before use.					
19	Keep the body away from the rotating part of the power tool/machine					
20	Never put the whole body weight on portable drill while drilling					
21	Never adjust any power tool or machine while running					
22	Check faults in the power tool or machines before re-use.					
23	Use brush to remove chips from drilling machine					
24	Remove all hand tools from power tools or machines table.					
25	Switch off the machine or power tool after use.					
26	Remove power tools and machines from the power source after use.					
27	Check and tighten drill bit before use					
28	Concentrate on work while using power tool or machine.					
29	Keep fingers away from cutting edge of power tool or machine.					
30	Maintain safety margin specified for a machine					
31	Use apron or overall while operating any power tool or machine.					

32	Report to the instructor any strange noise from the power tool or machine					
33	Stop operating power tool or machine if job is boring or when you get tired.					
34	Remove coat and jacket, tie and roll up loose sleeves before operating any machine.					
35	Turn off the power machine and wait until the motor stops.					

SECTION "D"

Research Question 3: What are the workshop safety skills required of electrical installation students in Technical Colleges in Plateau and Kaduna States?

S/No	Safety skills required for work in electrical workshops.	HR	R	SR	NR	
36	Keep gang ways clear and provide free access to every part of the workshop.					
37	Remove all loose cables from the floor of the workshop.					
38	Work in a very bright workshop.					
39	Keep the floor off grease, oil or any liquid.					
40	Remove all rings, brackets and similar metal item.					
41	Wear hand gloves when working in the workshop.					
42	Keep all tools in the workshop in their boxes.					
43	Never throw any hand tool to colleague in the workshop.					
44	Walk carefully in the workshop.					
45	Make use of the recommended fire extinguisher in the workshop in case of fire outbreak.					

SECTION "E"

Research Question 4: what are the personal protective equipment and materials required by students in electrical installation workshops of technical colleges in Plateau and Kaduna States?

S/No	The following are the personal safety equipment and materials required in electrical workshops:	HR	R	SR	NR	
46	Safety goggles					
47	Fire extinguishers					
48	Functional first aid box					
49	Safety helmet					
50	Written safety precautions signs					
51	Sand bucket					
52	Emergency exit					
53	Machine guard					
54	Protective hand gloves and boot					
55	Overall/aprons					
56	Zebra crossing warning sign					
57	Waste bin					
58	Traffic flow					
59	Machine speed warning sign					
60	Out of bound sign on entrance of hazardous components					
61	Prohibitory sign e.g. no smoking					
62	Tools cabinet/rack					
63	Work area					
64	Dust duct and turbo fans					
65	Protective foot wear					

APPENDIX 'D'

LIST OF TECHNICAL COLLEGES IN PLATEAU AND KADUNA STATES

S/N	TECHNICAL COLLEGES	TEACHERS	WORKERS	TOTAL
	PLATEAU STATE		14	14
1.	Government Science and Technical College, Bukuru.	6		6
	KADUNA STATE		27	27
2.	Government Technical College, Malali, Kaduna.	7		7
3.	Government Technical College, Soba, Zaria.	6		6
4.	Government Technical College, Kajuru.	4		4
5.	Government Technical College, Fadanchawe, Kaura.	6		6
6.	Government Technical College, Abet, Zango Kataf.	4		4
7.	Federal Science and Technical College, Kafanchan	6		6
	TOTAL	39	41	80

Source: Plateau State Ministry of Education, Kaduna State Science and Technical Board Management and Federal Inspectorate Division Kaduna 2014.