ELECTRICAL INSTALLATION COMPETENCIES REQUIRED BY ELECTRICAL/ELECTRONIC TEACHERS IN BAUCHI AND GOMBE STATES TECHNICAL COLLEGES

by

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DEPARTMENT OF VOCATIONAL TEACHER EDUCATION
(INDUSTRIAL TECHNICAL EDUCATION)

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A THESIS SUBMITTED TO THE DEPARTMENT OF VOCATIONAL TEACHER EDUCATION IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER DEGREE IN INDUSTRIAL TECHNICAL EDUCATION

APPROVAL PAGE

UNIVERSITY OF NIGERIA NSUKKA
FACULTY OF EDUCATION

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A Thesis
Submitted to the Department of Vocational Teacher Education in Partial Fulfillment of the Requirements for the Award of Master Degree in Industrial Technical Education

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I Abdullahi Shetima, a post graduate student in the Department of Vocational Teacher Education and with Registration Number PG/MED/07/43679 has satisfactorily completed the requirements for the course and research works for the Master Degree in Industrial Technical Education (Electrical/Electronic). The work in this project is original and has not been submitted in part or full for other Diploma or Degree of this or any other University

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DEDICATION

This project is dedicated to:

Dr Ogbuanya T. C.,

Alhaji Ismaila Shetima Akko,

Hajiya Adama Shetima

Maria A Shetima and

Abu-ubaida

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ABSTRACT

The study was motivated by a great concern about the future and continuity of Electrical installation in all tiers of society and our education system particularly in technical colleges. The concern stemmed from poor performance, low and declining skill practice in performance and in NBTEB Examination. Pertinent questions and doubts were raised on the required competencies of Electrical/Electronics Teachers currently teaching Electrical installation in technical colleges. The study therefore focused on the Electrical installation competencies required by Electrical/Electronics teachers in technical colleges using Bauchi and Gombe States of Nigeria as a frame of reference. Four objectives were stated, research questions asked, and hypotheses formulated and tested at 0.05 level of significance. A questionnaire, titled Electrical Installation Competencies Required by Electrical/Electronics Teachers in Technical Colleges (EICRETC), consisting of 112 items was structured, based on the four broad Electrical installation areas: Domestic installation, Industrial installation, Cable jointing and Winding of Electrical machines administered to 47 Electrical/Electronics teachers in Bauchi and Gombe States. Data thus collected were analyzed using the mean and t-test statistics. Respondents rated items as required in 112 competencies. The study has implication for re-training, in-service training for Electrical/Electronics teachers and therefore recommend involving continuous training not one but regular basis through workshops, seminars were made towards the implementation of the finding of the study.

CHAPTER I

INTRODUCTION

Background of the Study

Electrical Installation is one of the courses offered in technical college in Nigeria. It comprise the following; Basic Electricity, Battery Charging, Domestic Installation, Industrial Installation, Cable Jointing and Winding of Electrical Machines. As contained in the National Board for Technical Education (NBTE) (2001) curriculum. The goal of Domestic Installation is to provide the trainee with the knowledge and skill to enable him carryout Electrical Installation in a building. Domestic Installation is concerned with installation of electrical components or equipment in a building. Such electrical equipment or components include Home appliances fixed in position for use. Domestic Installation also involves surface wiring, conduit wiring as well as maintenance of electrical fittings; such as illumination lamps used in homes mostly within the range of 0.5V ï 415V (Thomson, 1973).

Industrial Installation goals according to (NBTE) (2001), are to provide the trainee with the knowledge and skills which will enable him carryout all types of industrial/factory installations. Indusial Installation involves voltage ranging from 415V and above is for industrial consumption using high tension conductors (Gupta, 2005). Conductors are made from aluminum or cupper and alloy. High voltage ranging from 415V and above is transmitted through over head conductor, underground and trunking, which could be in Alternating Current (AC) or Direct Current (DC) for the use of machines and equipment that control gears for effective protection.

Cable Jointing provides the trainee with knowledge and skills to enable him undertake with proficiency various methods of cable jointing and terminations. Cable means one or more conductors with or without insulating covering (Morley, 1964).

Cables are in different types; Armoured cable, over head conductors boss bars and communication cables. Cables Jointing and termination in transmission, are means of conveying, distribution and installation for effective use in homes and industries.

To understand and apply all statutory regulations during electrical winding work, (NBTE, 2001) specify the goal of module of winding electrical machine as aimed at providing trainee with the knowledge and skills to enable him wind or rewinding AC and DC rotating/static machines up to 10kvA and select appropriate tools and equipment used for winding jobs Winding of electrical machine involve both winding and rewinding of electrical generators and motors. Electric Motors and Generators are electrical machines used to convert mechanical energy into electrical energy, or electrical energy into mechanical energy, by electromagnetic means. A machine that converts mechanical energy into electrical energy is called a generator, alternator, or dynamo, while a machine that converts electrical energy into mechanical energy is called a motor. The construction of such machines involves, set of conductors wound in stator or rotor of machine (Miller, 1987). Electrical installation as subject is taught in technical college. Technical college graduates are trained to be skilled and self reliant.

Technical college students require knowledge and skills that will enable them to be employable, self reliant or proceed to higher education, but the result of National Business and Technical Examination Board (NABTEB) certificate examination show poor performance of technical students. According to Aina (2000), the NABTEB conducted in May 2000 shows the percentage of failure (F9) as follows; Engineering 41%.Construction trade 49% and Electrical installation 75%. A close examination of this result shows that electrical trade has the highest rate of failure. This implies that most students that sat for electrical trade will not gain admission into higher institutions. Many technical college graduates especially those in electrical installation are jobless. They are jobless not because of the absence of job opportunities in industries but because they lack Electrical installation competency enough to take up the available skilled jobs (Osuala, 2001). In extension this means the graduates of Technical colleges are not competent to take up available job opportunities in industries, one should not anticipate them to be self-reliant. A study conducted by UNEVOC (1997) shows that majority of graduates of Electrical installation in developing countries are not self-reliant due to incompetence.

Electrical installations trade is taught by Electricity/Electronic teachers (Okoro, 2006). Electricity/Electronic teachers are trained in Colleges of Education (Technical), Polytechnics and Universities. Such teachers are trained in order to teach electrical installation competently among others. Products of colleges of education (Technical) and polytechnics are referred to as non-graduate teachers while products of University are regarded as graduate teachers. Technical teachers from Universities and other institutions that have undergone educational training are termed as qualified teachers. Teachers who are graduates of Universities without education background are regarded as unqualified teachers. The function of training, therefore, proceeds from the assumption that the gap between the required and actual performance, which calls for a bridge via training, is the result of inadequacies in knowledge, skills and attitudes (Okorie, 2000).

Technical colleges are regarded as principal vocational institution in Nigeria. They give full training intended to prepare students for entry into various occupations (Okoro, 2006). Technical college offer course in Auto Mechanics, Plumbing, Carpentry and Joinery, Cabinet making, Welding, Painting and decoration, Electrical installation, Radio and Television repair among others. Technical colleges like other institutions exist in both rural and urban areas. Electricity/Electronic teachers in either rural or urban Technical colleges use the same curriculum in teaching and learning Therefore, Electricity/Electronic teachers require the same level of competency to teach effectively.

Offorma (2010) stressed that attention should be paid to the competence of teachers as that will determine the quality of graduates being produced

Competency is the ability to do something well, compared with standard, specific abilities are acquired through experience or training. Ability or capability to act in any action, skills, that are characterized with complexities and difficulties with accomplishment. Competency according to Blank (1982) is a state of knowledge, skills and attitude to act effectively. Man, Lau, and Chan (2002) viewed competency as the capacity to perform a task or task skillfully and effectively. A skill on the hand is the capability of accomplishing job with precision of certainty, practical knowledge in combination with ability, cleverness and expertness (Simpson and Weiner, 1991). This is to say that a skill is the ability acquired or learned with practice to perform a task. To Hull, in Mamman (2009) skill is a manual dexterity through repetitive performance of an operation. Okorie and Ezeji in Ezeji (2003) viewed skill as a well established habit of doing something in the most economic way involving the acquisition of performance capabilities. According to these authors, possessing a skill means demonstrating the habit of acting, thinking or behaving in a specific activity, which becomes automatic. Therefore, in planning technical education, emphasis should be given to the development of occupational competence. The ultimate test of a good technical education programme is not how much factual information students can remember but what technical skill they posses or perform in their technical fields of employment (Okoro, 2006)

If there is any field of human endeavours where technology changes rapidly, is the Electrical/Electronics. Electrical/Electronics is the pivot of technological growth and development. Most technological changes depend on electricity. Appliances cannot operate without electricity bringing about the technological development witnessed today. These appliances include various domestic and industrial machines and appliance, computers, audio and visual gadgets among others. Its importance notwithstanding, electricity involves a lot of hazards. Ogbuanya (2005) describe electricity as good servant but a bad master. In venturing a vision of technological possibilities rather than simply projecting linear or exponential changes in performance, it is crucial to think not only of how technical improvements lead to the substitution of a new generation of tools for existing ones, but also of how entirely new uses, and indeed new needs, might emerge (Riel, Wolfgang & Barrie 2009). Therefore, Electricity/Electronic teachers with varying qualification, knowledge and skills need to up date their knowledge and skills through regular training, in order not to be obsolete. That informed the introduction of Technical Teachers Training Programme (TTTP). The programme was principally designed for improvement of technical teachersô knowledge and skills. Unfortunately, this programme was conceived without first identifying the needs of the teacher (Oranu, in Sowande, 2001). In other word, there is need to first find out the areas the teachers lack required competency and need for improvement in their performance before embarking on any training or re-training of technical teacher.

In the midst of other factors that lead to poor performance of technical college trainee the competence of the teachers is outstanding. Unless Electricity/Electronic teachers possessed required competencies to effectively teach Electrical Installation, the problem of unemployable graduates will continue to hunt the countryøs technical education at secondary school level. As the saying goes, no education system can rise above the quality of its teachers. Hence this study designs to find out the Electrical Installation competencies required by Electricity/Electronic teachers in technical colleges.

Statement of the Problem

Todayôs world of technology depends largely on high skilled manpower for productivity. Technical college has major role to play in the production of this competent manpower for electrical industries. It is expected that graduates should possess skills which will enable them perform in their areas of discipline. Osuala (1995) observed that the skilled job opportunities in industries are not filled up. Okorie (1993) reported that technical college products are not competent enough to take up the available skilled jobs. Oranu (2001) stated that technical college product are weak in practice of their trades Furthermore, the standard of performance of Nigeria technicians in general is at the moment very low thereby retarding the overall productivity of the Nigeria economy (Okorie 2001).

Unfortunately, despite all effort by the government to ensure qualitative education at the technical colleges and bring about high competent products both in academic and employability, there have been persistent reports of high failure rate among graduates of the colleges (FGN, 2001; NABTEB, 2006). One probable cause of the high failure of students in recent years according to NABTEB (2002) chief examinersô report is partly due to lack of required competencies in teaching methods employed by instructors to teach the students.

The above situation creates doubt on the possessed competency of teachers in Technical Colleges. No education programme can rise above its teachers FGN (1998) therefore poor skill oriented Electricity/Electronics graduates of technical college is a reflection of the quality of Electrical/Electrical teachers in technical college. These teachers attended different institution and so possess different qualification and experience. Some of the skills they possess on graduation become obsolete as time goes and while others need updating. Good (1973) opined that teacher needs to be retrained not once or twice but on continuous basis to improve his knowledge, skill and attitude towards teaching. Bottoms (1975) attributed the studentsô lack of competencies necessary to develop and manage their career lives to the growing gap that exist between studentsô school experiences and the real world of work in which they live. He felt that this could not be bridged until there is a national commitment to the concept of career development education.

The problem of this study therefore is that electrical installation teachers are not competent to train skilled and productive technicians and craftsmen in technical colleges.

Purpose of the study

The major purpose of the study was to determine the competencies required by Electricity/Electronic teachers to enable them teach electrical installation effectively. Specifically the study aims at determining Electrical Installation Competencies required by Electricity/electronic teachers to teach:-

1. Domestic Installation.
2 Industrial Installation.
3 Cable joining.
4 Winding of Electrical Machines

Significance of the study

The finding of this study will be beneficial to the ministries of education and researchers; they can use the result of the study to organize training workshop and seminar for Electrical/Electronic Teachers in order to update their skills and knowledge in Electrical Installation. The ministries will also use the findings of study to employ teachers i.e. using the findings as an interview schedule to select qualified Electrical/Electronic teachers for technical colleges.

The findings of the study will be beneficial to Electrical/Electronics industries where technical college graduates seek for employment upon graduation. Electrical installation graduates will be better equipped with practical skills to perform more effectively in their various jobs and assignment in the industries. This will also help the industries minimize the huge financial expenditure on retraining of technical college graduates upon employment.

The findings of the study will provide suitable information that will aid at objective planning and successful curriculum, beneficial to curriculum planners and training institution. In that this institution will be able to incorporate the aspect of teacher competency required, as identified skills in the curriculum.

The findings will help the curriculum programmes aimed and persuading Electrical/Electronic teachers, technicians to adopt improve competence practice as well as develop skills, knowledge and attitude favorable to change in Electrical Installation world to day (develop anti absolute prove).

The findings of the study will be beneficial to Electrical/Electronics teachers because if the competences required of these teachers are upgraded through in-service training with the finding of this study, the teachers will use the new knowledge to teach practical better to students. This invariably will motivate the student to learn and also give the teacher job satisfaction.

The findings of the study will be beneficial to students because when the Electrical/Electronic teachers are well equipped with competencies required, he/she will instill this knowledge in the students. The students will therefore learn better and be able to work more effectively due to improved skill acquisition. If this is achieve parents will also be happy because they will see value in their efforts.

The society will also benefit from the findings of the study because when Students graduates with expected skills; they will reduce the problem of quack electrical installation technicians thereby, offering good services to the society. This will go a long way in achieving the much needed technological development in Nigeria.

Research Questions

The following research question was formulated to guide the study.

1 What are the Competencies required by Electrical/Electronic Teachers to teach Domestic Installation?

2 What are the Competencies needed by Electrical/Electronic Teachers to teach Industrial Installation?

3 What are the Competencies needs by Electrical/Electronic Teachers to teach Cable Joining?

4 What are the Competencies needs by Electrical/Electronic Teachers to teach Winding of Electrical Machine?

Hypotheses

The following null hypotheses were tested at 0.5 level of significance.

H_{01}: There is no significant difference in the mean responses of qualified and less-qualified Electrical/Electronic teachers in the competencies they require to teach Domestic installation.

H_{02} There is no significant difference between the mean responses of qualified and less qualified Electrical/Electronic teachers on competencies they require to teach Industrial Installation.

H_{03}: Significance difference does not exist between the mean responses of qualified and less qualified Electrical/Electronic teachers competencies they require in skilled improvement of Cable Joining.

H_{04} There is no significant difference posses between the qualified and less qualified teachers, in competencies required to teach Winding of Electrical Machines

Scope of the study

The focus of this study is on Electrical/Electronic teachersô ability to perform task, which will be delimited to Domestic Installation, Industrial Installation, cable joining and winding of electrical machine. Delimiting: - Basic Electricity and Battery Charging. With the view to ascertain what is required, what is obtainable (on ground), and what is needed from the teachers for improvement, in the technical colleges of Bauchi and Gombe States of Nigeria.

CHAPTER II

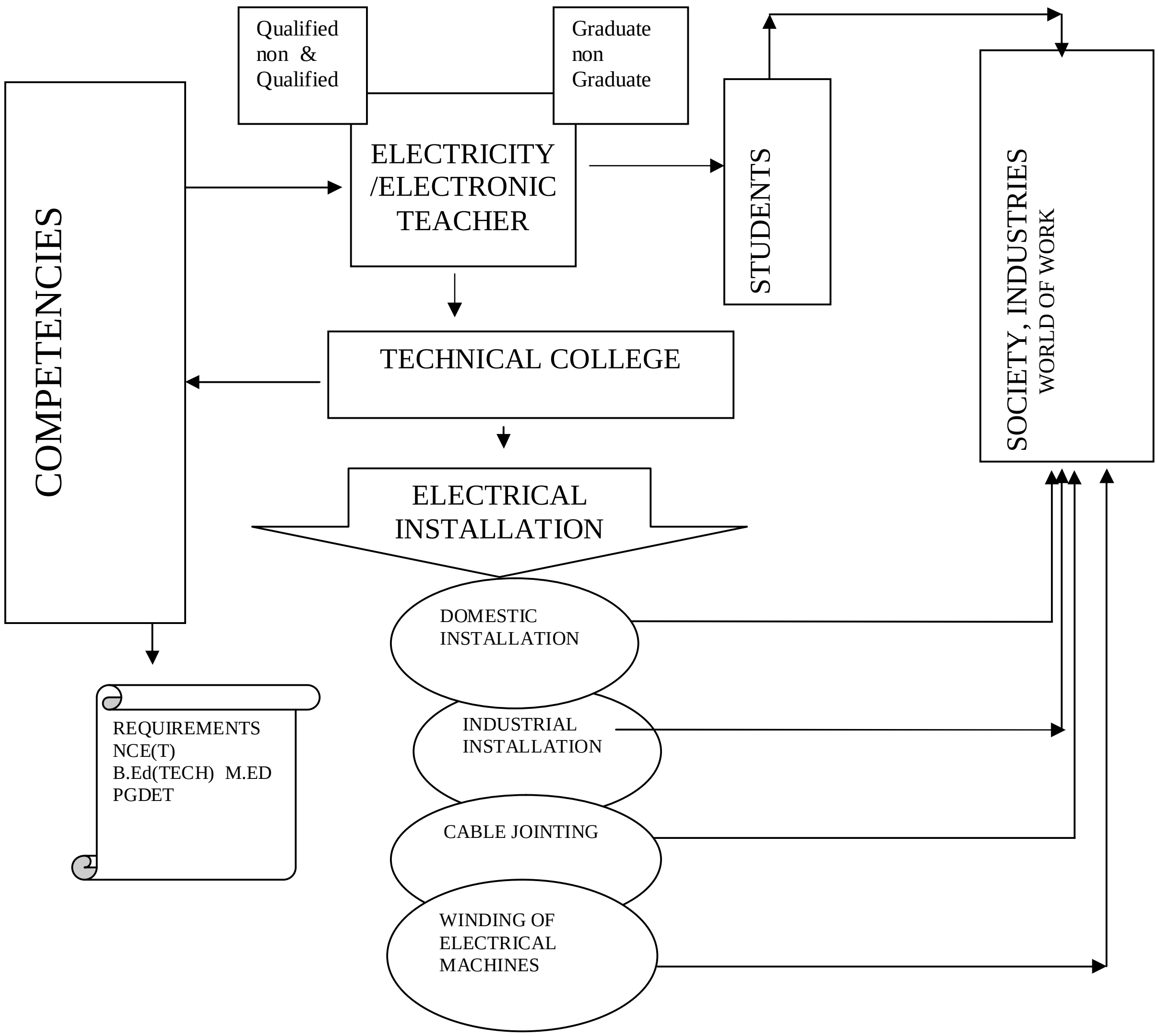
REVIEW OF RELATED LITERATURE

The literature reviewed for this study was organized and presented under the following sub-heading.

1. **Conceptual frame work**
    - Electrical Installation Technology
    - Concept of competencies
    - Electrical energy
    - Domestic installation
    - Industrial installation
    - Cable Jointing
    - Winding of electrical machines
2. **Theoretical frame work**
    - Need assessment Theory
3. **Review of related Empirical studies**
4. **Summary of the review of related Literature**

Conceptual framework

Conceptual framework, in essence attempts to integrate key pieces of information especially variables in a logical manner, and thereby conceptualizes a problem that can be tested.



Shetima 2010 Schematic diagram of competency in electrical installation

Competencies will be effective in proportion as it trains the individual directly and specifically in the thinking habits and manipulative habits required in the occupation itself, it enables each individual to capitalize his or her interest, aptitude and intrinsic intelligence to the highest possible degree...(Prosser and Quigley, 1949, pp. 217-232). Nwachukwu (2006) projected who shall be enterprising and self-reliant.

Technical Education aimed at providing students with knowledge, attitude and skills leading to gainful employment in the world of work. Technical college, offer course in, Electrical installation, which comprise the following; Basic Electricity, Battery Charging, Domestic Installation, Industrial Installation, Cable Jointing and Winding of Electrical Machines, used in homes mostly with the range of 0.5V ï 415V (Thomson, 1973).

The society being the receiving ends of the product of technical college graduates benefit from the product because when students graduate with required skills; they will reduce the problem of quack electrical installation technicians thereby, offering good services to the society. This will go a long way in achieving the much needed technological development in Nigeria

Electrical installation technology

Technology a process of integration of science and practice in the application of tools and methods, also a study, development, and application of devices, machines, and techniques for manufacturing and productive processes. Tools and machines, equipment, and systems are considered as a unit cultural anthropology.

Anthropology the sum of practical knowledge and skill with accepted methods. methodology of applying technical knowledge of tools, equipment and machines in the society. A society's or culture's practical knowledge, especially with reference to its material culture recent developments in seismographic technology, as result electrical technology.

Electrical technology refers to that technology in energy that course potential difference (pd) or known as movement of electrons in a conductor. Produce in chemical or mechanically for societal used when install in a building. According to Francis (1980) electrical installation could be described as an installation in a building, which comprises various kind of electrical apparatus fixed in a position ready for used, together with the necessary wiring, control gears. Francis (1980) went further mention the following as the various types of electrical installation. There are Bare conductors wiring, conduit wiring, Rubber Sheathed Wiring, P.V.C. polyvinyl chloride wiring, lead-alloy sheathed wiring, earthed concentric installation, mineral-insulated installation. Electrical Machine Installation the one seen to be most suitable for a particular condition or environment would be employed. None regarded as the best for all situations or environment. Installation: an act of installing equipment, the process of putting a piece of equipment or machine in place and making it ready for use such as housing equipments or machinery for a particular use, systems that has been put in place, made ready for use. Thompson (1973) ascertained that effective training of electrical installation programmers would equip students with broad knowledge of the world of work and prepare the student to grow and develop in relation to the world.

- **Generation electrical energy**

Electrical energy is generated by conversion of energy available in different forms from different natural source such as kinetic energy of blowing winds , pressure heat of water, chemical energy of fuels(either in solid, liquid or gaseous form) and nuclear energy of radio-active substances in to electrical energy. The conventional method of power generation make used of prime movers (such as turbines) for driving electrical machines (generators or alternators) which convert mechanical energy into electrical energy The electrical machine employed for generating *dc* are called the ñ*generator"* Whereas those employed for generating *ac* are called the ñ*alternators" Popular* methods of power generation by conventional methods are (i) thermal (ii) hydro and (iii) nuclear.

The alternative method of generating electrical energy without the used of prime-movers are called *non- conventional method of power generation* The magneto-hydro-dynamic (MHD) power generation in one of the example of a new unique methods of power generation The other non-conventional methods of power generation may be such as solar cell, fuel cells, thermionic converters solar power generation wind power generation geo-thermal energy generation tides power generation .All of these methods are still experimental stages and of little commercial or industrial importance.

- **Sources of energy in Nigeria**

The main sources of energy are the sun, wind terrestrial heat ocean tides and waves, water, fuels, and radio-active substances. Sun radiate heat energy that can be used for the generation of electric power but non conventional, non commercial rate energy

- **Comparison of sources of energy**

(I) *Initial cost.* The initial cost of erecting a power plant for using water as the source is very high as compared to the plant employing fuel as sources of energy this is due to large amount of excavation work and heavy cost of transportation of plant and machinery in case of power using water as a source of energy. But the cost of erection of hydro-electric power plant is less than that of nuclear power plant. Thus the highest initial cost is involved in erecting nuclear plant

(II) *Running cost* The running cost of hydro-electric power is less than that of steam or diesel plant.

(III) *Limit of sources of energy* Of all three source for generating electric power viz water, coal and nuclear, the nuclear source is inexhaustible The availability of water as a sources of power generation is not dependable because it depends upon the rain fall which is at the whim of nature.

Sources of fuel that is coal, reserves all aver the world is considered to be limited and coal mine are being exhausted and may come, possible after a few centauries, when all of these might finish. The raw material for producing nuclear energy fissionable materials in large deposits available all over the word,

(IV) *Simplicity and Cleanness* The hydro-electric power plant are the cleanest and simplest. There is no danger of any radiation hazards etc and no nuisance of smoke, ashes.

(V) *Reliability,* The hydro-electric power plant is the simplest, robust and more reliable. The nuclear power plant is also reliable

Field of Application If there is a perennial water source close by hydro-electric power plant is the best. The steam (coil based) power plants are adopted only when coal supply is available in plenty, large amount of power is required to be generated and financial, climatic and geographical conditions are not favorable to hydro-electric power stations

- **Power crisis in Nigeria.**

The electricity requirements in Nigeria have growth tremendously and demand has been running ahead of supply. Electricity generation and transmission progresses in the country are very inefficient in comparison with those of some developing countries. Generating capacity in Nigeria is utilized on an average for (3,600 hours) non comparable to any country. The transmission losses in 1974-75 on basis were 20.3% consisting of both technical losses in transmission lines and transformers and also non-technical losses caused by energy theft and non ï metering. The commissioning of many power projects has been delayed considerably due to various reasons such as non-availability of funds in time, shortage of building material, labour problems, shortage of trained personnel, delay in delivery of equipment, lack of coordination in construction activates, interstate disputes. PHCN have been less than normal, causing reduction in generation of hydro-energy. There had been also periodic closure of steam power stations due to shortage of coil, (either due to difficulties in mines or in transportation). There are the causes (i.e sharp increase in demand, poor utilization of electrical equipment, high transmission losses, the delay in commissioning of Abuja power project, erratic Enugu shortage of coal, faulty planning, among others are responsible for power crisis in Nigeria.

Electrical Energy

- **Importance of electrical energy**

Both the historical and the present day civilization of mankind are closely interwoven with energy, and there is no reason to doubt but that in the future our existence will be more and more dependent upon the energy. Electrical energy occupies the top position in the energy hierarchy It finds innumerable used in home, industry, agriculture and even in transport. Besides itôs used for domestic, commercial and industrial purposes it is required for increasing defense. Electrical energy is convenience from of energy because it can be generated centrally in bulk and transmitted economically over long distances and is almost pollution free at the consumer level. Further it can be adopted conveniently in the domestic, industrial and agricultural field.

- **Growth of power systems in Nigeria**

  Power development in Nigeria stated around 1898 when the fist 2 x 30KW units station was build at Marina ï Lagos to supply power to the government officer and residencies Quarters the Ijora power station was commissioned in 1921, followed by those at Enugu, Portharcourt, At the end of second world war isolated power station were established in some major urban center in country These stations were under the Native Authority (NA) and the public workers department (PWD).

In 1946 the Nigerian government Electricity undertaking was established to take over the responsibility of supplying power to Lagos area. The Electricity Corporation of Nigeria ECN was established by ordinace15 of 1950. Along with ECN, each other bodies as Nigerian Electricity supply company (HESCO), Jos and the African Timber and Plywood (AP &P) Sapele were license to produce and supply electricity in some locations in Nigeria. HESCO is still generating and supplying Electricity to some part of Jos Township. The Niger Dam Authority (NDA) was established in 1962 The NDA commissioned the fist Hydro-power station at Kainji in 1969 with an initial capacity of 4x80 MW. Decree 24 of April 1972 merged the NDA and ECN to form the National Electrical Power Authority (NEPA).

NEPA as of then has three Hydro- power generating station the oldest of which in located at kainji Two others located at Jebba and Shiroro respectively. The Authority has also four thermal stations. (steam or Gen-turbine station) located at Afam, Ugheli (Delta), Sapele and Egbin (L.T.S.). There are also few other smaller station located at Ijora, Ajaokuta and Calabar.

At the Power Transmission level, NEPA has one National and Six regional control centers. A good number of Area control centers also exist. The Distribution of the Authority in divided into seven zones with a good number of districts under each zones The National control centers supervises the GRID Network operation.

- **Superiority of electrical energy**

Electrical energy is considered superior to all other forms of (Chemical, heat, Light, sound or mechanical) of energy due to the fact that electrical energy is(i) Cheaper, economical to used in this form of domestic, commercial, industrial and agricultural purposes (ii)convenient and efficient Transmission from the generating station usually located quit away from the centers of usage (iii) Easy control Electrically operated machines have simple and convenient starting control operation (iv) Cleanliness electrical does not produce smoke, fumes, dust or poisonous gases pollution free (v) Greater flexibility to be taken to any corner of the house, factory, street, hospital, farm, mine through solid stranded or flexible conductors. and (v) Versatile Form that can be converted to forms energy heat, light, mechanical, sound, or chemical.

- **Future trends**

The electricity requirement of Nigeria will continue to increase tremendously in the coming years. Hence certain concrete steps will have to be taken the generating capacity so as to meet the increasing demand. Government of Nigeria has fixed a target of 20,000 MW of power capacity by year 2025 against the present generating installed of 2.270MW There is also a need to improve the utilization of generating equipment, take corrective measures to improve reliability of the electric power systems and take care of the environmental aspects of energy generation. Transmission voltage of the power system is also be increased from 300KVA to 400KVA.

Concept of Competencies

Concept of competency in learning and development perspectives it is necessary to identify competences and competence requirements of electrical installations in real and valid way. Applying them to different sub- sectors of electrical installation, providing Electrical/Electronic teacher with possible areas for development .Based on a triangulation of methods the assessment seems to generate required recognizable, usable and valid with further areas of development moreover, the profile provides clear standing point for factors that influence the process of competence improvement in the domain of Electrical Installation.

During the last decade, the issue of competence development has received a great deal of attention. Has mainly focused on larger organizations, using competences to manage and implement change (Mulder, 2001). However, increasing use is being made of competences in other contexts; the competence concept has become a central theme in the debate on the development of vocational education and training, scientific education and organizations (Mulder, 2004). There also seems to be increasing interest in competence concept within the conceptual domain of electrical installation (Caird, 1992; Chandler and Jansen, 1992; Bird, 1995; Dahlqvist, 1999 and Man et al, 2002). This interest in the concept rest on the assumptions that competences are recognizable, assessable and relevant for practical, that they can be developed, learned and described on different levels, and it is supposed that there is a strong relationship between competence and organizational effectiveness (Caird, 1992).

The identification and assessment of Electrical/Electronic competences required of teacher is interesting from a scientific as well as a practical point of view. If competences of Electrical/Electronic teacher can be assessed unambiguously, the learning process that underlies competence development, Electrical/Electronic teachersô performance and personal development can be studied in detail. However, concrete instruments to measure competences of Electrical/Electronic teachers with the accent on learning and development are not yet available. Therefore, tentative assessment procedure for identification and measurement of competences of Electrical/Electronic teachers in installation will be developed.

Man et al. (2002) categorized competences in six key areas of related competences. The key clusters are opportunity, relationship, conceptual, organizing, strategic and commitment competences. In the literature on competence profiles the teacher and students of technical college manage, several competences that meet the outlined criteria and fit in one of these six clusters can be recognized (Erkkila, 2000; Hoekstra & Van Sluijs, 1999, Van den Tillart, 1987, man et al., 2002; Onstenk, 2003; Muder, 2001; McCelland, 1987). These competence clusters and the underlying competences mentions in the literature.

Table 1. Competence clusters with description and underlying competences (after Man et al., 2002)

	Competence cluster (Man et al., 2002)	Description	Underlying competences
1.	Opportunity competences	Competences related to recognizing and developing skill opportunities through various means	General awareness International orientation Skill orientation
2	Relationship competences	Competences related to person-to-person or individual-to-group based interactions	Communication Negotiation Networking Persuasiveness Teamwork
3	Conceptual competences	Competences related to difference conceptual abilities which are reflected in the behaviour of the technical student	Conceptual thinking Problem analysis Vision and judgment with view to installation innovations
4.	Organizing competences	Competences related to the organization of different internal, external, human, physical, financial and technological resources	HRM/HRD Leadership Planning and organization
5	Strategic competences	Competences related to setting evaluating and implementing	Learning orientation Management control Result orientation Strategic orientation
6	Commitment competences	Competences that drive the teachers and student to move ahead with the skills	Self-management

Based on (Erkkila, 2000; Hoekstra & Van Sluijs, 1999, Van den Tillart, 1987, Man et al., 2002; Onstenk, 2003; Mulder, 2001; McClelland, 1987).

There are a variety of methods available for developing a model of electrical installation competences and to assess these competences; the various methods are qualitative, quantitative, retrospective, concurrent, objective and self-report based (Bird, 1995).

Caird (1992) evaluates four research strategies for assessing competences on their suitability for identifying installation competences. The first strategy is the critical incidents technique (CIT) (further developed as the well-known Behavior) Event Interview method by McClelland (1998). The CIT/BEI technique focuses on the differences between average and excellent performers in a job. Besides the fact that the technique is time consuming another important point of criticism is that the CIT/BEI highlights extremes. The focus is on the excellence of workers, rather than measuring the broad scale of competences that the student possesses. The CIT/BEI only provides information about the top level of competence (Caird, 1992). Respondents also have the tendency to focus on success rather than on failure, which biases the outcomes.

A second method described by Caird is the job function analysis. The job function analysis is a well-known technique for curriculum development and involves the analysis of task functions related to a certain job or profession. Specific knowledge and skills for this job or function can be inferred from this profile. The job analysis method has some major disadvantages. Firstly, the method is very time consuming. Secondly, the techniques focus on the job description and therefore fail to discern between levels of competence. Thirdly, the result of the job function analysis is often an atomized description of skills, knowledge and attitude, with no guarantee that mastery of these sets will lead to competent performance. Finally, the job function method is a rather conservative method, new competences are easily neglected.

A third method consists of the so-called behaviorally anchored rating scales (BARS). BARS are used to identify criteria for effective performance, using evaluation of job performance. The evaluation conducted by electrical supervisor, and therefore relies to a large extent on the ability of the electrical supervisor to observe behavior. A pitfall of this technique is that the focus is merely on the outcome, which may neglect the underlying learning process.

The fourth method described by Caird can be labeled the action research method (Morgan, 1988 in Caird, 1992). Morganȍs action research method promotes self-reflective enquiry and teamwork by managers. The method focuses on the organizational needs and strategic concerns. It provides a picture of the competence needs for strategic development. A disadvantage of this technique is that it focuses on the needs rather than the actual competences present.

There are also many variations on these four broad strategies, For a complete overview see Bird (1995). Bird (ibid.) argues that when considering using a particular assessment method, it is important to find examples of this method in other published research, consider time and money aspects, and moreover to determine the reliability and validity of the method for appropriate analysis and conclusions. Luken (2004) Mentions some additional aspects to take into consideration when measuring competences: (1) the definition of competence is not a homogenous definition; (2) competences are not suitable; (3) competence assessments are always subjective (4) competence assessments are based on individuals, whereas the definition of the competence concept tries to include the context as well; (5) the competence concept include capacity, whereas it is also important to look at actual performance. Although the above-mentioned methods do have elements that should be taken into consideration, it can be concluded that none of them are completely suitable for assessing electrical installation competences in this context. Hence, based on the considerations outlined, six man design criteria were formulated:

- A focus on the integration of knowledge, understanding, attitudes and skills (visible and hidden elements);

- A focus not merely on behavior outputs, but also on the ongoing training and education process;
- A focus in the first instance on the actual competences and not on competence needs;
- The measurement of competences is not a matter of measuring the facts, but also of discussing, interpreting and negotiation;
- It is important to rate competences in more than one way. One way of making a relatively valid and reliable assessment is to use different assessment methods;
- Although it is hard to explain the meaning of abstract construct such as competence, people do have some kind of notion of what it entails (Stoof et al. 2002). As McClelland argues, ÷people agree more readily on who is outstanding that on what make them outstandingø.

Thompson (1973) ascertained that effective training of electrical installation programmers would equip students with broad knowledge of the world of work and prepare the student to grow and develop in relation to the world of work.

Domestic Installation

The goal of Domestic Installation module is to provide the trainee with the knowledge and skill to enable him carry out complete electrical installations in a building and its associated equipment. Practice required Understanding electrical working diagrams. The architect uses, asset of working drawing or plans to make the necessary instructions available to the skilled crafts which are build the structure shown in the plans. The sizes, quantities, and locations of the materials required and the construction features of the structural members are shown at a glance. These details of construction must be studied and interpreted by each skilled construction craft-masons, carpenters, electricians and others before the actual work is started.

The electricians must be able to; convert the two-dimensional plans into an actual electrical installation, and visualize the many different views of the plans and coordinate them into a three dimensional picture, this ability to visualize an accurate three dimensional picture required a through knowledge of blueprint reading. Since all of the skilled trades used a common set of plans the electrician must be able to interpret the lines and symbols which refer to the electrical installation and also those which are used by other construction trade. The electrician must know the structural makeup of the building and the construction materials to be used.(Mullin, 1987) It states that the installation must be essentially hazard-free, Knowledge of different types of domestic surface wiring becomes necessary (Paddock & Galvin, 1987).

There are many system of wiring which can be used to provide a safe, efficient and economical installation. Each of the recognized system of wiring has its own particular merits, and the system used for any particular installation should be with regard to the following factors:

(i) Types of load to be supplied

(ii) Type of building in which the installation is situated.

(iii) Cost

(iv) Durability

(v) Appearance

(vi) Any special adverse conditions (e.g presence of inflammable vaporsq, risk of mechanical damage etc

(vii) Expected life of installation

Some of the principal wiring system in used at the current era are listed

(1) Bare conductor systems

(ii) Cleared wiring

(iii) All insulated wiring

(iv) Lead alloy sheathed V.R.I. cables.

(v) Mineral insulated copper sheathed cable

(vi) Earthed concentric wiring

(vii) Catenary supported wiring

(viii) Paper insulated cables

(ix) Steel conduit and insulated conduit system

(x) Cable trunking and bus-bar trunking system

(xi) Under floor and concealed duct systems.

In particularly dangerous situations, the use of a low voltage system should be considered. A ócompetent personô will be charge with the responsibility especially if an accident should occur, and so should make certain that the installation is always maintained in a satisfactory and safe condition for both surface and conduit wiring.

There are two types of domestic conduit wiring. Light gauge and heavy gauge. Light gauge conduit is produced from strip steel which is formed into a tube. This type of conduit has open seam and is only used for small installation at or below, 250V, the light construction of the tube makes it unsuitable for bending, although it can be set. Heavy gauge conduits are of two types; heavy gauge welded conduit and solid drawn conduit. Heavy gauge welded conduit is formed form strips of heavy gauge steel and is welded at seam, this is the most common type of conduit and is supplied in sizes from 16mm to 32mm (outer diameter) .solid drawn conduit is produced by drawing a heated bar over a ram, forming a heavy-gauge seamless tube. This type of conduit is more expensive than welded steel conduit and is only used for flameproof installation (for e.g. garages). Finish metallic conduit has two types of finish; enamel paint (black or grey) and galvanized (zinc coated for wet conditions).other types of conduit are flexible metallic conduit and non-metallic conduit (Donnelly 1987). Conduit installation must be completed before cables are drawn in when drawing-in larger runs, start at center of the run draw in to both sides separately. When drawing-in long length of cable, or a bunch of small cables, a reel stand should be used, the simplest reel stand consist of a short piece of conduit fixed in a pipe vice. Used of draw tape consist of a long strip of spring-steel which has a ball-point at one end and a close loop at the other end it should only be used for pulling in the actual draw-in wire (for e.g. a V.R.I. or P.V.C. cable). It should not be used for drawing cables as it is very brittle and soon becomes distorted or broken if misused. Metallic conduit have some merits to provides protection against mechanical damage, good earth retune path and Durability, conduit if installed, lasts for years without maintenance, can be easily extended and low fire risk. If not liability to corrosion, more expensive than T.R.S. and P.V.C. sheathed system, and difficult to conceal (Donnelly 1989).

Also Thomson (1973) projected that the wiring regulations restrict the member of conductors that can be drawn into conduit. This is to allow for ventilation of current-carrying cables to allow for removal and replacement of conductors and, in some cases where the existing conduit capacity is not up to its limit, to allow new circuits to be drawn in. although manufacturersô conduit bends can be obtained, on site conduit is bent on a bending machine which ensure that the minimum internal radius of the bend is equal to 2.5 times the outside diameter. If how ever, a bending block (made from a bulk of wood) is used it is essential that the internal radius of the bend complied with the dimension given.

PROTECTIVE DEVICES

1. **Circuit Breakers:** The circuit breaker is required to protect the electrical equipment against excessive overloads automatically. It is connected between the current collector and the main wiring. One circuit breaker is required in case of

tram car and two circuit breakers are required in case of trolley bus, one in each trolley circuit. The main contacts of the circuit breaker are located in an arc chute and are provided with a magnetic blow-out. The blow-out coil actuates also the tripping mechanisms. It is also provided with a handle to trip the circuit breaker when it is moved to the ñoffò position by hand.

2. **Radio Interference Suppressor:** The e.m.f.s of radio frequency may be induced in the wiring due to arcing of sparking at the collector, controller, motors e.t.c. and radiated out from the trolley wires. The most serious interference occurs at the contacts of the master controller in system with electro-magnetic contactors operated at line voltage. Radio-interference suppressor consists of two radio-frequency chokes, one connected in each supply lead to the master controller, a capacitor filter comprising three star-connected capacitors connected between the trolley wires and chassis. The capacity of each capacitors is about 0.1µF.

3. **Lightning Arrestor:** Only the vehicles operating in the area liable to lightning storms are provided with lighting arrestors or surge diverter. One type consists of a small cylindrical block of carbonrundum held between two electrodes. One electrode with a small air gap in series is connected to the positive trolley wire and the other one to the negative trolley wire or earth. Gupta, (2005).

4. Understanding the sequence for inspecting and testing domestic installations.

Applying statutory safety regulations for life, properties and environment, visually detect electrical and mechanical loose avoid partial contact connections 3 types of electrical installation tests using bell and battery. Test lamp, millimeter

Illumination differs from light very much though generally these terms are used more or less synonymously. Strictly speaking light is the cause and illumination is the result of that light on surfaces on which it falls. Light may be produce by passing electric current through filaments as in the incandescent lamp. Some bodies reflect light in some measure, and when illuminated from an original source they become secondary source of light. The devising modern lighting schemes and the selection of fittings and types of lamps require knowledge of the terms and quantities in general use for such purpose.

(i) **Light:** the radiant energy from a hot body which produces the visual sensation upon the human eye. It is usually denoted by Q, expressed in lumen-hours and is analogous to watt-hours.

(ii) **Luminous Flux:** It is defined as the total quantity of light energy emitted per second from a luminous body. It is represented by symbol F and is measured in lumens. (cd) The conception of luminous flux helps us to specify the output in efficiency of a given light source.

(iii) **Luminous Intensity:** Luminous intensity is any given direction is the luminous flux emitted by the source per unit solid angle, measured in the direction in which the intensity is required. It is denoted by symbol I and is measured in candela (cd) or lumens per steradian.

If F is the luminous flux radiated out by source within a solid angle of w steradians in any particular direction the I = F/w lumens/steradians or candela (cd).

(iv) **Lumen:** The lumen is the unit of luminous flux and is defined as the amount of huminous flux given out in a space represented by one unit of solid angle by a source having an intensity of one candle power in all directions.

i.e Lumens = Candle power x solid angle = CP x w

or total lumens given out by source of one candela is 4π lumens.

(v) **Candle Power:** Candle power is the light radiating capacity of a source in a given direction and is defined as the number of lumens given out by the sources in a unit solid angle in a given direction. It is denoted by symbol CP.

i.e CP = Lumen/w

(vi) **Illumination:** When the light falls upon any surface, the phenomenon is called the illumination. It is defined as the number of lumens, falling on the surface, per unit area. It is denoted by symbol E and is measured in lumens per square metre or lux or metre-candle. If a flux of F lumens falls on a surface of area A, then the illumination of that surface is E = F/A lumens/m^2 of lux (lx).

(vii) **Lux or Metre Candle:** It is the unit of illumination and is defined as the luminous flux falling per square metre on the surface which is every where perpendicular to the rays of light from a source of one candle power and one metre away from it.

$$\text{i.e 1 Foot-cande} = 1\ \text{lumen/ft}^2 = \frac{1\ \text{lumen}}{(1\text{m}/3.28)^2} = 10.76\ \text{metre candle or lux.}$$

(ix) **Candela:** It is the unit of luminous intensity. It is defined as the $1/60^{th}$ of the luminous intensity per cm^2 of a black body radiator at the temperature of solidification of platinium (2.043^o K).

(x) **Mean Horizontal Candle Power (MHCP):** It is defined as the mean of candle powers in all directions in the horizontal plane containing the source of light.

(xi) **Mean Spherical Candle Power (MSCP):** It is defined as the mean of powers in all directions and in all planes containing the source of light.

(xii) **Mean Hemi-Spherical Candle Power (MHSCP):** It is defined as the means of candle powers in all directions above or below the horizontal plane passing through the source of light.

(xiii) **Reduction Factor:** Reduction factor of a source of light is the ratio of its mean spherical candle power to its mean horizontal candle power.

i.e Reduction factor = MSCP/MHCP

(xiv) **Lamp Efficiency:** It is defined as the ratio of the luminous flux to the power input. It is expressed in lumens per watt.

(xv) **Specific Consumption:** It is defined as the ratio of the power input to the average candle power. It is expressed in watts per candela.

(xvi) **Brightness or Luminance:** When the eye receives a great deal of light from an object we say it is bright, and óbrightnessô is an important quantity of illumination. It is all the same whether the light is produced by the object or merely reflected from it. The object sends out light as though each small piece of its surface were of a certain luminous intensity. Generally, the brightness of an object is not the same from all points of view. When brightness is considered in terms of measurable quantity, the term luminance is employed.

Brightness of luminance is defined as the luminous intensity per unit projected area in a direction θ to the normal, then the luminance (brightness) of that surface is

$$L = \frac{1}{A \cos\theta} \text{ candela/m}^2 \text{ or nits}$$

i.e nit is defined as candela per square metre. Bigger unit of luminance is stilb which is defined as candelas per square cm. Lambert is also the unit of brightness which is lumens/cm^2. Foot-lamber is lumens/ft^2.

(xvii) **Glare:** The size of the opening of the pupil in the human eye is controlled by its iris. If the eye is exposed to a very bright source of light, the iris automatically contracts in order to reduce the amount of light admitted and prevent damage to retina; this reduces the sensitivity, so that other objects within the field of vision can be only imperfectly seen. This effect is referred to óglareô and is familiar in connection with motor-car headlights. In character as to cause annoyance, discomfort, interference with vision or eye-fatigue.

(xviii) **Space-height Ratio:** It is defined as the ratio of horizontal distance between adjacent lamps and height of their mountings.

i.e Space-height ratio = $\frac{\text{Horizontal distance between two adjacent lamps}}{\text{Mounting height of lamps above working plane}}$

(xix) **Utilization Factor or Coefficient of Utilization::** It is defined as the ratio of total lumens reaching the working plane to total lumens given out by the lamp.

i.e Utilization factor = $\frac{\text{Total lumens reaching the working plane}}{\text{Total lumens given out by the lamp}}$

(xx) **Maintenance Factor:** Due to accumulation of dust, dirt and smoke on the lamps, they emit less light than they emit when they are new ones and similarly the walls and ceilings e.t.c after being covered with dust, dirt and smoke don not reflect the same output of light, which is reflected when the are new. The ration of illumination under normal working conditions of the illumination when the things are perfectly clean is known as maintenance factor.

i.e Maintenance factor = $\frac{\text{Illumination under normal working conditions}}{\text{Illumination when every thing is perfectly clean}}$

(xxi) **Depreciation Factor:** This is merely the inverse of the maintenance factor and is defined as the ratio of initial metre-candles to the ultimate maintained metre-candles on the working planes. Its value is more than unity.

(xxii) **Waste Light Factor:** Whenever a surface is illuminated by a number of sources of light, there is always a certain amount of waste of light on account of overlapping and falling of light outside the edges of the surfaces. The effect it taken into account by multiplying the theoretical value of lumens required by 1.2 for rectangular areas and 1.5 for irregular areas and objects such as statutes, monuments e.t.c.

(xxiii) **Absorption Factor:** In the places where atmosphere is full of smoke fumes, such as in foundries, there is a possibility of absorption of light. The ratio of total lumens available after absorption to the total lumens emitted by the sources of light is called the absorption factor. It values varies from unity for clean atmosphere to 0.5 for foundries.

(xxiv) **Beam Factor:** The ratio of lumens in the beam of a projector to the lumens given out by lamp is called the beam factor. This factor takes into account the absorption of light by reflector and front glass of the projector lamp. Its value varies from 0.3 6o 0.6.

(xxv) **Reflection Factor:** When a ray of light impinges on a surface it is reflected from the surface at an angle of incidence. A certain portion of incident light is absorbed by the surface. The ration of reflected light to the incident light is called the "reflection factor". It is always less than unity.

(xxvi) **Solid Angle:** Plane angle is subtended at a point in a plane by two converging straight lines and its magnitude is given by

$$\theta = \frac{\text{Arc}}{\text{Radius}} \text{ radians}$$

The largest angle subtended at a point is 2g radians.

The angle is the angle generated by the surface passing through the point in space and the periphery of the area. Solid angle is denoted by w, expressed in steradians and is given by the ratio of the area of surface to the square of the distance between the area and the point.

$$\text{i.e } w = \frac{\text{Area}}{(\text{Radius})^2} = \frac{A}{r^2}$$

Light plays a most important role in many building, not only for functional purposes (simply supplying light) but to enhance the environment and surroundings. all these show not only the imagination of architects and light engineers but the skills of the practicing electrician in the installation of luminaries. Many sources of light are available today with continual improvement in lighting efficiency and colour of light. Two terms associated with lighting are **lumen (lm)** this is a unit of luminous flux (or "amount of light") emitted from a source, but **luminous efficacy**; this denotes the amount of light produced by a source for energy used therefore a number of Types of lamps are used today filament, fluorescent, mercury vapour, sodium vapour, neon. All these have specific advantage and applications. Looking at these one by one Filament lamps used a filament made from tungsten and raised to about 2,500 ^oC to produce a light which though it looks white, actually has a lot of red in it. Available in forms of general lighting, Festive lighting, spot and flood lighting, construction lamps, and special lamps among others. Discharge lamps under normal circumstances, an electric current cannot flow through a gas. How ever if electrodes are fused into ends of a glass tube and the tube is slowly pumped free of air, current does pass through at a certain low pressure. A faint red luminous column can be seen in the tube, preceding from positive electrode at the negative electrode a week glow is also just visible. There are two main types of electric discharge lamp (a) Cold cathode (b) Hot cathode. (Thomson 1973).

Industrial installation

Industrial Installations, the goal, according to NBTE (1987) is to provide the trainee with the knowledge and skill to enable him carry out all types of industrial/factory electrical installations and maintenance. Installations of different types of ducts and trunkings. Applying relevant regulation and safety precaution. Trunking is a fabrication casing for conductors and cables, generally rectangular in shape with a removable lid which allows the conductors to be laid in rather than be drawn in as the case with conduit. It is used where a large number of conductors are to be carried, or follow the same route,. Both steel and PVC Trunking are available, with a wide range of such accessories as bends, tees, flange adaptors, risers, and reducers. The variety of Trunking includes plain section, compartmented skirting bench, and floor truncking and busbars trunking. Trunking is not necessarily a complete wiring system in itself and is thus associated with conduit and MI cable to allow connection to wiring accessories and their mounting boxes. Finishers on steel Trunking, include grey enamel, galvanized and silver enamel on Zinkcoated mild steel. From I.E.E. Regulations dealing with cables duct systems (metallic or non metallic) it can be seen that the regulations governing conduit systems mostly apply also to trunking. All metal accessories such as junction boxes, inspection covers and duct outlets should be effectively earthed and, when earthed by a soldered joins should be provided .it is necessary because lengths of painted metal trunking are generally joined together by screws, so that the continuity resistance is liable to be high. Incase of machine earthling and operation. (Miller, 1987; Thomson, 1973; Donnelly, 1987).

The principles of operation AC and DC machine and their applications, if an armature revolves between two stationary field poles, the current in the armature moves in one direction during half of each revolution and in the other direction during the other half. To produce a steady flow of unidirectional, or direct, current from such a device, it is necessary to provide a means of reversing the current flow outside the generator once during each revolution. In other machines this reversal is accomplished by means of a commutator, a split metal ring mounted on the shaft of the armature. The two halves of the ring are insulated from each other and serve as the terminals of the armature coil. Fixed brushes of metal or carbon are held against the commutator as it revolves, connecting the coil electrically to external wires. As the armature turns, each brush is in contact alternately with the halves of the commutator, changing position at the moment when the current in the armature coil reverses its direction. Thus there is a flow of unidirectional current in the outside circuit to which the generator is connected. DC generators are usually operated at fairly low voltages to avoid the sparking between brushes and commutator that occurs at high voltage. The highest potential commonly developed by such generators is 1500 V. In some newer machines this reversal is accomplished using power electronic devices, for example, diode rectifiers. Modern DC generators use drum armatures that usually consist of a large number of windings set in longitudinal slits in the armature core and connected to appropriate segments of a multiple commutator. In an armature having only one loop of wire, the current produced will rise and fall depending on the part of the magnetic field through which the loop is moving. A commutator of many segments used with a drum armature always connects the external circuit to one loop of wire moving through the high-intensity area of the field, and as a result the current delivered by the armature windings is virtually constant. Fields of modern generators are usually equipped with four or more electromagnetic poles to increase the size and strength of the magnetic field. Sometimes smaller interpoles are added to compensate for distortions in the magnetic flux of the field caused by the magnetic effect of the armature.

DC generators are commonly classified according to the method used to provide field current for energizing the field magnets. A series-wound generator has its field in series with the armature, and a shunt-wound generator has the field connected in parallel with the armature. Compound-wound generators have part of their fields in series and part in parallel. Both shunt-wound and compound-wound generators have the advantage of delivering comparatively constant voltage under varying electrical loads. The series-wound generator is used principally to supply a constant current at variable voltage. A magneto is a small DC generator with a permanent-magnet field.

Electric Motor

In general, DC motors are similar to DC generators in construction. They may, in fact, be described as generators ñrun backwards.ò When current is passed through the armature of a DC motor, a torque is generated by magnetic reaction, and the armature revolves. The action of the commutator and the connections of the field coils of motors are precisely the same as those used for generators. The revolution of the armature induces a voltage in the armature windings. This induced voltage is opposite in direction to the outside voltage applied to the armature, and hence is called back voltage or counter electromotive force (emf). As the motor rotates more rapidly, the back voltage rises until it is almost equal to the applied voltage. The current is then small, and the speed of the motor will remain constant as long as the motor is not under load and is performing no mechanical work except that required to turn the armature. Under load the armature turns more slowly, reducing the back voltage and permitting a larger current to flow in the armature. The motor is thus able to receive more electric power from the source supplying it and to do more mechanical work. Because the speed of rotation controls the flow of current in the armature, special devices must be used for starting DC motors. When the armature is at rest, it has virtually no resistance, and if the normal working voltage is applied, a large current will flow, which may damage the commutator or the armature windings. The usual means of preventing such damage is the use of a starting resistance in series with the armature to lower the current until the motor begins to develop an adequate back voltage. As the motor picks up speed, the resistance is gradually reduced, either manually or automatically.

The speed at which a DC motor operates depends on the strength of the magnetic field acting on the armature, as well as on the armature current. The stronger the field, the slower is the rate of rotation needed to generate a back voltage large enough to counteract the applied voltage. For this reason the speed of DC motors can be controlled by varying the field current.

As stated above, a simple generator without a commutator will produce an electric current that alternates in direction as the armature revolves. Such alternating current is advantageous for electric power transmission, and hence most large electric generators are of the AC type. In its simplest form, an AC generator differs from a DC generator in only two particulars: the ends of its armature winding are brought out to solid unsegmented slip rings on the generator shaft instead of to commutators, and the field coils are energized by an external DC source rather than by the generator itself. Low-speed AC generators are built with as many as 100 poles, both to improve their efficiency and to attain more easily the frequency desired. Alternators driven by high-speed turbines, however, are often two-pole machines. The frequency of the current delivered by an AC generator is equal to half the product of the number of poles and the number of revolutions per second of the armature.

It is often desirable to generate as high a voltage as possible and rotating armatures are not practical in such applications because of the possibility of sparking between brushes and slip rings and the danger of mechanical failures that might cause short circuits. Alternators are therefore constructed with a stationary armature within which revolves a rotor composed of a number of field magnets. The principle of operation is exactly the same as that of the AC generator described, except that the magnetic field (rather than the conductors of the armature) is in motion.

The current generated by the alternators described above rises to a peak, sinks to zero, drops to a negative peak, and rises again to zero a number of times each second, depending on the frequency for which the machine is designed. Such current is known as single-phase alternating current. If, however, the armature is composed of two windings, mounted at right angles to each other, and provided with separate external connections, two current waves will be produced, each of which will be at its maximum when the other is at zero. Such current is called two-phase alternating current. If three armature windings are set at 120° to each other, current will be produced in the form of a triple wave, known as three-phase alternating current. A larger number of phases may be obtained by increasing the number of windings in the armature, but in modern electrical-engineering practice three-phase alternating current is most commonly used, and the three-phase alternator is the dynamoelectric machine typically employed for the generation of electric power. Voltages as high as 13,200V are common in alternators.

Electric Generator

Two basic types of motors are designed to operate on polyphase alternating current, synchronous motors and induction motors. The synchronous motor is essentially a three-phase alternator operated in reverse. The field magnets are mounted on the rotor and are excited by direct current, and the armature winding is divided into three parts and fed with three-phase alternating current. The variation of the three waves of current in the armature causes a varying magnetic reaction with the poles of the field magnets, and makes the field rotate at a constant speed that is determined by the frequency of the current in the AC power line. The constant speed of a synchronous motor is advantageous in certain devices; however, in applications where the mechanical load on the motor becomes very great, synchronous motors cannot be used, because if the motor slows down under load it will ñfall out of stepò with the frequency of the current and come to a stop. Synchronous motors can be made to operate from a single-phase power source by the inclusion of suitable circuit elements that cause a rotating magnetic field.

The simplest of all electric motors is the squirrel-cage type of induction motor used with a three-phase supply. The stator, or stationary armature, of the squirrel-cage motor consists of three fixed coils similar to the armature of the synchronous motor. The rotating member consists of a core in which are imbedded a series of heavy conductors arranged in a circle around the shaft and parallel to it. With the core removed, the rotor conductors resemble in form the cylindrical cages once used to exercise pet squirrels. The three-phase current flowing in the stator windings generates a rotating magnetic field. This field induces a current in the conductors of the cage. The magnetic reaction between the rotating field and the current-carrying conductors of the rotor makes the rotor turn. If the rotor is revolving at exactly the same speed as the magnetic field, no currents will be induced in it, and hence the rotor should not turn at a synchronous speed. In operation the speeds of rotation of the rotor and the field differ by about 2 to 5 percent. This speed difference is known as slip. Motors with squirrel-cage rotors can be used on single-phase alternating current by means of various arrangements of inductance and capacitance that alter the characteristics of the single-phase voltage and make it resemble a two-phase voltage. Such motors are called split-phase motors or condenser motors (or capacitor motors), depending on the arrangement used. Single-phase squirrel-cage motors do not have a large starting torque, and for applications where such torque is required, repulsion-induction motors are used. A repulsion-induction motor may be of the split-phase or condenser type, but has a manual or automatic switch that allows current to flow between brushes on the commutator when the motor is starting, and short-circuits all commutator segments after the motor reaches a critical speed. Repulsion-induction motors are so named because their starting torque depends on the repulsion between the rotor and the stator, and their torque while running depends on induction. Series-wound motors with commutators, which will operate on direct or alternating current, are called universal motors. They are usually made only in small sizes and are commonly used in household appliances.

- Know the installation of all types of electrical machine and equipment.
- Understand various methods of controlling electrical machines.
- Know methods of maintaining electrical machine and equipment.
- Diagnose faults in machines equipment and installations.

The installation of MICC cable, this type of cable consists of copper conductors embedded in highly compressed magnesium oxide power and enclosed in seamless copper tubing. Some advantage are ;(1) the cable has non-flammable, non-ageing insulation, (2) it is impervious to water, oil and many liquids (3) it is mechanically strong, (4) it has relatively a high current rating. Fixing of the cable to surface can be done with ready-made copper clips or saddles or by saddles made from copper strip; it can be run on brackets, hangers, racks and trays. It can be buried direct in the ground, but to prevent the possibility of corrosion a PVC sheath is usually included for underground runs. All terminations must be effectively sealed against the in-grees of moisture. The method commonly employed for ordinary insulations is the ÓscrewÊon, pot-typeÔ seal. A brass pot is screwed on to end of the copper sheath and filled with cold plastic compound, then a sub-assembly is fitted including insulating sleeves to fit over the conductors and then a fiber cap or disc is fitted and secured by crimping the pot over the compound.

Mineral- insulated copper-sheathed cable can buried with safety in most types of ground, but care should be taken in made up soil, especially when it contains cinders or in farm-yards where urine may be present. Certain plasters and cements cause corrosion, so that it is advisable to find out how they are constituted before burying cable in them. In general, non-acidic plasters Portland cement and mild alkaline ammonia-free plasters are harmless to the cable,

Cable Jointing

The NBTE curriculum and module specifications identify the goal of Cable Jointing as being intended to provide the trainee with knowledge and skill to enable him undertake with proficiency various methods of cable jointing and terminations. Cable means one or more conductors with or without insulating covering and with or without protective covering and also includes a wire. (FGN 1990) An electric Cable may be define as a single conductor insulated through its full length or two or more conductors each provide with its own insulation and laid up together under one outer protective covering. (Gubta 2005). Wire joining and termination point for attachment to a fitting for one or more lamps or other consuming device of any nature whatever. Fitting is any device for supporting or containing a lamp, together with its holder and shade or reflector, for example a bracket, pendant and ceiling-rose, electrolier, or portable standard.

There is no joining without conductor .Repairing and joining conductors repair-sleeves are employed for repairing of ACSR() or all aluminum conductors which have sustained surface ï damage causing a few of aluminum strands to be damage or broken When the damage is more severe, it is not advisable to use repair-sleeves because it is not necessary to cut the conductor completely and make a join with the help of the joining sleeve. The most popular type of repair sleeve is *swage type* which is designed for used with small size conductors. Such a sleeve is made of aluminium and applied on the damaged part of the conductor with a swage-and-die made of steel. for a large size conductors bigger sleeves are employed and a hydraulic compressor (instead of swage-and ï die) is used to the press the sleeve on the damaged conductor, working first towards one end and then towards the other end A joining sleeve consists of an oval, thin walled aluminium sleeve larger enough to slip over the overlapped ends of conductors to be jointed. Joining sleeves are employed for AA and ACSR conductors of area of cross-section of up to $30mm^2$.

Terminations of cable conductors must be accessible for inspection they must be electrically and mechanically sound. No stress should be imposed on the terminals. Where two dissimilar metals are being used (e.g. copper and aluminium) care must be taken to prevent corrosion, particularly in damp situation. All insulation damage by heat-jointing processes (e.g. soldering) must be made good. Soldering fluxes which remain acidic or corrosive at the completion of a soldering operation must not be used. Joints in cables: An electrically sound joint means that the resistance of the jointed conductor should not be greater than that of a jointed length of a similar conductor. A mechanically sound joint means that any pulling on the finished joint will not disturb the joint. A soldering joint must be mechanically sound before soldering a joint which is readily accessible is one which is located usually in a box of the inspection type and box it self must be readily accessible, the termination of a flexible cable or a flexible cord to an appliance must be either by wiring direct onto the appliance terminals or means of a joint must made between a flexible cord and/or flexible cable, an insulated mechanical connector must be used. Non-reversible cable couplers and connectors are desirable. Often flexible cables are required to be extended in length by the used of couplers. Their used is not regarded as being good practice. But if the situation demands it, only couplers to BS 4343 should used only BS 4343 couplers are permitted on construction site. Couplers should be non-reversible and so connected that the plug is on the side of the equipment. (Thompson, 1973; Henry, 1976).

Armouring in certain circumstances it is necessary for a cable to be protected against the occurrence of mechanical damage. Protection by armouring is define as the provision of a ñhelicalò wrappings of metal (usually wire or tape), primarily for the purpose of mechanical protection. The type of damage against which the cable is protected is rough treatment, abrasion, collision, the materials used, in tape or wire form for armouring cable is most often steel. But aluminium is also used. Section 333-1 of National Electrical Code, describes armored cable as an assembly of insulated conductors in a flexible metallic enclosure, designated as type ACT if the conductors have thermoplastic insulation, or as type AC if the conductors have thermosetting insulation. The conductor insulation is rated at 60^{o}C, unless suffix ñHò, indicating a 75^{o}C-rating, or a suffix ñHH,ò indicating a 90^{0}C-rating, is added to the type AC or type ACT label, Armored cable is generally available with two or three conductors in sizes from No. 14 AWG to No 1 AWG inclusive.

- Two-wire armored cable contains one black and white conductor.
- Three-wire armored cable contains one each of black, white, and red conductors

Armored cable (except ACL) must have an internal bonding of copper or aluminium in close contact with the armor for its entire length. This type of cable is used in a grounded system because of the metal bonding strip and the flexible steel armor. The armor also provides mechanical protection to the conductors. Mullin (1987)

Over head cables: Bare, lightly-insulated and insulated conductors of copper, copper-cadmium and aluminium generally, sometimes with steel core for added strength. Communication Cables includes television down-leads and radio-relay cables, radio-frequency cables telephone cables. It is usual practice to run telephone lines along the same route as the power lines. The transmission lines transmit bulk power at relatively high voltage and, therefore these lines give rise to electro-magnetic and electro-static fields of sufficient magnitude which induce currents and voltages in the neighboring telephone lines. The currents so induce are superimposed on the true speech currents in the neighboring telephone wires and set up distortion while the voltages so induced raise the potential of the communication circuit as a whole. In extreme cases the effect of there fields may make it impossible to transmit any message faithfully and may raise the potential of the telephone receiver above the ground to such an extent to render the handling of telephone receiver extremely dangerous and in such cases elaborate precaution are required to be observed to avoid this danger.

Joining of conductors: The used of mid-span tension joints is a subject on which there are different opinions .Some engineers do not use mid ï span joins except for repairs, while other do used joints on new construction . Too much stress is put on the mechanical properties of joins and too little on the electrical requirements. Some joint failures have occurred under fault conditions when the conductor was under normal tension. Joins which behave perfectly under ordinary conditions of current lauding often shows signs of distress under heavy fault currents, and for this reason new design are subjected to electrical as well as mechanical test.

Vital Features of good joints

- Conductivity of join should not be less an equivalent length of the conductor
- Joins should be capable of carrying maximum fault current without failure or deterioration for the time required for the protective system to operate
- Mechanical strength should not be less than 95% of the breaking load of the conductor.
- Life of joint should be equal to that of the conductors without deterioration either electrically or mechanically.
- Simple in design and assembly, since joins have often to be made under difficult working conditions in poor light and bad compression type.

Types of joins

Joints are of Splice, Britannia, Married, Sleeve, and Compression types

1. **Splice joint**. This joint is generally used with single strand conductors. The ends of the conductors to be jointed are scrapped and cleaned and placed together overlapping up to 200mm-300mm. The conductors are held firmly together and then the overlapped conductors are twisted. The number of twists that are usually given is four.

2. Britannia joint. Such a joint can be used for both solid and stranded conductors. In this case the two ends of the conductors are scrapped and cleaned and then they are made to overlap one above the other. The length of overlapping portion depends on the size of conductors and it may vary from 150$_{mm}$. Temporary binding of few turns are applied over the overlapping portion .The biding wire used for this purpose is soft copper wire for copper conductor and aluminium wire for aluminium conductor. The free ends of the line conductors are also bound and then soldered.

3. Married joint Such a joint is employed only for strand conductors. The strand conductors to be jointed are fist opened by one end then the strands of one conductor are fitted into the strands of the other conductor The strands are pressed generally by hand to make them lie close to the conductor. Each strand is served with few turns over the conductor one after the other. If this method is used for joining strand conductors then joint should also be soldered. In case of aluminium conductors there is no need of soldering.

4. Sleeve joint. This joint is preferred for joining aluminium and ACSR Conductors because it provides a good electrical contact and sufficient mechanical strength. If in this case the ends of the conductors are scrapped and cleaned then the inside part of an aluminium sleeve is thoroughly to make it free from dirt or grease. The sleeve is an over-shaped aluminium tube available in different lengths for joining different types of conductors. Only one sleeve is used for jointing AA conductors but two sleeves are required in case of ACSR conductors. The cleaner conductors are placed inside the aluminium sleeve from opposite ends and are drawn beyond the end of the sleeve. The sleeve is wrenches with dies of desired size are turns by twisting the wrenches in opposite direction. The conductor ends are turned up and cut to the sleeve. When two sleeves are used then each sleeve are used then each sleeve is four and half turns.

5. Compression Joint. Joint of the compression type are excellent for joining heavy ACSR conductors. The steel core and aluminium strands are gripped separately and fitting of joints is not required. The making of this joint required a portable compressor with special dies. Care should be taken that the joint is rotated a little before each fresh grip; otherwise the tendency is for the joint to be banana shaped. In such a joint 95% of the ultimate strength of the conductor is retained. The process for making compression joint is specified below:

1) The steel and aluminium sleeves are thoroughly clean.
2) The conductor ends are scrapped and thoroughly clean and grease and oxidation are completely removed.
3) The aluminium sleeve of a size matching the conductor is selected and is slipped over one of the two conductors.
4) The length equal to half length of the steel compression sleeve plus 12_{mm} is marked off and the steel reinforcement is expose by cutting aluminium strands from each conductor by a hacksaw. Taken care that hacksaw does not damage the steel core. Moreover, before cutting the aluminium strands the conductor is bound edge with aluminium binding wire just before cut.
5) The exposed reinforcement of the conductors is inserted into the steel sleeve in such a way that the two ends meet at the center of the sleeve. The sleeve in the compressed by a compressed tool at approximately 70 tonne pressure starting from the middle to the end in such a way that the two section of the die meet completely and a very thin paper cannot be inserted between them.
6) Now the binding from the conductors to be jointed is removed.

7) The aluminium sleeve, that was inserted right at the beginning on one conductor, is slipped back over the compressed steel sleeve till it covers the aluminium sleeve is coincident with the midpoint between the two conductors.

8) Filler paste is injected through the two filled holes provided on the aluminium sleeve until the holes are completely filled holes and they are hammered firmly

9) Finally the aluminium sleeve is compressed with the compression machine in the same way as was done in case of steel sleeve.

Winding of Electrical Machines

Understand and apply all statutory regulations during electrical winding work. NBTE (1987) specify the goal of module of Winding of Electrical Machines as being aimed at providing the trainee with the knowledge and skill to enable him wind or rewind AC and DC rotating/static machines up to 10 KVA and select appropriate tools and equipment used for winding jobs.

The skills for preparation and interpretation of winding drawing, Consider the four-pole armature for two conductors per slot in each of the 11 slots .the easiest way of indicating the connections of the wires to the commutator segments is to use a developed diagram, namely a diagram representing the winding cut radially at one point and then laid flat, the full lines 1, 2, 3, e.t.c. Represent conductors (and their end-connections) occupying the outer haves of the slots while dotted lines 1ô, 2ô, 3ô. e.t.c. represent the conductors occupying the inner halves; thus 1 and 9ô represent conductors the inner halves respectively f one slot, 2 and 10ô occupy the next slot e.t.c. the procedure in drawing the completed developed winding is as follows (Morley & Hughes 1964).

(a) Draw parallel full and dotted lines to represent the conductors in the 11 slots and label the full lines 1, 2, 3, 4 etc.

(b) Adopting the coil span of 3 the back end-connections by joining conductor 1 occupying the outer half of slot 1 to the conductor occupying the half of inner slot 4. this conductor is then labeled 1â. Similarly, conductor 2 in slot 2 is connected to 2ô in slot 5.etc.

(c) Draw two parallel horizontal lines with vertical lines to represent the mica strips separating the 11 commutator segments. The spacing of the vertical lines is the same as that of the slots.

(d) Join the front end of conductor 1 to segments 1 and the corresponding end of 1ô to segment 2; similarly, connect 2 and 2ô to segments 2 and 3 respectively, etc. the end-connections marked a, b, c, d, etc represent the point at which the winding is regarded as being cut to give the developed diagram.

(e) Inert rectangles to represent the position of the poles relative to the winding at the instant considered. The poles should be shown equally spaced; thus the left-hand edges of the pole should be spaced; 11/4=2 ¼ slot pitches apart in the present example, a slot pitch being the distance between the center of two adjacent slots. It is usually convenient to show the width of each pole about two-thirds of the pole pitch.

(f) Assume the winding to be moving towards, say, the right and the poles to be in front of the windings; consequently from the Right-hand it is found that the directions of the e.m.f.s generated in conductors moving in the magnetic fields are as indicated by the arrowheads.

(g) Indicate the position of the brushes. With a lap winding there must be as many brushes as there are poles, and they must be equally spaced around the commutator and connected through the latter to conductors in which practically no e.m.f.s are being generated. With the small number of slots used in the present example, it is impossible to satisfy this requirement to the extent that is possible with a normal armature. Let us start with, say, conductor 5, which is moving in the interpolar space and therefore generating no e.m.f., and let us follow the path from this conductor to the nearest segment, namely G, and place a narrow brush A opposite the centre of that segment. Since there are 11 segments, the distance between the centers of adjacent brushes must be 11/4 = 2¼ segment pitches. Hence, insert the other three brushes B, C and D.

(h) Determine the polarities of the brushes by taking any conductor, such as 1, which is definitely moving in a magnetic field, and following the direction of the arrowhead on that conductor until we come to a segment making direct contact with a brush, namely D in this instance. Since the e.m.f generated in the winding is acting towards D, the latter must be a positive brush. It is shown below that brushes A, B and C are negative, positive and negative respectively. The positive brushes B and D are then connected together to the positive terminal X, and A and C to the negative terminal Y.

(i) Trace the circuits between the negative and positive terminals. Starting from Y, we may branch to either A or C. At A, we can branch to either 5 of 4′; and at C we can branch to 10,9′′, 11 or 10′. If we follow 10, we can comeback via 10 to the same brush; in other words, coil 10-10′ is short-circuited by brush C when the armature is in position shown. Consequently we need only consider a branch 9′ and 11 as far as brush C is concerned.

Principe of Operations D.C. Generators

When a conductor cuts, or is cut by, lines of magnetic force, an e.m.f is induced into that conductor. The magnitude of the e.m.f induced into the loop depends on:

1. Strength of the magnetic field per pole.

2. Speed at which lines of force are cut by a moving conductor.

3. Number of active conductors connected in series.

4. Number of pairs of poles used.

Direction of Induced E.M.F

The direction of induced e.m.f in a generator is can be found by using Fleming's right-hand rule:

INDEX finger	Direction of the main field (N to S)
THUMB	Direction of rotation
SECOND finger	Direction of current flow in the rotation conductors.

Construction of a D.C. Generator

Armature: This consists of four basic parts:

(a) Copper coils fixed into slots in the armature core.

(b) The core, made up of laminated silicon steel sheets, insulated from one another to minimize the effects of eddy currents.

(c) The commutator, which consists of a series of copper segments insulated with mica. The armature coils, which generate alternating current, are connected to the risers on the commutator segments. The commutator is a device which is used, in the case of the generator to draw uni-directional current from the rotating armature coils.

(d) The armature shaft: both the armature core and the commutator are keyed on the steel shaft. The shaft may also contain a fan for cooling the generator windings.

The yoke is that part of the generator which forms the outer casing of the generator and supports the main field system inside the generator. It is made of wrought iron or steel as it makes up the magnetic circuit of the main poles.

The main poles are either moulded with the yoke or bolted to the yoke. Poles shoes are screwed on to the ends of the poles to hold the field coils in place and also to increase the efficiency of the magnetic path.

The field coils are usually cotton-insulated copper conductors and are wedged on the pole pieces.

Brush Gear: the purpose of the brushes is to collect the current from the armature conductors, through the commutator. The brushes are made of carbon and are housed in a brush box fitted with a spring, to ensure good contact on the commutator. The brush boxes are fixed on a rocket arm which allows movement of the brush positions.

Armature Reaction

This distortion of the main field by the field due to the current flowing in the armature conductors is termed armature reaction. Armature reaction causes sparking at the brushes, particularly on heavy loads, and a drop in output voltage.

To understand how armature reaction is minimized, we must first understand two terms: Geometric neutral axis: This is a line drawn at right angles to the main poles.

- Magnetic neutral axis: This is a line drawn at right angles to the resultant field.

Perfect (or sparkles) commutation is achieved by placing the brushes on the magnetic neutral axis, that is, in a position where the brushes are not shorting commutator segments which are connected to armature coils cutting lines of force (i.e generating an e.m.f.).

Inter-poles are small poles fitted between the main poles and are connected in series with the armature conductors; When the field due to the armature current attempts to distort the main field the inter-poles produce a field in opposition to it (i.e. N to N). If the inter-poles were not fitted, the brush position would have to be altered with differing armature currents because the magnetic neutral axis changes with changes in armature current. Polarity of Inter-poles: An inter-pole has the same polarity as the pole in front of it, in the direction of rotation.

D.C. Generator Field Systems

Shunt Generator Operation: This is as follows;

1. The prime mover (petrol engine, electric motor e.t.c) runs the armature up to the required speed.
2. The armature conductors cut lines of force due to the residua magnetism in the main poles. The shunt generator is a ósself excitedô machine.
3. This initial flux cutting induces an e.m.f. into the armature conductors.
4. The e.m.f. induced into the armature conductors is applied across the field since the field is connected in parallel with the armature.
5. A current flows in the field coils causing a field which strengthens the residual field.
6. The armature conductors are not cutting a stronger field and the induced e.m.f. builds up until maximum voltage is attained.

Control: The output voltage of the d.c. shunt generator is controlled by connecting a variable resistor in series with the field. Control is obtained by varying the field strength (e.g weak field gives a low voltage).

Generated Voltage and Output Voltage

(a) The voltage drop due to the current flowing through the armature conductors. This is termed and I_aR_a drop where I_a = armature current and R_a = armature resistance.

(b) The voltage drop due to the contact resistance of the brushes (V_b). this is general about 2V.

V_T (terminal voltage) = V_g (generated voltage) ï ($I_aR_a + V_b$)

Note: All current in a shunt generator, that is field current (I_f) and line current (I_L), flows from the armature.

I_a (armature current) = $I_L + I_f$

Capacity of each capacitors is about 0.1µF.

- Acquire skills For dismantling machines for rewinding them
- Understanding the rewinding of burnt static/rotating machines.
- Know the skimming/undercutting of armature, commutators and slip rings.
- Inspection rewound electric machines and equipment and test for continuity, insulation correct rotating voltage (Thompson 1960)

Theoretical frame work

There can be little doubt that this research is set in a context of complexity. óTo be able to analyze such complex, interactions and relationships, a theoretical account of the constitutive elements of the system under investigation is neededô (Engeström and Miettinen 1999: 9). Nash (2002: 398) argues that it is necessary to use an approach which is capable of giving óan account of mechanism and process . . . in terms of system properties, individual dispositions and individual action within recognized social practice, in such a way that the effective linkages between these levels may be demonstratedô.

Needs Theories

Some individual theories have made great impacts with their conceptual scheme of motivation which have implication for classroom teacher. Madsen (1961) note that personality development can be described as a combination of a press and a need, According to Madsen each theme in an individuals life is characterized by the existence of a need in relation to a particular press, a stimulus ï situation that has a potential influence upon the life of the organism.

In his view, Madsen (1961) saw need gratification as the basis for most human behaviors He argued that needs are arranged in a hierarchy (see figure 2).

Aesthetic Needs

Desire to know or understand

Self- Actualization Needs

Esteem Needs

Love and Belonging Needs

Safety Needs

Physiological Needs

Fig 2 Maslows Hierarchy of Needs.

Thus as one general type of need is satisfied, another higher order of need will emerge and become operative in life. The deficiency needs can be satisfied only by others. This shows that an individual can depend on others as need gratification. That of self ï actualization, desire to know or understand and aesthetics needs are the Being needs A need, therefore ,develops and motivate behavior only if an individual is expected to a certain press(Good and Brophy,1977), Hence the desire to satisfy or gratify these needs directs or dictates human behavior.

The above concept of need, have implications, among other things for teachers in general and the Electrical/Electronic teacher in particular. The teacher teaching electrical installation should concern him-self with efforts to find out how best to structure his instructional activities so that to meat the required competence that the college student will be opportune and encourage satisfying their individual needs. Thus the key concept to bear in mind is the occasional and appropriate involvement of technical college students interest and needs in planning of curriculum and instruction. Also, systematic exposure to environmental pressures will lead to reasonably strong interest in college students required competencies.

Review of Related Empirical studies

Hoefort (1978) carried out a study on minimum level of technical competencies relevant for teaching industrial arts electronic in the junior high and middle high schools in New York State and other industrial art electronics teacher education programmes. A content universe of technical categories was generated which the technical area of industrial arts junior and middle school electronics. The information was then validate by jury of five experts in the field of industrial arts electronics who reviewed the data concerning the theoretical justification and the questionnaire for its appropriateness as data collection instrument Hoefortœ respondents were both industrial art electronics teacher educators, and the teachers at the junior high and middle high schools in New York. The findings among others establish competency needs of technical staffs in education teachers of middle and high school electronics.

Most researchers have related their studies on need identification to implication for in-service education for Example Akubue (1981) investigated the in-service need of secondary school principle in instructional supervision where principles of secondary school in Anambra state need professional improvement. He formulated three research questions and one hypothesis Data were colleted through two set of question on importance and performance question for the principle the sample comprised 144 secondary school principle randomly drawn from five education zone in the state mean standard deviation and chi-square were used in the statistical analysis of the date the result showed that of the ten major functional area of instruction (which were organized in cluster) six were poorly observed.

Georgia State Department of Education, Atlanta (1983) conducted Analysis of skills up-date Needs of teachers in High Technology Programmes in Georgia, Georgia State University, Atlanta Department of Vocational and career development. The project was undertaken to assess the needs for skills and knowledge among Georgiaœ high technology teachers, and to develop a model for meeting those needs. During the project, 52 teachers involved in teaching electronics, electro-mechanical and mechanical courses at six pilot high technology schools were assessed. Included among the processes used to gather information on the teachersô deficiencies in high technology subject areas were a review of existing programme information, a review of literature, a consultation with industries and series of meetings with the 52 teachers themselves. While these data sources indicated the Georgiaœ technical school teachers involved in high technology programmes are educationally qualified for their jobs, a considerable need exists to provide teachers with experience and support services to maintain their level of expertise and to stay up to date in their field. In response to this need, it was recommended that the Georgia State Department of Education conducts routine skill assessments and staff development activities for high technology teachers, and that the state adopts a student to teacher ratio formula and class schedule that will permit at least one high technology teacher per quarter per development to be free for research study and or update activities.

1. Identification of business method competencies needed by the subject teachers in secondary schools.
2. Determination of the extent to which the teachers can performs the competencies and
3. The determination of the competencies in which the teachers needed help.

Data analyses reviewed are as follows:

1. Business method teachers needed all the 98 competencies developed in the study.

2. A need for in-service education existed for business methods teachers in all the clusters of competencies.

3. There were significance difference scores of perceived importance and those of expressed performance by the teachers with the scores of perceived importance being higher.

4. There were no significance differences in the perceived importance levels of the competencies between four categories of teachers based on educational qualification.

Anyakoha (1987) employed the competency approach in an in-service need investigation. The study was designed to identify technical competencies in clothing and textile required by post-primary school home economic teachers in Anambra state of Nigeria. This study also determined the aspects of the competencies where teachers needed improvement. The discrepancy between respondents perceived importance and performance level was employed to identify the competencies for in-service education. The t-test for correlated means was used for comparing perceptions levels of importance and level of performance. The findings show that a total of 98 competencies were identified as importance. The teachers were found to need in-service education in all the competencies identified as important. The teachers were found to need in-service education in all the competencies identified as important. The study recommended among other things that the identified competencies be in cooperated in the perceived programmes of post primary school teachers of home economics in Anambra state of Nigeria. In Anambra and Imo States of Nigeria, similar study was conducted by Anyaakoha (1986) to determine among other things 107 tasks necessary for entry into each of clothing occupations available to senior secondary school leavers in state.

Kole (1987)conducted an investigation to develop isolation reduction strategies in order to reduce the feeling of isolation expressed by many of the nova university programmes for higher education regional cluster student A need assessment was initiated to discover what the broad-range needs of regional student were and to actively develop strategies to meet those needs he also conducted a need assessment among the south Florida local cluster student to determine whether their feeling of isolation were the same A content analysis of the regional cluster survey results revealed that a major of the regional student did experience feeling of isolation the main area of concern was the general.

Mama (1991) determined the in-service needs of teachers in production agriculture. The study was designed to:

1. Identify the technical competencies in production agriculture required by the agricultural science teachers.
2. Determine the extent to which the teachers possessed competencies in production agriculture.
3. Identify the technical competencies in which the respective groups of teachers based on education qualification needed in in-services education.
4. Ascertain of teachersô education qualification, teaching experience and interactions between qualification and experience significantly ($P < 0.05$) influenced teacherøs perception of their competence.

The population comprised 674 agricultural science teachers in 374 secondary schools in Anambra state, as at March, 1990. The study aimed at using the entire population as subjects. Eventually, 442 (66%) of the 674 teachers were effectively reached and used for the study. A questionnaire, Production Agriculture Competency Inventory (PRACI), developed by the researcher, validated and tested for reliability was used for data collection. The mean, standard deviation, percentage, t-test for correlated means, two ANOA and Schaffeós multiple range tests were the statistical techniques used for data analysis. The result revealed that the agricultural science teachers in secondary schools in Anambra state perceived as required for the role, 68 out of the 70 technical competencies in production agriculture was selected for the study. Also, the teachers perceived themselves as possessing 43 (61%) out of 70 competencies at a moderate level, 14 (20%) at low level and 18 (19%) at a high level. This study seems to be in line that of Apagu. Hence, for all required competencies, the t-test result revealed significant different (P < 0.05) between the mean level of importance and mean level of possession, with mean level of importance greater. Out of the 68 competencies perceived required by the teachers, the NCE (Agriculture) holders in 36 (53%) of them. The ANOVA result sowed that respondents perceptions of level of competence were significantly influenced (P < 0.05) by their educational qualifications. Teaching experiences and interactions between experienced and qualification did not show significant (P < 0.05) influences on teachersô perception of level of possession of competencies. The NCE (Agriculture) holders expressed the lowest level of competence than each of the other three groups-HND, B.Ed. and B.Sc. (Agriculture) holders.

A study by Rogers (1993) identified what competencies secondary Trade and Industrial (T and I) instructors from Central Pennsylvania believed technology education should provide. A total of 33 instructors of 49 survey responded to a questionnaire developed from Pucelós (1993) categories of technology education and work attitude as identified by Gregson (1991). An analysis of variance treatment indicated 27 competency comparisons significant at the P:05 level. The result of the data analysis showed that the competencies T and I instructors would like technology education graduates to possess, were not current high tech issues. Rather they identified those competencies, good work ethics, the ability to measure, and the ability to identify and use of hand tools and equipments. Recommendations for technology education includes:-

1. Emphasis on those effective domains attributes following directions.
2. Pride of work
3. Being dependable and punctual
4. Exhibiting awareness of safety and
5. Being conscientious

These cognitive and psychomotor competencies were recommended as care content of any technology education curriculum, measurement, identification and use of common hand tools and equipment, and knowledge of technical terminology, display findings of subject area knowledge and competencies assessments, and frequency of response to numerical positions of rating scale by co-operating teachers and students in art and music from 1985 ï 1995. The paper concluded with a technical discussion of results and copies of evaluative instruments.

Apagu (1997) investigated the technical in-service competency Needs of Post Primary School Building Technology teachers in Adamawa State of Nigeria. Specifically, the study aimed at identifying areas of competencies in which the teachers perceived the need for in-service training. It was also aimed at determining whether years of teaching experience. Educational qualification had any significant effect on the leadersô perceived need for training in competency areas. A survey instrument designated Building Technology Teachers Competency Inventory for Post-Primary Schools (BUTCHIPS) with 83 items were developed by the researcher. It was validated and treated for reliability and used for data collection. A total 287 copies were distributed and 207 copies were returned, representing 72% return rate. Data was analyzed using mean, standard deviation per cent, t-test, one way ANOVA and Scheffe Multiple Range Test. The test reveals that, post-primary school building technology teachers in Adamawa State perceived all the 83 technical competencies in building technology occupations as being desirable for successful implementation of building technology education programme. Also the teachers perceived themselves as posing 1 (1%) of the 24 competencies in building drawing at very high level, and 22 (88%) at moderate level. As for blocklaying competencies, only 1 (2%) of the teachers perceived themselves as possessing the competencies at very high level, and 38 (33%) at moderate level. Similarly, the building technology teachers perceived themselves as performing 1 (6%) of the 18 carpentry and joinery competencies at high level, 14 (77%) at moderate level. For all required competencies, the t-test result revealed significant difference ($P < 0.05$) between the mean level of desired competencies and the mean level of performance.

Awonug (2007) conducted a research on óCurriculum Improvements requirements in Electrical installation Trade in technical college on Ogun State of Nigeria. To achieve this purpose five research question were developed and a survey instrument of 50 items was used to collect data from the respondents in Ogun state of Nigeria. Mean, Standard deviation and Cronbach Alpha were used to analyses the data. The result revealed that 16 items of the instrument were consider as appropriate criteria for curriculum improvements requirements in Electrical installation Trade, the instrument had a reliability co-efficient of 0.088 and could therefore serve as comprehensives requirements in curriculum involvements in Electrical Installation Based on findings f the study some implication of the study were indicated and recommendation made for consideration.

Mamman (2008) conducted a research on óworkshop practice management skill improvement needs of Electricity/Electronic teachers in technical colleges in Adamawa. Bauchi, and Gombe State. five research questions formulated, survey instrument of 75 items and reliability co-efficient of 0.98. The findings revealed that the respondents needs planning as it is the bedrock on which all other management skills are laid. Organization and skill needs among others, with a population of 81 Electricity/Electronics teachers, all questionnaires administered were correctly completed and returned 100%. With 19 items were find to be needed. All the above work did not address the required competencies of Electricity/Electronics teacher in technical college.

Summary of the Review of Related Literature

In this sub-section, a summary of review literature is presented in relation to the current study. A comprehensive review of the practical skill and theoretical contents of Electrical installation has been made.

For all occupations there is a minimum rate of competence which the workforce should possess in order to be functional. Pre-service training of teachers is indispensable but may not be adequate for the teachersô needs for continued effectiveness in the job for life due to inherent technological development. If there is any field of human endeavors whose technology changes rapidly is electricity is the pivot of technological growth and development. Hence that, staff development of serving teachers should be based on teachers perceived needs. The teachers also need to be current in their respective arrears of technological specialty. Their teaching methods, techniques, materials and equipments require reflecting the status of art in industry.

That a logical strategy for increasing the competencies of teacher education is to determine the various skills and knowledge required by all vocational technical teachers, which of these skills and knowledge are truly common across several service area and cluster them together. And which are truly unique to service area and cluster them then a training programme(s) could be designed relative replica to pre-service and future retraining priority of teaching skills and knowledge. While empirical work of Nigerian vocational technical education teachers,ô shows high need for training of Nigeria

Certificate of Education (NCE) Technical teachers and Bachelor of Education (B.Ed. Tech) in technical skill in all fields of vocational and Industrial Education.

There are many similarities between this study on Electrical installation competencies required by Electricity/Electronic teacher in technical college and those cited in the literature review. The present investigation is related to those presented in the review.

The major purpose includes the determination of competency requirement for effective job performance and the identification of general competency required of Electrical/Electronics teachers. Competencies rate required or important will be regarded by Electrical Installation trade teachers for success in their specific job roles. Level of competencies acquired will be determined from subject, self- appraisal of ability to do a task Therefore Teachers with varying qualifications, knowledge and skills need to-up-date their knowledge and kills through regular training in -order not to be obsolete.

However, most of the competencies identified by these researchers, although appeared useful for this study cannot be claimed to be completely needed as well as possessed by Electrical installation trade teachers in technical colleges. Hence specific competencies required to Electrical installation trade teachers should be identified, for instance, in the area of teaching pedagogy and techniques. Based on this therefore this researcher is convinced that the finding of the study will provide very useful information regarding theoretical and practical competencies required by Electrical/Electronic teachers. The gab between required and actual performance, which call for bridge via training is the result of in competencies in knowledge, skills and attitudes in the location of the study.

CHAPTER III

METHODOLOGY

This chapter deals on methodology used in conducting the study. They include; design of the study, area of the study, population; instrument for data collection; Validation and Reliability of the instrument, Method for Data Collection, and method for Data Analysis

Design of the Study

A survey research design was adopted for the study. According to Gall., Gall, and Borg (2007) a survey is a method of data collection using questionnaire or interviews to collect data from a sample that has been selected to represent a population to which the findings of the data analysis can be generalized. Hence the questionnaire on Electrical Installation Competencies required by Electrical/Electronic teacher in technical college was used to collect data from the population for analyses.

Area of the Study

The area of study consists of Bauchi and Gombe States. There are nine Government Technical Colleges in the two States namely; - Government Technical College. Kumo, Government Day Technical .College Gombe, Government Technical College Tula, Government Technical College Amada, Government Day Technical College Kwami, Government Day Technical College Deba, Government Technical College Itas/Gadau, Government Technical College Gumau and Government Day Technical College Bauchi these colleges are chosen because they are offering Electrical Installation trades.

Population of the Study

The population for this study consists of 47 electrical installation teachers of technical colleges in the two states. The data sources are from Bauchi and Gombe States. Ministries of Education, department of Science and Technical Education 2010 staff posting. The choice of Electrical/Electronic Teachers was based on the fact that students are not knowledgeable about the competencies requirements in Electrical Installation. Hence, teachers were used for the study. The absence of sampling is as a result of size of the population.

Instrument for Data Collection

The instrument was a structured questionnaire which consisted of 112 items developed by the researcher based on literature review. The instrument was made up of two sections. Section A is on respondent's personal data while Section B consists of 112 items that were designed to provide answers to the research questions, A four point response modes was used to determine the competencies required by Electrical/Electronic teachers

Numerical Value will be assigned to the options thus;

Highly Required (HR)	4
Require (R)	3
Moderately Required (MR)	2
Not Required (NR)	1

Method for Data Collection

Forty seven copies of the Questionnaire were administered through personal contact with the respondent with the help of research assistance which was employed and trained by the researcher.

Validation of the instrument

To ensure the validity of the instrument, the structured questionnaire was subjected to face validation by three experts, two from the Department of Vocational Teacher Education, and one from Federal Science and Technical College Uromi Edo State. A structural questionnaire with 137 items was given, to the experts. The questionnaire titled ñElectrical Installation Competencies required by Electrical/Electronic Teachers in Technical Colleges" was developed by the researcher. After validation some items were modify, reworded, re-structured while some removed to make the total of 112 items for the study.

Reliability of the Instrument

The reliability of the instrument was established using Cronbach Alpha (Ŭ). The validated instrument was administered to 6 teachers at Government Day Science Technical College Kafin Madaki in Bauchi State. Because Cronbach Alpha (Ŭ) ascertains the internal consistency of the test instrument. The data obtained from the respondent was computed based on Cronbach Alpha the reliability coefficients of 0.80 was realized so regarded as reliable for the study.

Method for Data Analysis

Data collected from the respondents was analyzed using mean and standard deviation obtained from responses on the four-point response categories. For decision, items with mean of 2.50 and above was considered as having high means, which indicate that teachers required competencies in areas and needed to be retained. Any item with mean rating less than 2.50 were considered as low and that the teachers do not require competencies in that area. All four (4) hypotheses stated, were tested using t-test and were tested at 0.05 level of significance.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

In this chapter, the data collected and analyzed is presented and discussed. The data is organized around the particular research question and Hypothesis to which it provides answers.

Research Question I What are the Competencies required by Electrical/Electronic Teachers to teach Domestic Installation?

Data for answering the above research question were derived from section B (items 1- 24) of the instrument and are presented in Table 2.

Table 2 Responses of respondents on the area of competencies required for Electricity/Electronic teaches in teaching. Domestic Installation

S/N	Skills in Domestic Installation :-	X	SD	Remarks
1	Explain the meaning of symbols	370	0.623	Required
2	Use scale-Rule on working drawing	311	1.147	Required
3	Identify the electrical symbols of working drawing	311	0.890	Required
4	Explain item, accessories on the list	3.34	0.788	Required
5	Explain appropriate distribution units for single and polyphase	3.47	0.504	Required
6	Identify clip, gimlet pins, broil drill & plug, and wiring materials	3.49	0.906	Required
7	Select types of cables PVC, MICC, Armoured standard size of cables	3.45	0.775	Required
8	Apply IEE charts cable rating, maximum load demand	3.36	529	Required
9	Apply plumb line, chalk line and sprit level.	3.26	736	Required
10	Identify tools, used for preparing conduit pipes	3.36	965	Required
11	Explain regulations guiding conduit installation	3.57	683	Required
12	Cut tread conduit and square cutting	3.34	962	Required
13	Distinguish merits & demerits of conduit wiring	3.36	764	Required
14	State regulation regarding set and bend conduit	3.57	512	Required
15	Draw cable in using fish wire	3.36	965	Required
16	Carry a continuity test, insulation test and insulation test	3.30	74.9	Required
17	Maintain tools and equipments for conduit installation	3.26	736	Required
18	Select protective circuit breakers, and fuses for single/polyphase	3.64	486	Required

S/N	Cont from table 2			Remarks
19	Explain function of circuit breaker and fuses in electric circuit	3.72	502	Required
20	Explain function of circuit breaker and fuses in electric circuit	3.64	640	Required
21	Install earthing devices	3.28	852	Required
22	Effect the regulations concerning circuit breakers and fuses	3.64	640	Required
23	Install earth leakage circuit breakers for single and 3- phase dwelling	3.45	904	Required
24	Inspect electrical and mechanical connections to avoid partial contact	3.45	653	Required
25	Carry a polarity test using bell	3.64	640	Required
26	Identify incandescent lamp, Tungsten filament lamp, gas filled tungsten filament lamp, neon tube, hot and old cathode	3.55	503	Required

Data in Table 2 on competency required by teachers in Electrical Installation indicates that all 26 are required. Items have mean value of 3.50 and above for Teachers in Government Technical Colleges.

Research Question 2 What are the Competencies required by Electrical/Electronic Teachers to teach Industrial Installation?

Data for answering the above research question were derived from section B (items 1- 34) of the instrument and are presented in Table 3.

Table 3 Responses of respondents on the area of competencies required for Electricity/Electronic teaches in teaching Industrial Installation

Research question 2

S/N	Skills in Industrial Installation	X	SD	Remarks
1	Identify key elements in the electrical installation	3.30	.954	Require
2	Demonstrate conduit on wiring Board	3.11	.784	Require
3	Install MICC Cable	3.17	1.10	Require
4	Explain duct wiring	3.09	905	Require
5	Different types of trunking	3.02	1.327	Require
6	Select Tools and equipments used on duct trunking	3.15	908	Require
7	Demonstrate Bus-bar trunking and wiring	3.38	491	Require
8	Use Accessories on duct	3.40	771	Require
9	Join trunking	3.17	816	Require
10	Run Earth continuity on ducting and trunking	3.21	832	Require
11	State Principles of generators and motors.	3.02	856	Require

S/N	Cont from table 3			Remaks
12	Explain Functions of AC and DC Machines	3.11	814	Require
13	Difference between AC and DC Motors and Generators	3.00	956	Require
14	Show DC motors (Series, Shunt, Compound)	2.91	974	Require
15	Explain AC motor-single phase and 3 phase.	3.21	1.020	Require
16	Illustrate Application of AC motors	3.66	.522	Require
17	Operate polyphase machine	3.23	1.026	Require
18	Differentiate ways by which machine can be enclosed	2.94	1.169	Require
19	Construct foundation for mounting a machine	3.02	944	Require
20	Lift and mount machine	3.19	924	Require
21	Distinguish Types of connections Star-delta-star	3.45	653	Require
22	Calculate current rating of cable	3.15	722	Require
23	Use flexible conduit in connecting motor	3.72	452	Require
24	Operate and use starters for motors.	3.20	934	Require
25	Test machines	3.57	878	Require
26	Identify various starters used to demonstrate speed control of a motor	3.28	877	Require
27	Apply lubricants on machines	3.26	846	Require
28	Demonstrate the use of Tools and Equipment for maintenance of machines the used of each	3.36	640	Require
29	Explain working principles of cooker, heater, iron with diagram	3.30	858	Require
30	Make data and manufactureŝs specifications in maintenance of machines	3.66	522	Require
31	Carry out test on machine	3.34	668	Require
32	Detect faults causes of break-down on machines	3.23	840	Require
33	Detect fault by noise	3.43	651	Require

Data in Table 3 on competency required by teachers in Electrical Installation indicates that all 34 are required. Items have mean value of 3.50 and above for Teachers in Government Technical Colleges.

Research Question 3 What are the Competencies required by Electrical/Electronic Teachers to teach cable Jointing?

Data for answering the above research question were derived from section B (items 1- 24) of the instrument and are presented in Table 4.

Table 4 Responses of respondents on the area of competencies required for Electricity/Electronic teaches in teaching. Cable Joining?

S/N	Skills in Cable Jointing	X	SD	Remarks
1	Joint and solder cables	.847	2.98	Required
2	Describe the procedure for cable joint, highlight the sizes and uses	287	1.035	Required
3	Apply insulation material copper and aluminum	3.40	970	Required
4	Explain the merit and demerit of conductors shown	3.17	916	Required
5	Demonstrate how to prepare cables for joint	330	1.121	Required
6	Demonstrate shaping of conductors	3.13	659	Required
7	Selection of lugs and glands used for terminations	3.02	1.032	Required
8	Show different armoured cable	3.21	.931	Required
9	Explain the usefulness of amouring and application of the cable	3.00	1.043	Required
10	Show the constructional parts of armoured cable	3.19	1.014	Required
11	Join two length of armoured cable and demonstrate how to terminate armoured cable	2.94	1.150	Required
12	Explain factors affecting underground cables and the types need for system	3.02	944	Required
13	Convey underground to the site	3.26	.736	Required
14	Demonstrate how to prepare trench depth for the cable laying	3.32	0.629	Required
15	Lay the cables in trench using jacks, rollers	3.17	.706	Required
16	Show tool and equipment used in terminating underground cables	3.28	655	Required
17	Explain the safety precautions and regulation	3.11	787	Required
18	Solder a joint show different types tapes used in underground cable	3.55	.880	Required
19	Explain operations of instruments used in testing underground work of bridge meggar, slide wire and Insulation assistance	3.36	1.131	Required
20	Explain transmission and distribution stating tools and equipment used in the two system	3.19	825	Required
21	Explain how to convey poles to site and how to erect such	3.11	667	Required
22	Describe stay wire and its function	302	872	Required
23	Demonstrate how to screw pole with stay wire	3.53	654	Required
24	Show cross-arms used in transmission line	3.45	886	Required
25	Demonstrate how to make a joint noting all precautions	3.60	496	Required
26	Different types of data cables, communication cables computer cables, fibre optic, co-axial cables	3.51	547	Required

Data in Table 2 on competency required by teachers in Electrical Installation indicates that all 27 are required. Items have mean value of 3.50 and above for Teachers in Government Technical Colleges.

Research Question 4 What are the Competencies required by Electrical/Electronic Teachers to teach Winding of Electrical Machine?

Data for answering the above research question were derived from section B (items 1- 24) of the instrument and are presented in Table 5

Table 5 Responses of respondents on the area of competencies required for Electricity/Electronic teaches in teaching Winding of Electrical Machines?

S/N	Skills in Winding of Electrical Machines	X	SD	remarks
1	Follow Regulations on the used of conductors, varnish and oven	3.02	737	Required
2	Select Tools used in Winding work	3.72	926	Required
3	Draw procedure for Wave winding	3.09	880	Required
4	Apply of lap windings	3.11	521	Required
5	Used Chalkboard/chart Coil ends positions on commutator and slip-rings	2.91	996	Required
6	Record information on machine nameplate before dismantling	3.02	642	Required
7	Identify shield	3.19	711	Required
8	Dismantle electric machines using core	2.79	954	Required
9	Notice winding connection, pitch, cross sectional area of winding Conductor	2.72	1.057	Required
10	Fix and replace the brush	2.68	980	Required
11	Display different conductors used in winding work	3.04	658	Required
12	Different insulation materials classification	3.06	763	Required
13	Construct a former	3.30	623	Required
14	Fix Winding coils properly in slots	3.26	530	Required
15	Prepare simple winding coil	2.77	865	Required
16	Use a Megger Test set, show how to Test for continuity and insulation Resistance	3.02	944	Required
17	Carry out Final Test on the job before recommissioning	2.74	871	Required
18	Use bar Test to test for good commutation	3.40	648	Required
1	Identify various parts of a motor	2.74	966	Required
20	Conduct visual inspection of ball bearing	2.87	612	Required
21	Assemble machine and apply grease	2.89	634	Required
22	Test for continuity and installation resistance using megger test set	3.28	649	Required
23	Test run machine and what to observe on record	2.87	1.035	Required
24	Carry out all reconnection test to conform to manufactures Specifications	2.94	1.030	Required
25	Test machine using tachnometer	2.98	531	Required

Data in Table 5 on competency required by teachers in Electrical Installation indicates all 25 are required. Items have mean value of 3.5 and above for Teachers in Government Technical Colleges.

Table 6

Hypothesis one

There is no significant difference in the mean responses of qualified and less-qualified Electrical/Electronic teachers in the competencies they require to teach Domestic installation. t-test analysis of the mean rating of qualified teachers and less qualified teachers on the competency required in teaching Domestic Installation.

S/N	Items	X	X	t- cal	Remarks
1	Explain the meaning of symbols	-998	-992	-0.188	NS
2	Use scale-Rule on working drawing	-1.587	-1.446	-0.532	NS
3	Identify the electrical symbols of working drawing	.230	.230	.0.046	NS
4	Explain item, accessories on the list	-2.888	2.748	-0.709	NS
5	Explain appropriate distribution units for single and polyphase	-2.587	-2.430	-0.571	NS
6	Identify clip, gimlet pins, broil drill & plug, and wiring materials	-1.856	-1.801	0.519	NS
7	Select types of cables PVC, MICC, Armoured standard size of cables	-1.743	-17.76	-0.256	NS
8	Apply IEE charts cable rating, maximum load demand	-2.940	-2.574	-0733	NS
9	Apply plumb line, chalk line and sprit level.	-1.761	-1.795	-0.397	NS
10	Identify tools, used for preparing conduit pipes	-686	-678	-1.000	NS
11	Explain regulations guiding conduit installation	-2.152	-1.876	-0.383	NS
12	Cut tread conduit and square cutting	-2750	-2.430	-0.523	NS
13	Distinguish merits & demerits of conduit wiring	-956	-902	-0.186	NS
14	State regulation regarding set and bend conduit	-3.640	-3.195	-0.925	NS
15	Draw cable in using fish wire	-1.628	-1.653	-0.258	NS
16	Carry a continuity test, insulation test and insulation test	-3.395	-3.142	-0.695	NS
17	Maintain tools and equipments for conduit installation	-3.546	-3.359	-0.694	NS
18	Select protective circuit breakers, and fuses for single/polyphase	-4.832	-4.416	-1.137	NS
19	Explain function of circuit breaker and fuses in electric circuit	-1.797	-1768	-0.266	NS
20	Install earthing devices	.166	167	0.405	NS
21	Effect the regulations concerning circuit breakers	-891	-886	-0.133	NS

	and fuses				
22	Install earth leakage circuit breakers for single and 3- phase dwelling	-059	-060	-0.101	NS
23	Inspect electrical and mechanical connections to avoid partial contact	-1883	-1.844	-0.464	NS
24	Carry a polarity test using bell	1.844	2.073	-0.342	NS
25	Identify incandescent lamp, Tungsten filament lamp, gas filled tungsten filament lamp, neon tube, hot and old cathode	-2.587	-2.430	-0.571	NS
26	Install Emergency light, shade reflectors	-1.797	-1768	-0.266	NS

Note: N.S. -- Not Significant

S. -- Significant

Data in Table indicates that the t-test analysis of the mean responses of qualified and less qualified teachers on required competencies in Industrial Installation. The analysis shows that all items have calculated t- values of less than the table t- value of 2.01 at 45 degrees of freedom at 0.05 levels significant, on Domestic Installation The null hypothesis of no significant difference between the mean rating of qualified teachers and less qualified teachers of Electrical Installation were therefore accepted From the analysis, it can be inferred that qualified teachers and less qualified teachers share identical opinions.

Table7

Hypotheses two

H_{02} There is no significant difference between the mean responses of qualified and less qualified Electrical/Electronic teachers on competencies they require to teach Industrial Installation. t-test analysis of the mean rating of qualified teachers and less qualified teachers on the competency required in teaching Industrial Installation.

S/N	Items	X1	X2	t cal	Decision
1	Identify key elements in the electrical installation	264	272	0.410	NS
2	Demonstrate conduit on wiring Board	-3.013	-2.919	0.538	NS

3	Install MICC Cable	-1.145	-1.057	-0.267	NS
4	Explain duct wiring	-825	-781	-0.235	NS
5	Different types of trunking	-1391	-1423	-0.201	NS
6	Select Tools and equipments used on duct trunking	-2.270	-2.213	-0585	NS
7	Demonstrate Bus-bar trunking and wiring	-3.629	-3.363	-1.273	NS
8	Use Accessories on duct	-2.737	-2.714	-0.692	NS
9	Join trunking	-3632	-3.422	-0.799	NS
10	Run Earth continuity on ducting and trunking	-892	-867	.0205	NS
11	State Principles of generators and motors.	-3.702	-3.361	-1.081	NS
12	Explain Functions of AC and DC Machines	-723	-711	-0.211	NS
13	Difference between AC and DC Motors and Generators	-1.566	-1.461	-0.374	NS
14	Show DC motors (Series, Shunt, Compound)	-2.299	-2.226	-0532	NS
15	Explain AC motor-single phase and 3 phase.	-932	-931	-0.285	NS
16	Illustrate Application of AC motors	-863	-996	-0.335	NS
17	Operate polyphase machine	-2.828	-2593	-0.799	NS
18	Differentiate ways by which machine can be enclosed	-490	-472	-0.127	NS
19	Construct foundation for mounting a machine	.159	.164	4.900	S
20	Lift and mount machine	-864	-832	-2.106	S
21	Distinguish Types of connections Star-delta-star	-438	-454	-0.124	NS
22	Calculate current rating of cable	-203	-194	-0.560	NS
23	Use flexible conduit in connecting motor	-220	-226	-0.430	NS
24	Operate and use starters for motors.	-1.170	-1.156	-0.250	NS
	Test machines	-1.851	-1.760	-0.242	NS
25	Identify various starters used to demonstrate speed control of a motor	-986	-898	-0.258	NS
26	Apply lubricants on machines	-1.741	-1.662	-4.290	S
27	Demonstrate the use of Tools and Equipment for maintenance of machines the used of each	-1.825	-1.182	-4.290	S
28	Explain working principles of, cooker, heater, iron with diagram	-2.945	-2.899	-0.519	NS
29	Make data and manufactureôs specifications in maintenance of machines	-3.979	-3.537	-0.870	NS
30	Carry out test on machine	-1.645	-1.436	-4.120	S
31	Detect faults causes of break-down on machines	1.100	-1.035	-0.218	NS
32	Detect fault by noise	-1.458	-1.461	2.204	NS
33	Rectify fault in installation	-203	-194	-0.560	NS

Decision rule

Reject ho at 0.05 level if t Ó=2.010, given df = 28+19-2=45.

Items 19, 20, 26, 27 and 30 are found to have significant deference between qualified and less qualified teachers.

Data in Table 7 indicates that the t-test analysis of the mean responses of qualified and less qualified teachers on required competencies in Industrial Installation. The analysis shows that only five items have calculated t- values of less than the table t- value of 2.010 at 45 degrees of freedom at 0.05 levels significant, on Industrial Installation The null hypothesis of no significant difference between the mean rating of qualified teachers and less qualified teachers of Electrical Installation were therefore accepted From the analysis, it can be inferred that qualified teachers and less qualified teachers share identical opinions.

Table 8

Hypothesis three

H_{03}: Significance difference does not exist between the mean responses of qualified and less qualified Electrical/Electronic teachers competencies they require in skilled improvement of Cable Joining. t-test analysis of the mean rating of qualified teachers and less qualified teachers on the competency required in teaching Cable jointing.

S/N	Items	X1	X2	t-cal	Remark
1	Joint and solder cables	-227	-277	0.77.	NS
2	Describe the procedure for cable joint, highlight the sizes and uses	160	164	.0260	NS
3	Apply insulation material copper and aluminum	1.1271	-1.264	-0.318	NS
4	Explain the merit and demerit of conductors shown	3.361	-3.049	-0.934	NS
5	Demonstrate how to prepare cables for joint	.648	.638	1.056	NS
6	Demonstrate shaping of conductors	-3.304	-3.272	-.0.919	NS

7	Selection of lugs and glands used for terminations	-818	-771	-2.037	NS
8	Show different armoured cable	-1.105	-1.086	-0.322	NS
9	Explain the usefulness of amouring and application of the cable	-1.338	-1.264	0.391	NS
10	Show the constructional parts of armoured cable	-3498	-3.214	-0.972	NS
11	Join two length of armoured cable and demonstrate how to terminate armoured cable	-0.13	-013	-0.004	NS
12	Explain factors affecting underground cables and the types need for system	-1.517	-1.504	-0.511	NS
13	Convey underground to the site	-3.820	-3.377	-1..118	NS
14	Demonstrate how to prepare trench depth for the cable laying	-1.980	-2.021	-30.59	NS
15	Lay the cables in trench using jacks, rollers	-770	-720	-2.55	S
16	Show tool and equipment used in terminating underground cables	-945	-914	-.0.197	NS
17	Explain the safety precautions and regulation	-3.055	-2.426	0.556	NS
18	Solder a joint show different types tapes used in underground cable	2.389	-2.426	0532	NS
19	Explain operations of instruments used in testing underground work of bridge meggar, slide wire and Insulation assistance	-2.706	-2.303	0.664	NS
20	Explain transmission and distribution stating tools and equipment used in the two system	-1.580	-1.594	-0.340	NS
21	Explain how to convey poles to site and how to erect such	-1.404	-1.384	-0.265	NS
22	Describe stay wire and its function	-2.107	-1.849	-4.098	S
23	Demonstrate how to screw pole with stay wire	-1.836	-1.914	-0.355	NS
24	Show cross-arms used in transmission line	-2.689	-2.428	.0.654	NS
25	Demonstrate how to make a joint noting all precautions	-1.539	-1.476	-0.397	NS
26	Different types of data cables, communication cables computer cables, fibre optic, co-axial cables	-3.630	-3.263	-0.628	NS

Data in Table 8 indicates that the t-test analysis of the mean responses of qualified and less qualified teachers on required competencies in Cable Jointing. The analysis shows that Only two (2) items have calculated t- values of less than the table t- value of 2.010 at 45 degrees of freedom at 0.05 levels significant, on Industrial Installation The null hypothesis of no significant difference between the mean rating of qualified teachers and less qualified teachers of Electrical Installation were therefore accepted From the analysis, it can be inferred that qualified teachers and less qualified teachers share identical opinions.

Table 9

Hypothesis four

H_{04} There is no significant difference posses between the qualified and less qualified teachers, in competencies required to teach Winding of Electrical Machines t-test analysis of the mean rating of qualified teachers and less qualified teachers on the competency required in teaching winding of Electrical Machines

S/N	Items	X1	X2	T cal	Remarks
1	Follow Regulations on the used of conductors, varnish and oven	-312	-295	-0.058	NS
2	Select Tools used in Winding work	-1.626	-1.689	-.0.252	NS
3	Draw procedure for Wave winding	.145	.155	0.028	NS
4	Apply of lap windings	-012	.014	-0.002	NS
5	Used Chalkboard/chart Coil ends positions on commutator and slip-rings	-1.207	1.362	2.209	S
6	Record information on machine nameplate before dismantling	-1.146	-1.362	0.299	NS
7	Identify shield	-388	-3.079	-1.020	S
8	Dismantle electric machines using core	409	4.023	-1.220	S
9	Notice winding connection, pitch, cross sectional area of winding Conductor	-010	0.011	-0.020	NS
10	Fix and replace the brush	-126	-0.124	-0.360	NS
11	Display different conductors used in winding work	.692	-0.798	-1.500	NS
12	Different insulation materials classification	-1.358	1..414	.2.120	S
13	Construct a former	-1590	-1.638	-4.002	S
14	Fix Winding coils properly in slots	-295	-304	0.805	NS
15	Prepare simple winding coil	-1.202	1.2.12	.0.376	NS
16	Use a Megger Test set, show how to Test for continuity and insulation Resistance	-2.268	2.171	-4.250	S
17	Carry out Final Test on the job before recommissioning	.562	.592	-1.240	NS
18	Use bar Test to test for good commutation	-2.542	-2.594	-0.701	NS
19	Identify various parts of a motor	1.697	1.872	3.030	S
20	Conduct visual inspection of ball bearing	-045	049	0.130	NS
21	Assemble machine and apply grease	-801	-830	-0.246	NS
22	Test for continuity and installation resistance using megger test set	987	1.044	2.009	NS
23	Test run machine and what to observe on record	1.264	-2.570	2..042	S
24	Carry out all reconnection test to conform to manufactures Specifications	2.644	-2.570	-0.684	NS
25	Test machine using tachnometer	-1.028	-1.038	-0.316	NS

Data in Table 9 indicates that the t-test analysis of the mean responses of qualified and less qualified teachers on required competencies in Wingding of Electrical Machines. The analysis shows that Only eighth items have calculated t- values of less than the table t-value of 2.010 at 45 degrees of freedom at 0.05 levels significant, on Industrial Installation The null hypothesis of no significant difference between the mean rating of Qualified teachers and less qualified teachers of Electrical Installation were therefore accepted From the analysis, it can be inferred that qualified teachers and less qualified teachers share identical opinions.

Findings of the Study

The following were the findings of the study;-

All items are conceded required for effective competencies in domestic Installation, Industrial installation, Cable Jointing and Winding of Electrical machines.

The findings reviled that all of the items are required.

Findings of the Hypotheses

There is no significance in mean responses of qualified teachers and less qualified teachers in all most all.

Qualified and less qualified teachers differ significantly in the following items

1. Carry out test on machine
2. Construct foundation for mounting a machine
3. Lift and mount machine
4. Apply lubricants on machines
5. Demonstrate the use of Tools and Equipment for maintenance of machines the used of each

6. Lay the cables in trench using jacks, roller
7. Describe stay wire and its function
8. Used Chalkboard/chart Coil ends positions on commutator and slip-rings
9. Identify shield
10. Dismantle electric machines using core
11. Different insulation materials classification
12. Construct a former
13. Use a Megger Test set, show how to Test for continuity and insulation Resistance
14. Identify various parts of a motor.

Discussion of the Findings

The technical competency needs of Electrical Installation teachers in Government Technical College's were analyzed and ascertained as they were found relevant. This finding is an indication that those competencies are complementary for effective job motivation performance and satisfaction of any worker. This is in line with Oranu (1 990) who stated that personality development can be described as a combination of a press and a need. Hence, the desire to satisfy or gratify these needs directs or indicates human behaviour. The above concepts of needs have implication, among other things, to teachers in general and Electrical Installation teachers in particular. This is in agreement with Olaitan (1978), Onwu (1982) and Onwu (1985) which emphasized the fact that before any training programme is established, the felt needs of teachers who will participate in such a programme must be ascertained. This is to support Hughes and Doughery (1977) who suggested that the perceived needs of teachers must be considered, and also in-service education programme should be based on the identified needs of the teachers which should be structured to permit their active involvement.

The analysis of research question two presented in table 2 provided such finding as indicated by the mean rating of teachers, Competencies needed by teachers Domestic Installation on competencies required were all agreed on by the respondents who believed it should be in both theoretical and more of practical in-service training programme. This supports the opinion of Akubue (1981) and Anyakoha (1982) which states that needs for in-service training should be based on competencies in which the respondents found them deficient and so need re-training in an in-service education programme.

According to research question three as analyzed in table 5, the finding of this table shows that there are some competencies that are needed in Electrical Installation teachers which could be acquired through theoretical programme. Though all respondents required that acquisition of desired competencies will be more through practical training programme. According to Green (1954), a comprehensive knowledge of the competencies in Electrical Installation is essential for teachers of Electrical/Electronic teachers of higher education level. Green explained that a competent Electrical Installation teacher must be skilled in the selection of appropriate materials in guiding the students to carry out successful projects using the selected materials through a planned practical activity.

In the analysis of research question four, presented in table 5, the findings revealed that the competencies needed by Electrical Installation teachers in Winding of Electrical Machines should be organized through practical training programme as indicated by the mean rating of the respondents' responses. This supports Ani (1989) proposal that teaching effectiveness is a function of what to teach, how to teach, to whom it will be taught and the condition under which it will be taught. In line with this, Cannon (1991) also focused on the personal and professional qualities of the teacher for effective teaching and learning. Respondents agreed that the acquisition of the desired competencies will be more through practical training programme. This agreed with Green (1954) who explained that professional teachers must be skilled in the selection of appropriate materials in guiding the students to carry successful projects Agwu (1988) supported by saying that quality education presupposes quality teaching which can only be achieved through mastery of the various skills in the teaching components.

Null Hypothesis

The result of the null hypothesis shows that there is no significant difference in the competencies required qualified and less qualified teachers on Domestic installation Industrial Instillation, Cable Jointing and winding of electrical machines this means that the competencies requirements of qualified teachers and the competencies required of less qualified teachers are the same.

CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter is concerned with the summary of the research problem, purpose of the study and its methodology. The major findings, conclusions, recommendations and suggestions for further research are also presented.

Re-Statement of the Problem

Changes in technical college graduates have been in programme structure, curriculum, content and implement. Primarily, the objective of technical college programme is to produce at craft level, graduates who should either take up skilled job opportunities in industries or be self employed. Unfortunately, technical college graduates are weak in the practice of their trades. Therefore, poor skill oriented technical college graduate is a reflection of the quality of teachers in technical colleges. These teachers attend different institutions and so, possess different qualifications and work experiences. The technical nature of teacherøs area of specialization requires specific technical competencies for career success. Competencies required are those theory and practical knowledge/skills and pedagogical competencies necessary for execution of task in an area of specialization.

Electrical Installation which consists of courses at technical college level where topics are aimed at studying the technical competencies include: Basic Electricity, Battery Charging, Domestic installation, industrial Installation Cable Jointing and winding of Electrical Machines. Teachers have to show mastery in both the theory and practical of the trade. The problem of this study therefore, is to examine the competency intensity of teachers of Electrical installation in Government Technical Colleges. The specific purposes of the study are to: identify the Electrical Installation competencies required by teachers in Domestic installation, industrial Installation Cable Jointing and winding of Electrical Machine for the effective teaching

Summary of Procedures used

In the study, a survey research design was used for the study, The study covered all the Electrical Installation teachers in Government Technical Colleges in Bauchi and Gombe States of Nigeria. The population was made up 47 Electrical Installation teachers in all the states mentioned above. A structured questionnaire with 122 items which consists of two sections, was used. Section A consists of items on the personal data about the respondents. Section B consists of items based on the research questions. The response category was structured according to the four point responses of highly required (HR), Moderately Required (MR), Required and Not Required

Major Findings of the Study

The following are the major findings of the study: There is need for in-service training programme for teachers of Electrical Installation in Government Technical Colleges. The theoretical and practical competency requirements of teachers of Electrical Installation on Domestic, installation industrial installation cable joining and winding of electrical machines should be addressed to include both theoretical and practical competencies with more emphases on practical abilities in competencies. The length of teaching experience has no relationship with the level of technical competency needs of Electrical Installation teachers in Government Technical Colleges, The status of Electrical Installation teachers has no effect on the technical competency needs for their job performance. The perceptions of both qualified and less qualified teachers of Electrical Installation are similar on competency required of Electrical Installation ' for qualitative job performance.

Implication of the Study

The findings of the study have the following implications. The effects of using the appropriate competencies required in Electrical Installation for psychomotor skill development is not well felt due to shortage of the needed competencies by teachers. This leads to one sided psychomotor skill development, leaving the area Electrical Installation programmes where the competencies exist. The next implication of the findings of the study is that most Government Technical Colleges due to lack of competent teachers embark only on theoretical aspects of Electrical Installation to the detriment of psychomotor skill development in the students. Expectedly, the resultant effect to this is the over production of academically sound but technically deficient Electrical Installation graduates who are capable of reciting all the principles and theories

The study also proved that the teachers of Electrical Installation desire for more practical competency in xxx and only when they are assured of the in-service training opportunity to equip themselves with skills through workshop and site experiences could these needs be met. This accounts for the reason why students of Electrical Installation do not take practical aspect of their studies more seriously since they believe that all their teachers are deficient in practical competencies.

The implication of the null hypotheses for the study as was observed after testing the hypothesis are: For null hypothesis one, the implication is that teachers of Electrical Installation were not commonly competent in Domestic installation in Government Technical Colleges and so negatively affected psychomotor development of the students. For null hypothesis two, it proved that different competency requirement was needed for psychomotor skill development in Industrial installations by teachers. This led to inadequate development of students in Industrial installation skills. The third null hypothesis discovered that there were deficiencies in competencies possessed by

Electrical/Electronic teachers for teaching Cable Jointing in Government Technical College in the states under study hoping to improve on their competency level if given the pre-service and in-service training opportunity, the psychomotor skills of the students and teachers of Electrical Installation were not fully and properly developed.

Conclusion

It is through effective technical teacher education programme that the nations technological development objective can best be achieved, since training is one of the conditions which can influence teachers effectiveness, The following conclusion were made base on the result of the study. The findings of this study has shown some salient points that needs to be revisited by the National Board for Technical ducat ion (NBTE) in assessing actually the competency improvement requirements of teachers of Electrical/Electronic in Government Technical Colleges. From the findings, there is the Conclusion that there were shortages in the desired competencies Electrical Installation teachers. As a result of this, the performance of teachers on Electrical Installation was limited to a few competencies available.

Furthermore, the shortage of adequate competencies of teachers of Electrical Installation in Government Technical Colleges brings about poor psychomotor skill development in the students. As a result, the few competencies possessed by the teachers were utilized in teaching Electrical Installation for psychomotor skill development in Electrical Installation students. In summary therefore, it is understandable that the purpose of this study has been met. Discovering that competency requirements of Electrical Installation teachers in Government Technical Colleges were inadequate and glaring, that few competencies were adopted Electrical Installation activities based on the competencies possessed by teachers. that effects of the deficient competency (theoretical and practical) by Electrical Installation teachers equally felt in the area of teaching

Electrical Installation students and effective performance on the part of teachers, and that many ways would be adopted for more acquisition of competency in Electrical Installation and effective utilization of teachers, confirm the fact that the purpose of the study has been effectively achieved.

Recommendations

The following recommendations are made from this study. Since there were inadequate competent teachers of Electrical Installation in Government Technical Colleges, the Federal government should make effort to provide enough in-service training programmes for Electrical/Electronic teachers. Such in-service technical training programme should be in form of workshops, post-graduate programmes, seminars, conferences and any other forms of training that will assist the teachers of Electrical Installation in improving their competencies. Electrical/Electronic teachers in Government Technical Colleges should be given in-service courses, workshop and seminars on practical aspects of Domestic Installation Industrial Installation Cable jointing and Winding of Electrical machines This will enable them to adapt actively in Electrical Installation workshop and relevant to students' psychomotor skill development. The identified competencies required needs improvement for teachers of Electrical Installation should form the basis for the in-service training programme to be organized by the training institution. Curriculum planners can also use the identified competencies improvement needs in planning and developing the curriculum content of the in-service training programme. This study finds no deficiency in the curriculum so no evidence for review. The above recommendations if considered and implemented will go along way in improving the competencies Electrical/Electronic teachers of Government Technical Colleges.

Suggestions for Further Research

This study which dealt with Electrical Installation competencies required by Electrical/Electronic teachers in Governmen1 Technical Colleges

(1) Gain of in-service training, pre-service and post-training, programmes and on the job efficiency of Electrical Installation

(2) In-service training programmes for teachers of Electrical Installation problems and prospects. Finally, a similar study could be carried out to identify the technical competency improvements in Electrical Installation for teachers of Introductory Technology in sampled states to ascertain whether there is deficiency transfer from the teachers to the students at the level of learning in Government Technical Colleges.

(3) A Study to be carried in the aspect winding of electrical machine and battery charging that this study delimited

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Appendixes A

Department of vocational teacher Education

University of Nigeria Nsukka

01st September, 2010

Dear Sir/Madam,

REQUEST FOR INSTRUMENT VALIDATION

I, am a postgraduate student in the department of Vocational teacher Education (industrial Technical), University of Nigeria Nsukka, currently undertaking a research project aimed at finding out ñElectrical installation competencies required by Electricity/Electronic teachers in Bauchi and Gombe states technical colleges ñ

Attached is a draft copy of the questionnaire a survey instrument for the study, topic of the study, purpose of the study and Hypotheses. You are please requested to vet the items for clarity, relevance and total coverage of Electrical installation competencies, for consistency and stability.

Please use the plain sheet provided for general comments and suggestions you deem necessary, concerning any aspect of electrical installation competencies not covered in the instrument. Your responses will be held in strictest confidence.

Thanks.

Yours faithfully

Abdullahi, Shetima
PG/MED/07/43679

Appendixes B

DEPARTMENT OF VOCATIONAL TEACHER EDUCATION
SCHOOL OF POSTGRADUATE STUDIES
UNIVERSITY OF NIGERIA, NSUKKA

ELECTRICAL INSTALLATION COMPETENCIES REQUIRED BY ELECTRICITY/ELECTRONIC TEACHERS IN BAUCHI AND GOMBE STATES TECHNICAL COLLEGES

SECTION A: Personal Data

Instruction: Check (ã) against the box or fill the gap as applicable to you.

School G.T.C.: ....

Highest Educational Qualification:

(i) C & G FTCI ☐ ANTC/NTC ☐ (ii) C & G FTC/ANTC with ATTC ☐

(iii) B.Sc./B.Ed. ☐ (iv) HND Elec..Eng. With PGDE ☐

(v) M.Sc. / M.Ed ☐ (VI) others (please specify).................

SECTION B: ELECTRICAL INSTALLATION COMPETENCIES REQUIRED BY ELECTRICITY/ELECTRONIC TEACHERS IN BAUCHI AND GOMBE STATES TECHNICAL COLLEGES

Instruction: This section contains a list of: Competencies required in electrical installation with a check (ã) indicate required as related to the identified concept and the teaching that will best suit the training exercises in Domestic installation, Industrial installation, Cable Jointing and Winding of Electrical Machines.

Appendixes C

Research Question One: What are the competencies required by Electrical/Electronic teachers to teach Domestic Installation?

S/N	Electricity Teaches should have the Ability to:-	HR	R	MR	NR
1.	Explain the meaning of symbols				
2.	Use scale-Rule on working drawing				
3.	Identify the electrical symbols of working drawing				
4.	Explain item, accessories on the list				
5.	Explain appropriate distribution units for single and polyphase				
6.	Identify clip, gimlet pins, broil drill & plug, and wiring materials				
7.	Select types of cables PVC, MICC, Armoured standard size of cables				
8.	Apply IEE charts cable rating, maximum load demand				
9.	Apply plumb line, chalk line and sprit level.				
10.	Identify tools, used for preparing conduit pipes				
11.	Explain regulations guiding conduit installation				
12.	Cut tread conduit and square cutting				
13.	Distinguish merits & demerits of conduit wiring				
14.	State regulation regarding set and bend conduit				
15.	Draw cable in using fish wire				
16.	Carry a continuity test, insulation test and insulation test				
17.	Maintain tools and equipments for conduit installation				
18.	Select protective circuit breakers, and fuses for single/polyphase				
19.	Explain function of circuit breaker and fuses in electric circuit				
20.	Explain function of circuit breaker and fuses in electric circuit				
21.	Install earthing devices				
22.	Effect the regulations concerning circuit breakers and fuses				
23.	Install earth leakage circuit breakers for single and 3- phase dwelling				
24.	Inspect electrical and mechanical connections to avoid partial contact				
25.	Carry a polarity test using bell				
26.	Identify incandescent lamp, Tungsten filament lamp, gas filled tungsten filament lamp, neon tube, hot and old cathode				
27.	Install Emergency light, shade reflectors				

Research Question Two: What are the competencies required by Electrical/Electronic Teachers to teach technical college students industrial installation?

S/N	Electricity teachers should have the ability to:-	HR	R	MR	NR
1	Identify key elements in the electrical installation				
2	Demonstrate conduit on wiring Board				
3	Install MICC Cable				
4	Explain duct wiring				
5	Different types of trunking				
6	Select Tools and equipments used on duct trunking				
7	Demonstrate Bus-bar trunking and wiring				
8	Use Accessories on duct				
9	Join trunking				
10	Run Earth continuity on ducting and trunking				
11	State Principles of generators and motors.				
12	Explain Functions of AC and DC Machines				
13	Difference between AC and DC Motors and Generators				
14	Show DC motors (Series, Shunt, Compound)				
15	Explain AC motor-single phase and 3 phase.				
16	Illustrate Application of AC motors				
17	Operat polyphase machine				
18	Differentiate ways by which machine can be enclosed				
19	Construct foundation for mounting a machine				
20	Lift and mount machine				
21	Distinguish Types of connections Star-delta-star				
22	Calculate current rating of cable				
23	Use flexible conduit in connecting motor				
24	Operate and use starters for motors.				
25	Test machines				
26	Identify various starters used to demonstrate speed control of a motor				
27	Apply lubricants on machines				
28	Demonstrate the use of Tools and Equipment for maintenance of machines the used of each				
29	Explain working principles of, cooker, heater, iron with diagram				
30	Make data and manufactureôs specifications in maintenance of machines				
31	Carry out test on machine				
32	Detect faults causes of break-down on machines				
33	Detect fault by noise				
34	Rectify fault in installation				

Research Question Three: What are the Competencies required by Electrical/Electronic Teachers to Teach Technical College Student Cable Jointing?

S/N	Electricity Teaches should have the Ability to:-	HR	R	MR	NR
1	Joint and solder cables				
2	Describe the procedure for cable joint, highlight the sizes and uses				
3	Apply insulation material copper and aluminum				
4	Explain the merit and demerit of conductors shown				
5	Demonstrate how to prepare cables for joint				
6	Demonstrate shaping of conductors				
7	Selection of lugs and glands used for terminations				
8	Show different armoured cable				
9	Explain the usefulness of amouring and application of the cable				
10	Show the constructional parts of armoured cable				
11	Join two length of armoured cable and demonstrate how to terminate armoured cable				
12	Explain factors affecting underground cables and the types need for system				
13	Convey underground to the site				
14	Demonstrate how to prepare trench depth for the cable laying				
15	Lay the cables in trench using jacks, rollers				
16	Show tool and equipment used in terminating underground cables				
17	Explain the safety precautions and regulation				
18	Solder a joint show different types tapes used in underground cable				
19	Explain operations of instruments used in testing underground work of bridge meggar, slide wire and Insulation assistance				
20	Explain transmission and distribution stating tools and equipment used in the two system				
21	Explain how to convey poles to site and how to erect such				
22	Describe stay wire and its function				
23	Demonstrate how to screw pole with stay wire				
24	Show cross-arms used in transmission line				
25	Demonstrate how to make a joint noting all precautions				
26	Different types of data cables, communication cables computer cables, fibre optic, co-axial cables				
27	Supervise connections				

Research Question four: what are the competencies required by Electricity/Electronic Teachers to teach technical college student Winding of Electrical machines.

S/N	**Electricity Teaches should have the Ability to:-**	**HR**	**R**	**MR**	**NR**
1	Follow Regulations on the used of conductors, varnish and oven				
2	Select Tools used in Winding work				
3	Draw procedure for Wave winding				
4	Apply of lap windings				
5	Used Chalkboard/chart Coil ends positions on commutator and slip-rings				
6	Record information on machine nameplate before dismantling				
7	Identify shield				
8	Dismantle electric machines using core				
9	Notice winding connection, pitch, cross sectional area of winding Conductor				
10	Fix and replace the brush				
11	Display different conductors used in winding work				
12	Different insulation materials classification				
13	Construct a former				
14	Fix Winding coils properly in slots				
15	Prepare simple winding coil				
16	Use a Megger Test set, show how to Test for continuity and insulation Resistance				
17	Carry out Final Test on the job before recommissioning				
18	Use bar Test to test for good commutation				
19	Identify various parts of a motor				
20	Conduct visual inspection of ball bearing				
21	Assemble machine and apply grease				
22	Test for continuity and installation resistance using megger test set				
23	Test run machine and what to observe on record				
24	Carry out all reconnection test to conform to manufactures Specifications				
25	Test machine using tachnometer				

Appendix D

Technical College	Figure	State
Government Science Tech college Kumo	7	Gombe
Government Day Technica College Gombe	9	Gombe
Government Technical College Tula	2	Gombe
Government Technical College Deba	3	Gombe
Government Technical College Kwami	5	Gombe
Government Technical College Amada	4	Gombe
Government Science Tech College Gumau	5	Bauchi
Government Technical College Itas/Gadau	3	Bauchi
Government Science Day Tech Col Bauchi	9	Bauchi
TOTAL	47	

Source states ministry of education staff posting list for both Bauchi and Gombe states.