ASSESSMENT OF DOMESTIC ELECTRICAL INSTALLATION PRACTICES OF TECHNICIANS IN MINNA METROPOLIS

BY

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT

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CERTIFICATION

I Umeh Edith Happiness with matriculation number PGD/ITE/08/031 a post graduate diploma student of the Department of Industrial and Technology Education, certify that the work embodied in this project is original and has not been submitted in part or full for any other Diploma or Degree of this or any other University.

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APPROVAL PAGE

This project has been read and approved as meeting the requirements for the award of Post Graduate Diploma in Industrial and Technology Education of the Department of Industrial and Technology Education, School of Science and Science Education, Federal University of Technology, Minna.

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DEDICATION

This project is dedicated to my late parents Mr. and Mrs. Simon Madu, and my lovely and caring husband, Mr. Sylvanus Umeh for his support and encouragement given to me during the course of my studies.

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My appreciation goes to God Almighty who bestows His favour upon me. My profound gratitude goes to my supervisor, Mallam Sani A. Musa for his tireless effort, advice, instruction and suggestions that brought this work to a completion. Special thanks to my husband, Mr. Sylvanus Umeh for his financial and moral support, without which it could have been impossible to complete my course of study.

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ABSTRACT

This project is on the Assessment of Domestic Electrical Installation Practices of Technicians in Minna Metropolis. This research study sought to investigate the practices of technicians in domestic electrical installation work; the factors that influences the practices of technicians in domestic electrical installation work and ways of improving the practices of domestic electrical installation technicians. Three research questions and one null hypothesis were formulated to guide the study. A sixty (60) item questionnaire was developed and used to collect data from five major locations in Minna. Data collected was analyzed using frequency count, mean, standard deviation and t-test statistics. The null hypothesis were tested at 0.05 level of significance and 348 degree of freedom. The findings revealed that the practices of technicians are not favourable to them, the electricity consumers and the electrical profession. It was also revealed that the technicians do not adhere to the IEE Regulations and often carry out wrong installation. The findings also revealed that the technicians have low level of education and finds it difficult to produce or interpret wiring diagrams. The study also revealed that technicians can update their work skills and improve their practices by having a standard trade curriculum, a standard form of evaluation and through undergoing training and retraining courses on modern electrical installation practices. The implications of the findings were discussed and recommendations made to enable technicians to acquire the needed work skills and knowledge to enable them improve their pactices

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CHAPTER I

INTRODUCTION

Background of the Study

Vocational training has been accorded the foundation of modern day vocational and technical education all over the world. This is because it focuses on the use of manipulative skills to solve the dynamic problems in the society. Ogwo and Oranu (2006) describe vocational training as a skill acquisition programme acquired through the informal apprenticeship system where the basic scientific knowledge inherent in the skill is not emphasized.The domestic electrical installation technician otherwise called domestic electrician is a typical product of vocational training.The National Board for Technical Education (NBTE, 2002) described a domestic electrician as a tradesman or individual who specializes in the repair and installation of electrical wiring systems and associated devices in domestic buildings (homes).The domestic electrician carries out domestic electrical installation practices to ensure availability of electricity in the home. According to Adewale (2000),domestic electrical installation practices encompasses all domestic electrical installations and wiring activities which is aimed at ensuring availability and safe use of electricity in residential buildings.

Electricity refers to the electrical power that we receive in our houses from power stations in the form of alternating current and voltage.NBTE (2000) emphasizes that a domestic electrician is neither a labourer nor a professional but is somewhere between the two. Domestic electricians are very important today because they make sure residential areas are properly wired, maintain that wiring and ensure a safe electrical system. As with most aspect of life regulations are put in place to perfect the people and to ensure their activities comply with set standards.Domestic electrical installation is also one area where regulations are enforced in order to save lives.Adegoke (2001) revealed that one of such regulations approved by the Nigerian Electric Regulatory Commission (NERC) is the

Institution of Electrical Engineers (IEE) Regulations.The IEE Regulations stipulate some basic rules that must be followed in order to ensure high quality standards and safe use of electrical installations in buildings. Non observance of these rules may have negative consequences in the operation of electrical installations such as electrocution (electric shock), electric fire leading to injury and lose of life and properties at home.

By the IEE Regulations, all electrical installation work within the home should be carried out by a certified electrician or a highly experienced electrician to ensure safety. Nuru (2010) in a review of the state of domestic electrical installations practice in Northern Nigeria pointed out that, presently the domestic electrical installation practices in Minna metropolis is in a poor state and far below the IEE Regulations. Minna has recorded a lot of fire outbreak and electrocution cases that led to injury, lose of life and properties in residential buildings due to the bad state of domestic electrical installation practices rampant in Minna metropolis. Adeyemi (2004) attributed the poor state of domestic wiring practices in Nigeria to the electricians desire to make excess profit by habitually cutting corners on jobs.

The problem facing domestic electrical installation practices in Minna are numerous to the extent that every electrical technologists and engineers both in the industrial sector and in the academic is being challenged to proffer possible solutions. Therefore, there is need for the assessment of domestic electrical installation practices in Minna metropolis. Olaitan, Igbo, Ekong Nwachukwu and Onyemachi (1999) describe assessment as a process that seeks to identify area of strengths and weakness of a particular programme or practice. It is based on these facts that it becomes necessary to assess the domestic electrical installation practices in Minna to ensure availability and safe use of electricity in residenteial buildings inMinna metropolis.

Statement of the Problem

Experience has shown that the domestic electrical installation practices in Minna metropolis is in a "sorry" condition. The present practices of these domestic electrical installation technicians appears to be unfavourable for them, their customers and the electrical profession at large. The wiring inside many residential buildings is unable to convey adequate and safe electricity to domestic appliances, lightings and electronics. Nuru (2010) lamented the increasing case of wires and cables overheating, damaging their protective insulation and consequently resulting in electric shock and fire outbreak which has claimed a lot of lives and properties in residential buildings. As at now, there is no empirical evidence as to whether the increasing cases of electrical shock and fire outbreak is caused by the practices of electrical electronic technicians. It is upon these facts that this study attempts to assess the domestic electrical installation practices of technicians in Minna metropolis.

Purpose of the Study

The purpose of the study is to assess the domestic electrical installation practices in Minna metropolis. Specifically, the study intend to:

1. Determine the practices of technicians in domestic electrical installation work.
2. Determine the factors that influence the practices of technicians in domestic electrical installation work.
3. Determine ways of improving the practices of domestic electrical installation technicians.

Significance of the Study

The findings of this study will be of benefit to the domestic electrical installation technicians, users of electricity, government and the electrical profession. It is hoped that the results of this study will provide information for the government and electrical profession administrators on the best way to improve the practices of domestic electrical installation technicians. The study will also be of importance to users of electricity in the community in saving lives and properties. The study will also improve the performance skills of domestic electrician and also enable them to be informed and responsible on the job.

Scope of the Study

This study is on the assessment of domestic electrical installation practices in Minna metropolis with respect to: determining the practices of technicians in domestic electrical installation work; determine factors that influence the practices of technicians in domestic electrical installation work, and determining ways of improving the practices of domestic electrical installation technicians. The study covered only domestic electrical installation technicians in Minna metropolis.

Research Questions

The following research questions are raised to guide the study:

1. What are the practices of technicians in domestic electrical installation work?
2. What are the factors that influence the practice of technicians in domestic electrical installation work?
3. What are the ways of improving the practices of domestic electrical installation technicians?

Hypothesis

This hypothesis was formulated and tested at 0.05 level of significance.

$H0_1$: There is no significant difference in the mean responses of electrical installation technicians and domestic electricity consumers concerning the practices of technicians in domestic electrical installation work.

CHAPTER II

REVIEW OF RELATED LITERATURE

The literature related to this study is reviewed under the following sub-headings:

1. Practices of domestic electricians
2. Electricity Regulations
3. Concept of Grounding (Earthing)
4. Electrocution and Fire Hazards
5. Wiring Techniques
6. Electrical Safety
7. Summary of Related Literature

Practices of Domestic Electricians

The power that we receive in our houses from power stations in the form of alternating current and voltage is in fact the electricity. It is usually called **mains** electricity. To a Nigerian electrician, it is the electricity from Power Holding Company of Nigeria (PHCN). Any electrical gadget that needs to be operated using electricity constitutes an electric load. Every piece of electrical equipment from an incandescent electric bulb to the refrigerator that consumes electric power to remain operative is an electric load. The amount of electrical current flowing in a circuit depends on the load being powered at any particular moment. The maximum capacity of a circuit is limited by the capacity of its wire or cable, and for safety the feed wire is usually equipped with a circuit breaker or fuse. Wikipedia (2010) revealed that all electrical wiring are useless without electricity and thus it becomes the life line of all electrical systems. Electricity supply in our houses are either around 110, 220 or 240 volts at 50 or 60 hertz depending upon which part of the world you reside. Its main line is termed the phase or live while the other receiving terminal is called the neutral. It can be absolutely fatal to touch the phase terminal whereas the neutral is just the opposite and won't produce any effect.

Adeolu (1998) refers to domestic electricity as any form of electrical power associated with residential buildings. It is the electricity used in our houses. In today's world, nothing significance can be done without electricity, heating, cooling, food storage and healthy living needs some form of electricity in the home which is what makes a domestic electrician so important today. According to Stevenson (1982), a domestic electrician refers to a person who specializes in equipment that are associated with electrical wirings of structures and buildings where people live. An electrician is a tradesman, which means that he is a manual worker who happens to be skilled in a particular field of craft or trade. This also means that he is not considered a labourer. But then, he is also not a professional. An electrician is somewhere between a professional and a labourer (NBTE, 2000). An electrician sets up, maintains and fixes electrical wiring conditions. The task of a domestic electrician include fitting and testing electrical appliances, wiring and rewiring the home, working on lights and plugs, and various other wiring related jobs in the home. Domestic electrical installation practices in Minna involves among others: the use of wrong wire sizes,sub-standard sockets,wrong installation and location of electrical devices and equipments such as trailing wires and cables,uncovered junction box,overlamping,and bad earthing connection(ungrounded connections).

Nuru (2010), emphasizes the need to hire the service of a highly experienced domestic electrical installation technician to ensure good quality of domestic installations, safety assessment, fault finding and repair work to prevent electrical accident, electrocution and electrical fire outbreak. Although there are regulations to ensure safe domestic electrical installation practices by technicians all over the world, electrical accident, electric shock and electric fire still occur due to non observance of the rules. The basic requirements for good domestic electrical installation service are often not met due to the desire of some home owners to save money, and lack of good technical knowledge on the part of the electrician due to the habit of cutting corners on jobs and desire to make excess profit per time (Herrick, 2001). Presently, in most localities in Nigeria, domestic electrical installation practices is in a poor state because the Nigeria Electric Regulatory Commission (NERC) lack adequate machinery to monitor and ensure strict adherence to the IEE Regulations (Fuji, 2002). This has led to bad electrical installation practices in the home which is characterized by defective and inadequate electrical wiring such as: overlamping, uncovered junction box, frequent tripping of circuits, flickering of lights, wrong location of electrical devices, trailing wires, too few outlets, over-wired panel, overloads and ungrounded earth connection causing increase in cases of electric shock, and fire outbreak.

Okoro (1993) attributed the poor performance of electrical technicians to the gross inadequacy of the apprenticeship system of training which is lacking in theoretical content. He pointed out that the apprentice are told what to do but not why they have to do it in the particular way specified. Ezeagu (1998) is of the opinion that the low educational level of electricians is a key factor that influences their behavior on the field. He further stated that their poor educational level makes it difficult for electricians to understand wiring diagrams, cable sizes, cable rating and electric lighting circuit designs. Okonkwo (1997) stressed the need for certification and licensing of vocational practices in Nigeria to ensure standardization and quality control. According to him, it is only through this means that the Nigeria electricity regulatory bodies can monitor and check the vocational practices in the informal sector.

Yakubu (1999) opined that the absence of government in the affairs of the informal sector is a major reason for the deterioration in electrical installation practices in the home. He advised the government to participate actively in the private sector activities to increase economic growth. Aduloju (2005) stated that training, and retraining programmes along side with technical education is the sure way to enhance the performance skills of technicians in the informal sector. Through education and training courses, the electrical technicians will be expose to theoretical content and regulations guiding domestic electrical installation practices to ensure accuracy and safety on the job.

Electricity Regulations

Increased legislation is being enforced in an attempt to prevent accidents from faulty installations and incompetent repairs (Wikipedia, 2009). The Electricity Regulations are produced by the Institution of Engineering and Technology (IET). The Institution of Electrical Engineers (IEE) produces all books related to the wiring regulations. Stevenson (1982) revealed that there are three main sets of regulations to which the electrician must conform in order that an installation shall be safe from excess current, shock, fire, corrosion, mechanical damage and leakage. These are as follows:

1. Electricity (Factories Act) special Regulations (1908 and 1944). These regulations cover the generation, transformation, distribution and use of electrical energy in factories and workshops.
2. The Electricity Supply Regulations (1937). The purpose of the Electricity Supply Regulations is to secure the safety of the public and for ensuring a proper and sufficient supply of electrical energy under these regulations, the Power Holding Company of Nigeria (PHCN) undertakes to supply the consumer at a stated voltage, phase, and frequency, with permissible variations (NERC, 2005). PHCN has the right to withhold connections or disconnect a supply if their regulations are not adhered to.
3. Regulations for the Electrical Equipments of Buildings or the IEE Regulations. These regulations have been devised by the wiring committee of the Institution of Electrical Engineers (IEE) to ensure safety in the utilization of electricity in and

about buildings. The IEE Regulations are of considerable assistance to electricians as they largely cover the requirements of the Electricity Supply Regulations. The IEE Regulations consists of two parts: part 1 contains "requirements for safety" and part 2 contains "means of securing compliance with part 1". Generally, if an installation complies with the IEE Regulations it complies both with the Factory Acts and with the Electricity Supply Regulations since the IEE Regulations are based on the requirements of these statutory regulations (Stevenson, 1982).

The IEE Regulations stipulate some basic rules that must be followed in order to ensure electromagnetic compatibility. Non observance of these rules may have serious consequences in the operation of electrical installations, disturbance of communication systems, nuisance tripping of protective devices, and even destruction of sensitive devices (Stanley, 2005).

Wikipedia (2010) pointed out that in Nigeria, the Nigerian Electric Regulatory Commission (NERC) is charged with the responsibilities of enforcing the standards set by the IEE Regulation since the standards are designed to save lives. This means that the practices defined in the IEE publication are legal obligations. Each employer has a legal obligation to ensure that a safe work environment is provided to all employees; both regular and non-regular. All domestic electrical installation technicians are required to follow the best practices and safety standards in the IEE Regulations publication.

Concept of Grounding (Earthing)

The earth is an important concept with electrical wiring because the earth does not carry a current. As such, any electricity will flow to the earth if it escapes from an electric flex or cable. This phenomenon occurs because the neutral wire is purposely connected to the earth in order to help prevent someone from electric shock. Wikipedia (2010) defined grounding or earthing as a permanent and continuous path to the earth with sufficient capacity to carry any excess current liable to be imposed on it and of a sufficient low impedance to limit the voltage rise above ground and to facilitate the operation of the protective devices in the circuit. Stevenson(1982) advices that to ensure safety, the earth fault loop should be capable of carrying three times the rating of the fuse or one and half times the setting of the overload circuit-breaker. Maximum allowable voltage between earthed metal work and the consumer's earth terminal should be 40volts. Common methods or practice of protection against Earth Leakage include using: "All-insulated" electrical construction; double insulation; Earthing of all exposed metalwork and isolation of metal work so that there is no danger of it "coming into contact with live parts."

According to the Nigerian Electric Regulatory Commission (NERC, 2005), earthing of electrical systems is required for a number of reasons, principally to ensure the safety of people near the electrical system and to prevent damage to the system itself in the event of a fault. The function of the protective conductor or earth is to provide a low resistance path for fault current so that the circuit protective devices operate rapidly to disconnect the supply. The National Electrical Code (NEC, 2005) defines a ground as "a conducting connection whether intentional or accidental between an electrical circuit or equipment and the earth, or to some conducting body that serves in place of the earth." Talking about grounding actually involves two different subjects, earth-grounding and equipment grounding. Earth grounding is an intentional connection from a circuit conductor usually the neutral to a ground electrode placed in the earth. Equipment grounding is to ensure that operating equipment within a structure is properly grounded (Wikipedia, 2010). These two grounding systems are required to be kept separate except for a connection between the two systems to prevent differences in potential arising from a possible flashover from a lighting strike. The purpose of the ground besides the protection of people, plants and equipment is to provide a safe path for the dissipation of fault currents, lighting strikes, static discharges, signals and interference.

Improper grounding can create a lethal hazard. Correct grounding is essential for correct operation and safety of electrical equipments. Grounding can solve many problems, but it can also create/cause new ones. One of the most common problem is called "ground loop." Kisner (1998) defines a ground loop as a condition where an unintended connection to ground is made through an interfering electrical conductor. Generally, ground loop connection exists when an electrical system is connected through more than one way to the electrical ground. When two or more devices are connected to a common ground through different paths, a ground loop occurs. Currents flow through these multiples paths and develop voltages which can cause damage, noise or 50Hz/60Hz hum in audio or video equipment. To prevent ground loops, all signal grounds need to go to one common point and when two grounding points cannot be avoided, one side must isolate the signal and grounds from the other.

Wikipedia (2010) emphasizes that a perfect "quiet" ground does not exist due to the presence of objectional current. The standard electrical grounding system throughout the building is not designed to have current constantly flowing through it, and yet it does, you cannot stop it because electricity always tries to take a shorter route to ground. Remember that there is no absolute ground. There is a certain amount of resistance to electrical current between all grounding points. This resistance can change with humidity, temperature, connected equipment and many other variables. No matter how small, the resistance can always allow an electrical voltage to exist across it. The ground wires between wall sockets and power transformers are not perfect conductors and neither is the shield of your coaxial video cable. If they were, ground loops would not be a problem. Effects of ground loops in video pictures are in the form of a black shadow bar across the screen or as tearing in the top corner of a picture. This is caused by different earth potentials in a system.

Electrocution and Fire Hazards

Electrocution (electrical shock) and fire are the two common lethal hazards that can result from electricity. Whenever you work with power tools or on electrical circuits, there is a risk of electrical hazards. Engineers, electricians and other professionals who work with electricity directly or indirectly are likely to be exposed to electrical hazards. Yakubu (1999) stated that many workers are not aware of the potential electrical hazards present in their work environment, which makes them more vulnerable to the danger of electrocution. Electrocution is the passage of electric current through the human body as a result of direct contact (Wikipedia, 2010). When an electric shock happens, the current enter the body at one point of contact and then leave the body at another point causing injury or deaths.

Parker (1992) reveal that the severity of electric shock injuries depends on the current's voltage, the amount of current (amperage), the type of current (direct or alternating), the body's resistance to the current, the current's path through the body, and the length of time the body remains in contact with the current. How electric shocks affect the skin depends on the skin's resistance to current, which in turn depends on the wetness, thickness and cleanliness on the skin. Thin or wet skin is much less resistance than thick or dry skin. When the skin's resistance to current is low, the current may cause little or no skin damage but severely burn internal organs and tissues. By contrast, high skin resistance can produce severe skin burns but prevent the current from entering the body. The nervous system (brain, spinal cord and nerves) is very sensitive to electric shock injuries and as a result neurological problems are the most common consequences suffered by electric shock victims. Damage to the respiratory and cardiovascular systems is highest at time of injury (Wikipedia, 2010). Electric shock can paralyse the respiratory system or disrupt heart action, causing instant death. Many other injuries are possible after an electric shock, including amputation, cataracts, kidney failure and destruction of muscle tissue. Fire hazards occur when electric arc from electric shock set clothing or nearby flammable substances on fire.

Wikipedia (2010) stated that electric shocks are caused by the passage of electric current through the body. In infants and young children, it is caused by their playing with electrical appliances or cords and in older children by mischievous exploration of electrical systems or use of faulty electrical appliances or tools. Parker (1992) stressed that to prevent electric hazards, parents and adults need to be aware of possible electric dangers in the home. Damaged electric appliances, wiring, cords and plugs should be repaired, replaced or discarded (Stevenson, 1982). Hair dryers, radios and other electric appliances should never be used in the bathroom or where they may accidently come in contact with water. Young children need to be kept away from electrical appliances and should be taught about the dangers of electricity as early as possible. They should not be allowed to play with any electrical cord. Electric outlets also require safety covers in homes with young childrens. Children should be warned not to climb on power towers, play near transformer systems or explore electrified trail or other electrical systems.

Adegoke (2001) highlight the following practices to individuals and electricians to prevent electric hazards: employ the service of a professional electricians, wear rubber shoes/gloves while doing electrical work, light up and lock main electric panel, switch off power supply immediately when there is electric arc, cut off electricity supply while repairing, install plugs and switches properly, make use of good wiring, provide effective earthing, remove or insert fuse carefully, utilize safety standards, do electric jobs cautiously, and use wooden ladders while doing electrical repairs.

Wiring Techniques

It is often asked "what is the best wiring system?" There is no simple answer as the choice depends upon the technical and economic suitability for the conditions of service. Kisner (1998) revealed that the code of practice on electrical installation (CP 321: 1965) gives the following considerations as necessary for the design and planning of installations:

1. The type of supply and the earthing arrangements available.
2. The probable maximum and minimum ambient air temperature in all parts of the installation.
3. The possible presence of moisture or corrosive conditions or both.
4. The possible presence of flammable or explosive dust, vapour or gas.
5. The degree of mechanical protection necessary.
6. The importance of continuity of service, including the possible need for standby supply for general or special purposes.
7. The probable need for modification and re-wiring during the life of the building and the question whether it is necessary to avoid disturbance of surface finishes.
8. The probability of future extension of the initial installation.
9. The probable operating and maintenance costs, taking into account the electricity supply tariffs (bills) available.
10. The relative cost of various alternative methods, e.g. of wiring, in relation to the estimated life of the installation.

Thus many factors have to be taken into account. The type of wiring may be dependent upon as to whether the building is existing or under construction.

Akanbi (1998) stated that, the materials for wiring interior electrical system in domestic building vary depending on:

- Intended use and amount of power demand on the circuit.

- Type of occupancy and size of the building
- National and local regulations.
- Environment in which the wiring must operate.

For example, wiring systems in a single family home or duplex are simple with relatively low power requirement, infrequent changes to the building structure and layout, usually with dry, moderate temperature and non corrosive environment conditions. In a light commercial environment, more frequent wiring changes can be expected, large apparatus smay be installed and special conditions of heat or moisture may apply. Generally, wiring methods are either surface wiring or conduit wiring. Surface wiring involves running wires and cables which can be seen physically while conduit wiring involves running wires and cable through an enclosure in the form of pipe or tubes (Wikipedia, 2009). However, in facilities that handle flammable gases or liquids, corrosive or wet or explosives atmosphere, special rules may govern the installation and wiring of electrical equipment in such areas and all other hazardous areas.

Wires and cables are very important in domestic electrical installation because they are used to conduct electric power from the generated point to the point where it is used. A cable is defined in the IEE Regulations as "a length of insulated single conductor (solid or stranded) or of two or more such conductors, each provided with its own insulation, which are laid up together (Wikipedia, 2009). A cable consists of basically two parts, a conductor and an insulator. Copper and Aluminum are the most common materials used as conductors in electrical work. The conductor is generally in the form of either a single-core or two-core or three-core or multi-core. Cables consists of conductors, insulators and sometimes mechanical protectors. Wikipedia (2009) revealed that a practical electrician will meet two common types of cables used in his work which are: flexible cables (flexible cord) and sheathed cables. The flexible cables include: polyvinyl chloride (P.V.C.) insulated single core wire (cable), two core or twin cable and three core (twisted) cable while the sheathed cables include P.V.C. sheathed cables, tough rubber sheathed (TRS) cables, lead alloy P.V.C. sheathed (LAS) cables and polychloroprene (P.C.P.) sheathed cables. The groups of cables and wires that exists in electrical field include: power cables, mining cables, overhead cables, communication cables, appliances-wiring cables, electric-sign cables and equipment cables. Adewoyin (2001) stresses the importance of understanding wires and cable ratings for safe domestic electrical installations. Wires and cables are rated by the circuit voltage, temperature rating and environmental conditions (moisture, sunlight, oil, chemicals) in which they can be used. A wire or cable has a voltage rating and a maximum conductors surface temperature rating. The amount of current a cable or wire can safely carry depends on the installation conditions.

Cables size is classified according to the current rating. Wikipedia (2009) defined cable rating as the amount of current it can be allowed to carry continuously without deteriorations. The basic factor to be considered when selecting the size of a cable is the current of the circuit or the current rating. The current rating is obtained by calculation depending on the nature of the circuit, the power absorbed by the load and the supply voltage. The current is sometimes called the design current and used to select the size of cable. The factors that govern the rating of cable include: conductor cross-sectional area, type of insulations, ambient temperature, type of protection, grouping, disposition and type of sheath. A cable selected to supply a particular load must be able to do so without undue heating.

Electrical Safety

Safety is a top priority for every electrician and the customer because it creates consciousness in every workman. Electricity is something many people take for granted. People often forget how dangerous electricity can be. In order to save money, people often try to do electrical installations by themselves. This practices are very dangerous if the installation is not done correctly. Improper installation system can lead to electric shock, damage to electrical appliances and fire outbreak. Stevenson (1982) stated that it is not only giant power lines that can or injure you if you contact them. You can also be killed by a shock from an appliance or power cord in your home. Strange as it may seem, most fatal electrical shocks happen to people who should know better.

Martin (2003) reveal some electro medical facts that should make you think twice before taking chances. It is not the voltage but the current that kills. People have been killed by 240 volts AC in the home and with as little as 24 volts DC. The real measure of a shock's intensity lies in the amount of current (in milliamperes) forced through the body. Any electrical device used on a house wiring circuit can, under certain conditions, transmit a fatal amount of current. Currents between 100 and 200 milliamperes (0.1 ampere or 0.2 ampere) are fatal. Anything in the neighbourhood of 10 milliamperes is capable of producing painful, severe shock. Severe electric shock stops the respiratory system and heart from functioning. Martin (2003) stress that it is necessary to perform artificial respiration to try to get an electric shock victim breathing again, or if the heart is not beating, cardio pulmonary resuscitation (CPR) is necessary. Prevention is the best medicine for electric shock. Respect all voltages, have a knowledge of the principles of electricity, and follow safe work procedures. Do not take chances. All domestic electrical installation technicians should be encourages to take a basic course in CPR so they can aid a coworker in emergency situations. Stevenson (1982) advices electricians to always make sure portable electric tools are in safe operating condition. Make sure there is a third wire on the plug for grounding in case of shorts. The fault current should flow through the third wire to ground instead of through the operator's body to ground if electric power tools are grounded and if an insulation breakdown occurs.

Akinyemi (1988) emphasizes the need for first aid skills in ensuring safety in electrical jobs. He further stated that a person who has stopped breathing is not necessarily dead but is in immediate danger. Life is dependent on oxygen, which is breathed into the lungs and then carried by the blood to every body cell. Since body cells cannot store oxygen and since the blood can hold only a limited amount of oxygen, death will surely result from continued lack of breathing. Akinyemi (1988) highlighted three stage practices that are to be kept in consideration as follows:

1. Recognizing the Hazards: In order to avoid or control the hazards, you must recognize the hazards around you.
2. Evaluating the Hazards: This involves identifying all possible hazards first and then evaluate the risk of injury from each hazard.
3. Controlling the Hazards: This involves creating a safe work environment and using safe work practices. In order to control the hazards around you in the workplace, you must know what could go wrong while performing the job and also have the knowledge, tools and experience to do the work safely so as to ensure that you, coworkers and equipments are safe.

Akinyemi (1988) further stated that to control the hazard and ensure safety, domestic electrical installation technicians must do the following:

a. Plan for the work to be done and plan for safety. This involves working with a team that is well trained and knows what to do in an emergency.
    - Know how to shut off and de-energise circuits to avoid any possible electrical hazards
    - Make sure that the energy sources are secure.
    - Remove jewelry and metal objects from your fingers, hands and neck.
    - Avoid falls from scaffolding or ladders.

b. Avoid dangers like wet work place
    - Do not work wet
    - Do not work in damp conditions like working outdoors while its raining.

- Check the condition of the ladder before using it.
- Position the ladder at a safe angle to prevent slipping.
- Make sure that the floor is level.
- Use special locks when necessary.
- Be careful when placing the ladder on wet or any slippery surfaces.
- Follow the manufacturer's recommendations for proper and safe use.

However, it is worthy to note that the general requirements for safety are contained in IEE Regulations part I.

Summary of Related Literature

The practices of domestic electrical installation technicians were discussed with respect to: determining the practices of technicians in domestic electrical installation work, determining factors that influences the practices of technicians in domestic electrical installation work, and determining ways of improving the practices of domestic electrical installation technicians. The electricity regulations and the effects of non adherence to the IEE regulations was also analyzed. The concept of grounding, electrical hazards, electrical safety and general features of domestic electrical installation practices was also discussed. The literature has also stressed the need for government to make effort towards restructuring and upgrading the domestic electrical installation practices in Minna metropolis.

CHAPTER III

METHODOLOGY

This chapter deals with the description of procedures used in carrying out this study. It includes the research design, area of study, population, sample, instrument for data collection, validation of the instrument, administration of the instrument, method of data analysis and the decision rule.

Research Design

The research design that was used in carrying out this study is the descriptive survey method, where questionnaire was used to determine opinions of the respondents on the issue under investigation. Olaitan and Nwoke (1999) define a survey research design as a descriptive study in which the entire population or representative sample of the entire population is studied by collecting and analyzing data from the group through the use of questionnaires. Therefore, the survey design was considered suitable since the study will seek information from a sample that was drawn from a population using questionnaire.

Area of the Study

The study was carried out in Minna metropolis to cover domestic electrical installation technicians and domestic electricity consumers in Minna metropolis. This comprised of the following areas: Bosso, Maikunkele, Tunga, Chanchaga and Kpakungu.

Population

The target population for this study consists of Electrical Installation Technicians, Association, Power Holding Campany of Nigeria and domestic electricity consumers in residential buildings in Minna.

Sample

As a result of the disorderly locations of domestic electrical installation technicians in Minna, the researcher decided to obtain a sample size from the population using convenience sampling. Convenience sampling is the type of sampling where a sample is selected according to the researcher's convenience without necessarily referring to the representatives of the sample to the population (Aloysius, 1998).Hence a total of 350 technicians and domestic electricity consumers was selected from 5 major locations in Minna metropolis as tabulated below:

Table 1: Distribution of the sample of the respondents

Location	Technicians	Electricity Consumers
Bosso	30	40
Maikunkele	30	40
Tunga	30	40
Chanchaga	30	40
Kpakungu	30	40
Total	**150**	**200**

Instrument for Data Collection

The instrument used for data collection was a structured questionnaire. The questionnaire was developed by the researcher and was divided into two sections "A" and "B". Section A contains the personal data of the respondent. Section B which contains 60 questionnaire items was further subdivided into three sections according to the research questions 1,2,3 with 20 items each.

Validation of Instrument

The instrument used for the study was validated by 3 lecturers in the department of Industrial and Technology Education, Federal University of Technology, Minna. All necessary corrections was effected in the items before administering the instrument to the respondents.

Administration of the Instrument

A total of 350 questionnaires were administered to the respondents by the researcher and 336 was collected (i.e. 96% return). Most of the technicians have low educational attainment. Where a technician finds it difficult to comprehend, the researcher interprets the question and help to fill in their response option on the questionnaire.

Method of Data Analysis

Data collected for this study were analysed using mean, standard deviation and t-test Statistics. A 4 point scale was used with the following response options:

Strongly Agree = SA = 4 points

Agree = A = 3 points

Disagree = D = 2 points

Strongly Disagree = SD = 1 points

Now adding up the results and dividing by 4 that is taking the average we have;

4+3+2+1=10

10/4=2.50

Decision Rule

To determine acceptance level, mean of 2.50 was used as deciding point between agreed and disagreed. Thus, responses with a mean of 2.50 and above was considered agreed while responses below 2.50 was considered disagree. Also, a t-test was used to test the hypothesis at 0.05 level of significance to compare the mean response of the two groups. A t-critical value of ±1.96 was used based on the 148 degree of freedom at 0.05 level of significance. Therefore, any item with t-calculated value less than t-critical (t-table value) was accepted. While any item with t-calculated value equal or greater than t-critical was rejected.

	sockets.				
10	Electricians carry out bad earth connections.	3.65	3.00	3.33	Agreed
11	Technicians make excess profit per job.	3.55	3.00	3.28	Agreed
12	Technicians leave junction box uncovered.	3.40	3.00	3.20	Agreed
13	Technicians wiring are sometimes not mechanically strong/sound.	3.60	2.90	3.25	Agreed
14	Technicians uses inferior materials.	3.50	2.90	3.20	Agreed
15	Technicians adopt obsolete method of wiring.	3.75	3.00	3.28	Agreed
16	Technicians overload wires and cables.	3.85	3.10	3.48	Agreed
17	Sometimes electricians install excess lamp.	3.75	2.90	3.33	Agreed
18	Technicians wiring frequently trip off.	3.50	2.90	3.20	Agreed
19	Technicians installations usually lead to electrical hazards.	3.50	2.90	3.20	Agreed
20	Technicians do not work with wiring diagrams.	3.20	3.10	3.50	Agreed

Key

N_1 = Number of Technicians

N_2 = Number of Electricity Consumers

$\bar{X}_1$ = Mean of Technicians

$\bar{X}_2$ = Mean of Electricity Consumers

$\bar{X}_t$ = Average Mean of Technicians and Electricity Consumers

The data presented in table 2 reveal that all the respondents agreed with all the items with mean scores ranging between 2.75 – 3.53.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

This chapter deals with the presentation and analysis of data with respect to the research questions and hypothesis formulated for this study. The result of data analysis for the research questions were presented first followed by those of the hypothesis tested for the study.

Research Question 1

What are the practices of technicians in domestic electrical installation work?

Table 2: Mean Responses of Electrical Installation Technicians and Electricity Consumers on the Practices of Technicians in Domestic Electrical Installation Work.

$N_1 = 150$ $N_2 = 200$

S/N	ITEMS	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_t$	REMARKS
1	Technicians install electrical wiring in houses.	3.65	2.60	3.13	Agreed
2	Technicians correct electrical wiring faults.	3.55	2.70	3.13	Agreed
3	Electricians do not adhere to the IEE Regulations.	3.50	2.70	3.10	Agreed
4	Technicians installation are sometimes not accurate.	3.65	3.00	3.33	Agreed
5	Most electricians do not observe safety rules.	2.80	2.70	2.75	Agreed
6	Sometimes technicians use wrong wire and cable sizes.	3.40	3.00	3.20	Agreed
7	Technicians use substandard sockets.	3.25	3.00	3.13	Agreed
8	Technicians cut corners on jobs.	3.75	2.80	3.28	Agreed
9	Technicians wrongly position switches and	3.85	3.20	3.53	Agreed

Research Question 2

What are the factors that influence the practice of technicians in domestic electrical installation work?

Table 3: Mean Responses of Electrical Installation Technicians and Electricity Consumers on the Factors that Influence the Practice of Technicians in Domestic Electrical Installation Work.

$N_1 = 150$ $N_2 = 200$

S/N	ITEMS	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_t$	REMARKS
21	Low level of education.	3.85	3.80	3.83	Agreed
22	The inadequacy of the apprenticeship system.	3.80	3.60	3.70	Agreed
23	Inadequate scientific knowledge.	3.85	3.70	3.78	Agreed
24	Lack of theoretical principles.	3.75	3.40	3.58	Agreed
25	Desire to make excess profit per jobs.	3.45	3.00	3.23	Agreed
26	Desire to cut corners on jobs.	3.45	3.60	3.53	Agreed
27	Inability of the Nigerian Electric Regulatory Commission (NERC) to monitor electric installation practices carry out by local technicians.	3.70	3.60	3.64	Agreed
28	Lack of certification of the electrician vocation.	3.50	3.60	3.55	Agreed
29	Non licensing of the technicians.	3.70	3.60	3.65	Agreed
30	Non involvement of government agency in the affairs of private sectors like local electrical installation works company,team,etc.	3.75	3.70	3.73	Agreed
31	Desire of home owners to reduce cost and save money.	3.45	3.70	3.58	Agreed
32	Lack of knowledge of modern wiring techniques.	3.85	3.60	3.73	Agreed
33	Lack of periodic retraining courses.	3.55	3.50	3.53	Agreed
34	Lack of exposure to recent electrical	3.55	3.70	3.63	Agreed

	technologies.				
35	Inability to interpret lighting circuit diagrams.	3.75	3.50	3.63	Agreed
36	Inability to produce wiring diagrams.	3.85	3.70	3.78	Agreed
37	Inability to use modern electrical installation tools and equipments.	3.70	3.30	3.50	Agreed
38	Inability to understand the implication of current rating on appliances.	3.25	3.30	3.53	Agreed
39	Unorganized nature of the technicians training.	3.15	3.50	3.33	Agreed
40	Apprenticeship system of training is haphazard and disorderly.	3.75	3.80	3.78	Agreed

The data presented in table 3 revealed that the entire respondents agreed with all the items with mean scores ranging between 3.23 – 3.83.

Research Question 3

What are the ways of improving the practices of domestic electrical installation technicians?

Table 4: Mean Responses of Electrical Installation Technicians and Electricity Consumers on the ways of improving the Practices of Electrical Installation Technicians.

$N_1 = 150$ $N_2 = 200$

S/N	ITEMS	$\bar{X}_1$	$\bar{X}_2$	$\bar{X}_t$	REMARKS
41	Licensing of the electrician vocation.	3.80	3.50	3.65	Agreed
42	Certification of apprenticeship training.	3.90	3.60	3.75	Agreed
43	Hiring services of highly experienced technicians.	3.85	3.70	3.78	Agreed
44	Home owners should avoid unnecessary reduction of cost.	3.80	3.00	3.40	Agreed
45	Technicians should avoid cutting corners on jobs.	3.80	3.50	3.65	Agreed
46	Technicians should avoid excess profit.	3.70	3.50	3.60	Agreed
47	Electricians should adhere to the IEE	3.70	3.60	3.65	Agreed

	Regulations.				
48	NERC should monitor practices of technicians.	3.80	3.60	3.70	Agreed
49	Government should regulate vocational practices in the informal sector.	3.45	3.70	3.58	Agreed
50	Evening schools should be organized for technicians.	3.45	3.50	3.48	Agreed
51	Technicians should undertake periodic retraining courses.	3.20	3.50	3.35	Agreed
52	Curriculum should be developed for training technicians.	3.20	3.70	3.45	Agreed
53	Technicians should be taught theoretical principles.	3.40	3.50	3.45	Agreed
54	A standard form of evaluation should be developed for technicians.	3.50	3.70	3.69	Agreed
55	PHCN should monitor and regulate the practices of technicians.	3.45	3.70	3.58	Agreed
56	Technicians training should be improved upon.	3.60	3.70	3.65	Agreed
57	Technicians should always observe safety rules.	3.60	3.70	3.65	Agreed
58	Technicians should be expose to recent electrical technologies.	3.70	3.60	3.65	Agreed
59	Technicians should always use quality materials.	3.65	3.70	3.68	Agreed
60	Technicians should be taught modern wiring techniques.	3.60	3.80	3.70	Agreed

The data presented in table 4 revealed that all the respondents agreed with all the items with mean scores ranging from 3.40 – 3.78.

H_{01}: There is no significant difference in the mean responses of electrical installation technicians and electricity consumers concerning the practices of technicians in domestic electrical installation work.

Table 5: T-test Analysis of Electrical Installation Technicians and Electricity Consumers Concerning the Practices of Technicians in Domestic Electrical Installation Work.

$N_1 = 150$ $N_2 = 200$

S/N	ITEMS	$\bar{X}_1$	SD_1	$\bar{X}_2$	SD_2	t-cal	REMARK
1	Technicians install electrical wiring in houses.	3.65	0.57	2.60	0.80	3.71	S
2	Technicians correct electrical wiring faults.	3.55	0.59	2.70	0.90	2.72	S
3	Electricians do not adhere to the IEE Regulations.	3.50	0.81	2.70	0.90	2.38	S
4	Technicians installation are sometimes not accurate.	3.65	0.48	3.00	1.00	1.94	NS
5	Most electricians do not observe safety rules.	2.80	0.98	2.70	1.10	0.24	NS
6	Technicians uses wrong wire and cable sizes.	3.40	0.80	3.00	1.00	1.10	NS
7	Technicians used substandard accessories.	3.25	0.92	3.00	1.00	0.66	NS
8	Technicians cut corners on jobs.	3.75	0.54	2.80	0.87	3.15	S
9	Technicians wrongly position switches and sockets.	3.85	0.36	3.20	0.98	2.04	S
10	Electricians carry out bad earth connections.	3.65	0.57	3.00	1.00	1.91	NS
11	Technicians make excess profit per job.	3.55	0.67	3.00	1.00	1.58	NS
12	Technicians sometimes carry out unfinished installation.	3.40	0.86	3.00	1.00	1.08	NS
13	Technicians wiring are sometimes not mechanically strong/sound.	3.60	0.54	2.90	0.94	2.16	S
14	Technicians uses inferior	3.50	0.97	2.90	0.94	1.63	NS

	materials.						
15	Technicians adopt obsolete method of wiring.	3.75	0.84	3.00	1.00	2.04	S
16	Technicians overload wires and cables.	3.85	0.36	3.10	0.94	2.44	S
17	Sometimes electricians install excess lamp.	3.75	0.54	2.90	0.94	2.65	S
18	Technicians wiring frequently trip off.	3.50	0.89	2.90	1.04	1.56	NS
19	Technicians installations usually lead to electrical hazards.	3.50	0.81	2.90	1.04	1.60	NS
20	Technicians do not work with wiring diagrams.	3.20	0.98	3.10	1.04	0.25	NS

Key:

N_1 = Number of Technicians

N_2 = Number of Electricity Consumers

$\bar{X}_1$ = Mean of Technicians

$\bar{X}_2$ = Mean of Electricity Consumers

SD_1 = Standard Deviation of Technicians

SD_2 = Standard Deviation of Electricity Consumers

t-cal = t-calculated

t-critical (t-table value) = ±1.96

S = Significant NS = Not Significant

Df (degree of freedom) = $N_1 + N_2 - 2 = 150 + 200 - 2 = 348$

The analysis in table 5 showed that the t-cal values of 9 items: 1,2,3,8,9,13,15,16 and 17 were greater than the t-table values, while 11 questionnaire items 4,5,6,7,10,11,12,14,18,19 and 20 were below the t-table value (±1.96). Therefore, the null hypothesis was rejected for each of the 9 items while it was accepted for each of the 11 items. This implies that there is no significance difference for items accepted but there is significance difference for the items rejected in the mean rating of technicians and electricity consumers concerning the practices of technicians in domestic electrical installation work.

Findings

The findings of this study are presented below: The study revealed the following in terms of the practices of technicians in domestic electrical installation work.

1. Technicians install electrical wiring and correct electrical wiring faults in house.
2. Technicians do not observe safety rules and IEE Regulation.
3. Technicians installations are usually not accurate and characterized by wrong wire/cables sizes, substandard sockets, wrong positions of switches and sockets, uncovered junction box, bad earth connection and overlamping.
4. Technicians uses inferior materials, cut corners on jobs and makes excess profit per job.
5. Technicians wiring are not mechanically strong, frequently trip off and liable to electrical hazards.
6. Technicians do not work with wiring diagrams and usually overload wires and cables.
7. Technicians adopt obsolete method of wiring.

The study also revealed the following in terms of the factors that influence the practice of technicians in domestic electrical installation.

1. Technicians have low level of education, inadequate scientific knowledge and theoretical principles.
2. Inadequacy of the apprenticeship system, non licensing/non certification of the electrician vocation.

3. Desire to cut corners on jobs and make excess profit per job.
4. Desire of home owners to reduce cost by cutingt corners on jobs.
5. Inability of the government,NERC, PHCN and SON to monitor and regulate electrical installation practices.
6. Lack of periodic retraining courses, modern wiring techniques and exposure to recent electrical technologies.
7. Inability to interpret lighting circuit diagrams and inability to produce wiring diagrams.
8. Inability to use modern electrical installation tools and equipments.
9. Unorganized and disorderly nature of the technician training.

The study further revealed the following in terms of the ways of improving the practices of domestic electrical installation technicians.

1. Licensing and certification of the electrical technician vocation.
2. Home owners should avoid unnecessary reduction of cost and hire the services of highly experienced technicians.
3. Technicians should avoid excess profit and avoid cutting corners on jobs.
4. Technicians should adhered strictly to the IEE Regulations and also observe safety rules.
5. The government, NERC, PHCN and SON should monitor and regulate the practices of technicians.
6. Evening schools and periodic retraining courses should be organized for technicians.
7. Curriculum and a standard form of evaluation should be developed for technicians.
8. Technicians should be taught theoretical principles circuit diagrams, wiring diagrams, modern wiring techniques and recent electrical technologies.
9. Technicians training should be improve upon.

Discussion of the Findings

The discussion of the findings are based on the research questions posed for the study.

Findings from table 2 of this study confirms that technicians install electrical wiring and also correct electrical wiring faults in houses. This is in agreement with NBTE (2002) description of a technician as a tradesman who specializes in the repair and installation of electrical wiring systems and associated devices in homes. The domestic electrician carries out domestic electrical installation practices to ensure availability of electricity in the home. Also, findings from the study reveals that the technicians do not observe the IEE Regulations and safety rules in their practices. This is in line with findings of Nuru (2010) in a review of the state of domestic electrical installation practices in Northern Nigeria, who stated that the domestic electrical installation practices in Minna is in a poor state and far below the IEE Regulations and these has led to a lot of electrocution and fire outbreak.

In addition, findings of this study revealed that technicians installations are usually not accurate and characterized by wrong wire/cable sizes, substandard sockets, wrong position of switches and sockets, uncovered junction box, bad earth connection and overlamping. This is in agreement with Fuji (2002) findings that electrical installation practices in the Northern States is characterized by defective and inadequate electrical wiring such as: overlamping, uncovered junction box, frequent triping of circuits, flickering of lights, wrong location of electrical devices, trailing wires, too few outlets, over-wired panel, overloads and ungrounded earth connections which has led to increased cases of electrical hazard. Furthermore, findings from the study revealed that technicians uses inferior materials, cut corners on jobs and makes excess profit per job. Technicians also adopt obsolete method of wiring. This was supported by Herrick (2001) who stated that the basic requirement for good domestic electrical installation service are often not met due to the desire of some home owners to reduce cost/save money and the technicians dubious habit of cutting corners to make excess profit per job. The technicians do not undergo upgrading courses and as a result, they stick to obsolete method of wiring.

Findings from table 3 of this study indicated that the technicians have low level of education, inadequate scientific knowledge and theoretical principles. Okoro (1993) attributed the poor performance of technicians to the gross inadequacy of the apprenticeship system of training which is lacking in theoretical content. He pointed out that the apprentice are told what to do but not why they have to do it the particular way specified. This also agrees with Ogwo and Oranu (2006) description of vocational training as a skill acquisition programme acquired through the informal apprenticeship system where the basic scientific knowledge inherent in the skill is not emphasized. Findings from table 3 also revealed the inadequacy of the apprenticeship system, non certification and non licensing of the electrician vocation. This is buttressed by Okonkwo (1997) who stressed that it is only through certification and licensing of the vocational practices in Nigeria that the Nigeria Electricity Regulatory Bodies can monitor and check the vocational practices in the informal sector.

The findings of the study also highlighted the inability of the government, NERC, PHCN and SON to monitor and regulate electrical installations practices as a factor that influences the practices of technicians. This was supported by Fuji (2002) findings that domestic electrical installations practices in most Nigerian localities is in a poor state because the NERC lack adequate machinery to monitor and ensure strict adherence to the IEE Regulations.

The study further revealed lack of periodic retraining course, modern wiring techniques and exposure to recent electrical technologies as a factor that influences technicians practices. This was buttressed by Aduloju (2005) who stated that training and retraining course alongside with vocational and technical education is the sure way to enhance the performance skills of technicians in the informal sector.

Findings from the study further revealed the inability of technicians to interpret lighting circuit diagrams and inability to produce wiring diagrams. The findings also stated the inability of technicians to use modern electrical installation tools and equipments. These agrees with Ezeagu (1998) opinion that the low educational level of electricians is a key factor that influences their behaviour in the field. He further stated that their poor educational level makes it difficult for technicians to understand/interpret wiring diagrams, cable sizes, cable rating and electrical lighting circuit designs.

Findings from table 4 indicated that licensing and certification of the electrical technician vocation is a sure way of improving the practices of electrical installation technicians. This is in line with Okonkwo (1997) who stressed the need for licensing and certification of electrical installation vocation to ensure standardization and quality control. Findings from the study also stated that to improve technicians practices, home owners should avoid unnecessary reduction of cost and hire the services of highly experiences technicians. This agrees with Nuru (2010) who emphasize the need to hire the service of a highly experienced domestic electrical installation technician to ensure good quality of domestic installations, safety assessment, fault findings and repair work to prevent electrical accidents, electrocution and fire outbreak.

Findings from table 4 further reveal that the government through the electricity regulatory bodies should monitor and regulate the practices of technicians to ensure strict adherence to the IEE Regulation and to shy away from cutting corners on jobs or dubiously making excess profit. This also agrees with Yakubu (1999) who stated that the absence of government in the affairs of the informal sector is a major reason for the deterioration in electrical installation practices in residential buildings. He advised the government through the electricity regulatory bodies to participate actively in the private sector activities to increase economic growth.

Findings from the study further pointed that evening schools and periodic retraining courses should be organized for technicians. This was supported by Okoro (1993) who stated that to be able to provide useful contributions to the National Economy, the technicians require a strong updating in technology and theoretical principles which can best be acquired through evening schools and retraining courses.In addition, findings from the study highlight the need for curriculum and a standard form of evaluation to be developed for technicians. This is in agreement with Ogwo and Oranu (2006) definition of curriculum as the totality of all those experiences, knowledge, skills and activities systematically planned to educate individuals for gainful employment and advancement in any chosen occupation or a cluster of occupation.

Okoro (1993) also recommended the need for a standard form of evaluation of technicians because improper form of evaluation can lead to poor skill formation in an apprentice who studied under a master with poor skills. He further revealed that customers determines the mastery of apprentices through consistent approval of services rendered by the apprentices, which he condemned as a bad method of evaluation. The study further revealed that the technicians training should be improved upon to include adequate theoretical principles and technical knowledge that will enable technicians to be able to understand, interpret and utilize wiring diagrams, circuit diagrams, modern wiring tools and equipments and modern wiring techniques.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter presents the findings of the study under the following subheadings: summary of the study,implication of the study,conclusion, recommendation and suggestion for further study.

Summary of the Study

Domestic electricity is seen as the electrical power that we receive in our houses from power stations in the form of alternating current and voltages. Electricity cannot be available in a house without adequate electrical wiring. All electrical wiring are useless without electricity, thus it becomes the life line of all domestic electrical systems because nothing significant can be achieve in the house without electricity. Electricity has help people in lots of ways. People use electricity to make their tasks easier and faster. Electricity has made people's live so comfortable that it even made it easier for people to see things clearly at night.

Electricity has the power to run all things smoothly however if it is misused, it also has the power to burn all things resulting to damages on homes and lose of life and properties.This is why people need a licensed technician in order to install, repair and maintain electrical systems in the house.

The study used a survey research approach to determine the practices of technicians in domestic electrical installation work, determine the factors that influence the practices of technicians in domestic electrical installation work and to determine ways of improving the practices of domestic electrical installation technicians. Sixty (60) items were generated in the questionnaire to elicit domestic electrical technicians and electricity consumers responses and the questionnaire was validated by 3 lecturers in the department of Industrial Technology Education. A total of 350 validated questionnaires were issued to 150 technicians and 200 electricity consumers in Minna metropolis. The instrument for data collection was analysed using mean, standard deviation and t-test statistics.

Implication of the Study

It could be deduced from the study that the current practices of domestic electrical installation technicians is unfavourbale for them, their customers and the electrical profession. Domestic electrical installation technicians usually carry out defective and inadequate wiring making it difficult to have sufficient electricity in the house and also resulting in increase cases of electrical shock and fire outbreak leading to lose of life and properties. The study also has implication for the factors that influences the practices of technicians in domestic electrical installation work. This implies that the technicians method of training is insufficient because of the following defects: lacks curriculum, lacks theoretical principle, lacks standard form of evaluation and falls below the IEE Regulations. This means that if the defects are corrected, the technicians will be able to carry out better electrical installation in residential buildings that will ensure safe use of electricity. As to the ways of improving the practices of technicians; it implies that evening schools and adequate training and retraining courses needs to be organized for technicians to make them better informed so as to perform in accordance with IEE Regulations.

Conclusions

In conclusion, it was discovered from the study that the current practices of domestic electrical installation technicians is unfavourable to the technicians, their customers and the electrical profession due to the inadequacies and defects in the apprenticeship system of training technicians. Therefore, efforts should be made towards redesigning the apprenticeship system of training to enable technicians to acquire and develop modern work skills and wiring techniques needed to carry out efficient domestic electrical installation in residential buildings to ensure safe utilization of domestic electricity. The domestic electrical installation technicians should be made to understand the content and implication of the IEE Regulation to improve their practices for the betterment of the electrical technicians, electricity consumers and the electrical profession. It is worthy to state here that, unless these facts are seriously taken into consideration and fully implemented, the domestic electrical installation practice of technicians in Minna metropolis will continue to deteriorate and consequently lead to increasing cases of electrocution and fire outbreak that will claim lives and properties woefully.

Recommendations

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

1. Domestic electrical installation technicians should attend evening school to obtain theoretical knowledge that govern the operation of modern electrical installations in residential buildings.
2. Technicians training should be improved upon. The technicians should be made to understand the content, utilization and importance of the IEE Regulations in their work.
3. The government should license qualified technicians who shall be the only one allowed to practice domestic electrical installation.
4. The National Board for Technical Education (NBTE) should carry out certification of the domestic electrical installation vocation.
5. Technicians should be taught circuit diagrams, wiring diagrams, modern wiring techniques and recent electrical installation technologies.
6. Curriculum should be developed for training technicians.
7. A standard form of evaluation should be developed for training technicians.

8. Technicians should adhere strictly to the IEE Regulations and also observe safety rules while working.
9. The government, NERC, PHCN and SON should constantly monitor and regulate the practice of technicians.
10. Technicians should avoid excess profit and avoid cutting corners on job.
11. Home owners/electricity consumers should avoid unnecessary reduction of cost and hire the services of qualified or highly experienced technicians.
12. Adequate periodic training and retraining courses should be organized for technicians to upgrade and update their knowledge and skills.

Suggestions for Further Research

Based on the findings of the study, the following suggestions were made for further study:

1. Developing a curriculum for the training and retraining of domestic electrical installation technicians.
2. Developing a standard form of evaluation for assessing the competency of domestic electrical technicians.
3. Investigation of the best practices needed by domestic electrical installation technicians.
4. Incorporating Information and Communication Technology (ICT) into the apprenticeship system of training technicians to increase their performance.

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APPENDIX A

FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

OPTIONS:
AUTO TECHNOLOGY
BUILDING TECHNOLOGY
ELECTRICAL/ELECTRONICS TECHNOLOGY
METAL WORK TECHNOLOGY
WOOD WORK TECHNOLOGY
DATE: 25th MARCH, 2011

YOUR REF: ____________

OUR REF: PGDITE/SSSE/ITE/2008/031

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LETTER OF INTRODUCTION OF CANDIDATE CONDUCTING RESEARCH WORK

This is to certify that the bearer UMEH EDITH HAPPINESS with registration number PGD/ITE/2008/031 is a Post Graduate Student of the Department of Industrial and Technology Education, Federal University of Technology Minna. He/She is currently undertaking a Research titled: Assessment of domestic electrical installation practices of technicians in Minna metropolis

It would be highly appreciated if you could supply him/her with the information required from you. All information supplied will be used solely for the purpose of Research and will be treated as confidential.

Thank you for your cooperation.

APPENDIX B

FORMULA

Mean $\overline{X} = \frac{\sum fx}{\sum f}$

$\overline{X}$ = Mean

$\sum$ = The Sum of

X = The Score

F = The Frequency of each point in the scale

Standard Deviation

$$SD = \sqrt{\frac{\sum f(x - \overline{x})}{\sum f}}$$

X = Mean

$\sum$ = The Sum of

X = The Score

F = The Frequency

t – test Formula

$$t\text{– test} = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_1^2}{N_2}}}$$

$\overline{X}_1$ = Mean Score of Technicians

$\overline{X}_2$ = Mean Score of Electricity Consumers

S_1 = Variance of Technicians

S_2 = Variance of Electricity Congumers

N_1 = Number of Technicians

N_2 = Number of Electricity Consumers

Hypothesis 1, item 1, Standard deviation for Technicians response

X	F	FX	$x-\overline{x}$	$(x-\overline{x})^2$	$F(x-\overline{x})^2$
4	78	312	0.70	0.4900	38.22
3	52	156	-0.30	0.0900	4.68
2	11	22	-1.30	1.6900	18.59
1	9	9	-2.30	5.2900	47.61
	$\sum f = 150$	$\sum fx = 499$			$\sum f(x-x)^2 = 109.10$

$$\overline{X}_1 = \frac{\sum FX}{\sum F} = \frac{499}{150} = 3.33$$

$$S_1^2 = \frac{\sum F(X-\overline{X})}{\sum F} = \frac{109.1}{150} = 0.73$$

$$SD_1 = \sqrt{\frac{\sum F(X-\overline{X})^2}{\sum F}} = \sqrt{\frac{119.16}{100}} = \sqrt{0.73} = 0..85$$

Hypothesis 1, Item 1, Standard Deviation for Master Craftsmen

X	F	FX	$x-\overline{x}$	$(x-\overline{x})^2$	$F(x-\overline{x})^2$
4	112	448	0.56	0.3136	35.12
3	68	204	-0.44	0.1936	13.16
2	16	32	-1.44	2.0736	33.18
1	4	4	-2.44	5.9536	23.81
	$\sum f = 200$	$\sum fx = 688$			$\sum f(x-x)^2 =$ 105.27

$$\overline{X}_2 = \frac{\sum FX}{\sum F} = \frac{688}{200} = 3.44$$

$$S_2^2 = \frac{\sum F(X-\overline{X})}{\sum F} = \frac{105.27}{200} = 0.53$$

$$SD_2 = \sqrt{\frac{\sum F(X-\overline{X})^2}{\sum F}} = \sqrt{\frac{40.02}{50}} = 0.73$$

s

t-calculated =

$$\frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_1^2}{N_2}}}$$

$$= \frac{3.33 - 3.44}{\sqrt{\frac{0.73}{150} + \frac{0.53}{200}}}$$

$$= \frac{-0.11}{\sqrt{0.0049 + 0.027}} \qquad = \frac{-0.11}{\sqrt{0.0076}}$$

$$= \frac{-0.11}{0.0872} \qquad = -1.26$$

t – calculated = - 1.26

APPENDIX C

FEDERAL UNIVERSITY OF TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

RESEARCH QUESTIONNAIRE

DOMESTIC ELECTRICIAN QUESTIONNAIRE

Research Topic: Assessment of Domestic electrical installation practices of technicians in Minna metropolis.

Instruction: Please read the questions and respond appropriately. Indicate your choice with a tick (√)

Response options are: Strongly Agree = SA, Agree = A, Disagree = D, Strongly Disagree = SD.

Section A

Electrical Installation Technician( )/Electricity Consumer ( )

Location :____

Section B

Question 1: What are the practices of technicians in domestic electrical installation work?

S/N	ITEMS	SA	A	D	SD
1	Technicians install electrical wiring in houses.				
2	Technicians correct electrical wiring faults.				
3	Electricians do not adhere to the IEE Regulations.				
4	The technician's installation are usually not accurate.				
5	Electricians do not observe safety rules.				
6	Technicians uses wrong wire and cable sizes.				
7	Technicians use substandard sockets.				

8	Technicians cut corners on jobs.				
9	Technicians wrongly position switches and sockets.				
10	Electricians carry out bad earth connections.				
11	Technicians makes excess profit per job.				
12	Technicians leave junction box uncovered.				
13	Technicians wiring are not mechanically strong.				
14	Technicians uses inferior materials.				
15	Technicians adopt obsolete method of wiring.				
16	Technicians overload wires and cables.				
17	Electricians practice overlamping.				
18	Technicians wiring frequently trip off.				
19	Technicians installations usually lead to electrical hazards.				
20	Technicians do not work with wiring diagrams.				

Question 2: What are the factors that influences the practice of technicians in domestic electrical installation work?

S/N	ITEMS	SA	A	D	
21	Low level of education.				
22	The inadequacy of the apprenticeship system.				
23	Inadequate scientific knowledge.				
24	Lack of theoretical principles.				
25	Desire to make excess profit per jobs.				
26	Desire to cut corners on jobs.				
27	Inability of the Nigerian Electric Regulatory Commissio (NERC) to monitor electrical installation jobs.				

28	Lack of certification of the electrician vocation.				
29	Non licensing of the technicians.				
30	Absence of government in the affairs of the informal sector.				
31	Desire of home owners to reduce cost and save money.				
32	Lack of knowledge of modern wiring techniques.				
33	Lack of periodic retraining courses.				
34	Lack of exposure to recent electrical technologies.				
35	Inability to interpret lighting circuit diagrams.				
36	Inability to produce wiring diagrams.				
37	Inability to use modern electrical installation tools and equipments.				
38	Inability to understand the implication of current rating on appliances.				
39	Unorganized nature of the technicians training.				
40	Apprenticeship system of training is haphazard and disorderly.				

Question 3: What are the ways of improving the practices of domestic electrical installation technicians?

S/N	ITEMS	SA	A	D	SD
41	Licensing of the electrician vocation.				
42	Certification of apprenticeship training.				
43	Hiring services of highly experienced technicians.				
44	Home owners should avoid unnecessary reduction of cost.				
45	Technicians should avoid cutting corners on jobs.				
46	Technicians should avoid excess profit.				

47	Electricians should adhere to the IEE Regulations.				
48	NERC should monitor practices of technicians.				
49	Government should regulate vocational practices in the informal sector.				
50	Evening schools should be organized for technicians.				
51	Technicians should undertake periodic retraining courses.				
52	Curriculum should be developed for training technicians.				
53	Technicians should be taught theoretical principles.				
54	A standard form of evaluation should be developed for technicians.				
55	PHCN should monitor and regulate the practices of technicians.				
56	Technicians training should be improved upon.				
57	Technicians should be taught circuit diagrams.				
58	Technicians should be expose to recent electrical technologies.				
59	Technicians should be taught basic wiring diagrams.				
60	Technicians should be taught modern wiring techniques.				