COMPARATIVE EFFECT OF DEMONSTRATION AND GUIDED DISCOVERY INSTRUCTIONAL METHODS ON STUDENTS ACHIEVEMENT IN ELECTRICAL INSTALLATION AND MAINTENANCE WORKS IN TECHNICAL COLLEGES IN MINNA AND SULEJA.

BY

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2007/1/27288BT

DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

FEDERAL UNIVERSITY OF TECHNOLOGY
MINNA

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION, SCHOOL OF SCIENCE AND SCIENCE EDUCATION FEDERAL UNIVERSITY OF TECHNOLOGY MINNA

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF TECHNOLOGY (B.TECH) IN INDUSTRIAL AND TECHNOLOGY EDUCATION

OCTOBER, 2012

CERTIFICATION

I Bello Abdulrahman with matriculation number 2007/1/27288BT an undergraduate of the Department of Industrial and Technology Education certify that the work embodied in this project is original and has not been submitted in part or full for any Diploma or Degree of this or any other university.

....

Name **Sign-date**

APPROVAL PAGE

This project has been read and approved as meeting the requirement for the award of B.Tech degree in Industrial and Technology Education of the Department of Industrial and Technology Education, School of Science and Science Education, Federal University of Technology, Minna.

.....	.....
Supervisor	**Sign /Date**
.....	.....
Head of Department	**Sign/Date**
.....	.....
External Supervisor	**Sign/Date**

DEDICATION

With profound joy and gratitude in my heart, I dedicate this project to Almighty Allah for making it possible for me to complete this project work successfully. I also want to dedicate the project to my parents Mr. And Mrs. Bello for their constant guidance and support in my life.

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My profound appreciation goes to my mentor and my supervisor Mr. E. Raymond for his fatherly advice, kind gesture, healthy criticism, resourcefulness and guidance towards the successful completion of this project. I want to also acknowledge Mr. J.F. Magida and Mr. I.K. Kalat for painstakingly going through this project work for correction. My sincere appreciation goes to the Project Coordinator, Mr. T.M. Saba for his support all through this project work, the H.O.D. Industrial and Technology Education Department, Dr. E.J. Ohize and to all the lecturers in the department of Industrial and Technology Education, Federal University of Technology, Minna.

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ABSTRACT

The study compared the relative effectiveness of demonstration and guided discovery instructional methods in relation to students' achievement in electrical installation and maintenance work in technical colleges. A quasi-experimental research design in which pre-test and post-test design with the experimental and control groups was used. The population of the study comprised of 160 technical college II (TC II) students of electrical installation works in two technical colleges in Niger state. There were two different treatment patterns applied during the experimental period. The experimental group received treatment of guided discovery approach while the control group was treated using demonstration method. Three research questions and three hypotheses were formulated, the mean and standard deviation was used to analyze the data for answering the research questions while analysis of variance (ANOVA) was used to test the hypotheses at 0.05 level of significance. The study found out that both guided discovery and demonstration method are powerful instructional methods for improving students achievement in electrical installation and maintenance works and both posses high retention ability. Based on this, it was recommended that teachers should adopt both methods in teaching electrical installation and maintenance works.

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CHAPTER 1

INTRODUCTION

Background Study

Teachers are increasingly facing serious instructional challenges as the diversity of students within each class room continues to widen. Patterson (2002) noted that within each classroom student of a wide academic range with different labels such as gifted, fast learners, average learners, slow learners and the low learners all face their teacher daily with full hope that their need will be met. The conventional teaching method seems not to be adequate in equiping students with necessary knowledge and skills.

These major challenges occur mostly in Technical Education. Uwaifo (2009) defined Technical Education as the acquisition of skills and techniques in chosen occupation or profession to enable an individual earn a living. Technical Education offers various courses or programmes which includes Woodwork, Plumbing, Building, Metalwork, Carpentry and Joinery, Auto mechanics, Metal fabrication, Drafting, Electrical installation work etc.

Technical Colleges are regarded as the principal vocational institution in Nigeria. They impact full vocational training, with the intent to prepare students for entry into the various occupations Okoro (1993). The products of these institutions are employed as operatives, artisans, and craftsmen in industries. Grant (1979) however maintained that Technical Education is based on the fundamental of the industrial production, he stated that the main objectives of Technical Education is to make students familiar with most important branches of production in an industry, commerce, imparting of skills and practical competencies in handling of tools, materials and generally equipping the students with both theoretical

knowledge and work habits. Technical colleges provide students with vocational competencies needed in various disciplines of producing skilled personnel needed for provision of the maximum economic security Atsumbe (2001). One of the areas where Technical Colleges equip young people is in the field of Electrical Installation.

Electrical installation is the aggregate of all the process involved in wiring a house, maintaining and repair of electrical equipments, machines and appliances. The graduates of Technical Colleges should demonstrate sound practical skills in Electrical installation. An Electrical installation craftsman is required to know the procedures of installation as well as causes and control measures to minimize dangers inherent in the use of electricity, in addition, standardized regulations, safety rules, requirements and code of practice for a safe and efficient electrical system installation provided by the appropriate regulatory bodies. Therefore for electrical installation programme to adequately meet the societal expectations at this computer age, teaching needs to be improved; this improvement includes selection of appropriate and more effective teaching methodology.

Teaching and learning is a process that includes many variables which interacts as learners work towards their goals and incorporate new knowledge, behaviours and skills that add to their range of learning experiences. A teaching method comprises the principles and methods used for instruction. Commonly used methods in technical education include Lecture method, Project method, Demonstration method, Guided discovery, Field Trip, Discussion method etc. However, Demonstration and Guided discovery teaching methods are among the most commonly used methods in technical education. These methods have some similarities and are purported to be effective in problem solving.

Demonstration method is commonly used to teach operations in technical education this method helps the teacher to explain the steps involved in a lesson or an operation while

teaching them (Oranu,1994). Demonstration involves showing by reason or proof, explaining or making clear by use of examples or experiments to conceptualize students knowledge. Furthermore, Demonstration method helps the instructor to show the students various scientific procedures, processes and troubleshooting skills. It can be employed during problem solving to serve a fairly large class at a time

Guided discovery on the other hand, is largely unstructured situational method of teaching whereby students are permitted to find solutions to problem on their own or at their own pace, often jointly in group activities under the guidance of the instructor. The student receives problems to solve, but the teacher provides hints and directions about how to solve the problem to keep the student on track (Mayer, 2003). Guided Discovery is a learner centred methodology in which students are encouraged to take more active role in their learning process and allowed to take control of their learning by learning at their own pace.

Demonstration and Guided discovery method are reported to have the capacity to stimulate interest and curiosity among students. Also they posses higher retention ability for students offering Electrical Installation works than the conventional Lecture method.

Retention according to (Casper, 2008) is the ability of and individual to recall or recognize acquired skills or knowledge after extended period of time. Acquired skills can fade over a period of non-use. This is a critical training problem that needs to be addressed. Efforts need to be made to prevent skills from deteriorating below an acceptable performance level. Artherson (2003) reported that the degree of original learnt material/task, degree of overlearning and instructional methods employed in teaching are the most important factors in knowledge and skills retention. It is reported that the use of problem solving technique for instruction can improve student's achievement and retention. Unfortunately, students are

sometimes unable to recall useful information and skills necessary for task performance when desired, hence, the importance of retention in the learning process.

Furthermore, researchers have also attributed student's achievement in technical trades to gender. Gender issue has assumed prominence in Vocational and Technical Education discourse. Gender is a sense of awareness of being male or female. It is a behavioural pattern and attitude perceived as masculine or femine within a culture (Coleman, 2000: 77). It is believed that technical trades and related tasks belong to the male students. For instance, Raji (1994) opined that males perform better than females on tasks requiaring logical operation. This may be responsible for the ratio of males and females students' enrolment in technical colleges. Lona (2004:92) also revealed that female students performed significantly higher than their male counterparts in electronic works achievement test. Hence, an attempt will be made in this study to find out if these disparities exist in Electrical installation works.

However, it has been discovered that the persistently poor performance of students emanates from the inappropriate teaching methods adopted by technical education teachers in the instruction of Electrical Installation (NABTEB, 2010). For Electrical installation to meet up with the societal expectation at this computer age, there is an increasing need for effective performance of Electrical Installation students, thus teaching needs to be improved. This study was carried out to ascertain the effectiveness of Demonstration and Guided Discovery methodology on student's achievement in Electrical installation at Technical Colleges.

Statement of the Problem

Technical education is the engine for economic growth, it helps to solve the problem of unemployment by producing citizens which can set up their own business and be self employed and can even create employment for others. No nation can fight a war without an army. In the same vein, Nigeria cannot compete effectively in the emerging global economies

with poorly educated and unskilled workforce (Dike, 2005). The rapid rate of change of technology and effect of globalization has brought about the need to effectively equip Electrical Installation students at Technical Colleges in the acquisition of necessary knowledge and skills in the trade, so as to meet the needs of the society.

Student graduating from technical colleges in Nigeria are expected to have acquired adequate knowledge and skills necessary for effective performance in the workplace (F.G.N, 2004). It is however apparent that there is an astronomical decline in student's academic achievement in trade subjects including Electrical Installation works (NABTEB, 2010). The weakness of the teaching methodologies may have partly contributed to the poor performance of students in trade subjects, in the National exams over the years and also at the work place when eventually employed upon graduation (Aina, 1999). Ineffectiveness of the instructional method can be considered among one of the major factors responsible for this low performance.

However, for this problem to be solved, appropriate methods must be adopted in order to address the problem of poor student achievement in Electrical installation. Demonstration is a traditional method of teaching Electrical installation in technical college while Guided discovery is a relatively new method of instruction which is similar to demonstration. It prepares learners for problem-solving and has the ability to stimulate interest and curiosity among learners. Okorie (1979) stressed that, there is a great diversity in teaching methods and techniques, there is no one of them that can be regarded as the best. Two or more methods can be effective in teaching Electrical Installation in Technical College. However, to ascertain the effect of each method on student's achievement and retention level, the study on the comparative effect of Demonstration and Guided Discovery instructional method on student achievement in Electrical installation in Technical Colleges is desirable.

Purpose of the Study

The purpose of this study is to compare the effect of Demonstration and Guided Discovery Instructional Method on student achievement in Electrical Installation in Technical colleges. Specifically this study sought to find out:

1. The difference in mean achievement of students taught Electrical Installation using Demonstration method and those taught using Guided Discovery method.
2. The difference in retention level of students taught Electrical Installation using Demonstration and those taught using Guided discovery method.
3. The difference in the achievement of male and female students taught Electrical Installation using Demonstration and Guided Discovery instructional method.

Significance of the Study

This study will be of immense benefit to the curriculum developers, teachers, textbook writers, examination bodies among others.

The findings of this study will assist curriculum developers in improving or developing new curriculum in which effective instructional teaching methods will be introduced and also help the textbook writers in developing textbooks for Electrical Installation works.

Technical education teachers, especially those teaching Electrical Installation in Technical colleges will also find this study useful. It will provide them with contemporary view of student's manipulative skills and their vast learning capabilities. It will guide the teacher in adopting of effective instructional methodology and it the development of appropriate lesson

plans. It will equally help the teacher to develop suitable methods for assessing students achievement in Electrical installation works.

The students will also find this study beneficial, because when appropriate teaching methods are used, student retention and interest level will be increased. Hence, graduates of Electrical installation work will be better equipped to face the societal challenges.

Finally, the findings of this study will assist the examination bodies on how to develop appropriate assessment instrument that will effectively measure student's academic achievement in Electrical installation works.

Scope of the Study

The study is designed to compare the effect of Demonstration and Guided Discovery instructional methodology on student's achievement and manipulative skills in Electrical installation.

Research Questions

The following research questions has been formulated to guide the study

1. What is the difference in mean achievement of student taught Domestic Industrial Installation using Demonstration method and those taught using Guided Discovery method?
2. What is the difference in the retention scores of students taught Domestic Industrial Installation using Demonstration and those taught using Guided discovery method?
3. What is the difference in the achievement of male and female students taught Domestic Industrial Installation using Demonstration and Guided Discovery method?

Hypotheses

The following null hypotheses will be tested at 0.05 level of significance.

$HO_{1.}$ There is no significant difference in the mean achievement of student taught Domestic Industrial Installation using Demonstration and those taught with Guided Discovery method.

$HO_{2.}$ There is no significant difference in the retention scores of students taught Domestic Industrial Installation using Demonstration and those taught using Guided discovery method.

$HO_{3.}$ There is no significant difference in the achievement of male and female students taught Domestic Industrial Installation using Demonstration and Guided Discovery instructional method.

CHAPTER II

REVIEW OF RELATED LITERATURE

Literature related to the study is reviewed under the following sub-headings:

- ✓ Technical Education in Nigeria
- ✓ Electrical Installation Technology in Technical Colleges
- ✓ Teaching and Learning
- ✓ Method of Teaching Technical Education
    - Demonstration Method
    - Guided Discovery Method
    - Lecture Method
    - Field trip Method
    - Discussion Method
    - Project Method
- ✓ Retention and Academic Achievement
- ✓ Gender and Academic Achievement
- ✓ Summary of Reviewed Literature

Technical Education in Nigeria

Technical education has a slow and developed less quickly than other forms of education in Nigeria. This was because the advent of western education itself is closely linked up with the missionary activities whose emergence in the 19th century brought this type of education. The

development of technical education was not their major priority because according to Bamana (1987).

> "The interest of the various missionaries was not to turn out technically trained Nigerian who could be beneficial to both themselves and the government, but to turn out individual capable of reading and interpreting the Bible". Pp. 5

Technical and vocational education (TVE) has been an integral part of national development strategies in many societies because of its impact on productivity and economic development. Despite its contributions, the leaders of Nigeria have not given this aspect of education the attention it deserves. And that is one of the reasons for the nation's underdevelopment. According to Dike(2005), Technical education "is a planned program of courses and learning experiences that begins with exploration of career options, supports basic academic and life skills, and enables achievement of high academic standards, leadership, preparation for industry-defined work, and advanced and continuing education". And vocational education and training "prepares learners for careers that are based in manual or practical activities, traditionally non-academic and totally related to a specific trade, occupation or vocation." In other words, it is an "education designed to develop occupational skills." Vocational and technical education gives individuals the skills to "live, learn and work as a productive citizen in a global society."

Technical college are institution concerned with the teaching of subjects that lead to acquisition of practical as well as basics scientific knowledge, the colleges are establish for the purpose of satisfying community, state and the country needs in term of training and educating the younger once in various trades and to make them self-reliant. Technical

Colleges which are identified as the principal vocational institution in Nigeria according to the National policy of Education (FGN, 2004) provides technical and vocational training for quite a number of occupations including Auto mechanics, Building, Wood work, Metal fabrication, Painting and Decoration, Metal work, Carpentry and Joinery, Radio and Television work, Plumbing, Furniture making, Weaving and Dyeing, Refrigeration and Air conditioners repairs, Printing, Agriculture mechanics work, Computer technology, Electrical installation work etc.(Olaitan, 1997). The duration of Technical College training program is for three years leading to the award of National Technical Certificate (NTC) or National Business Certificate (NBC) by the National Business and Technical Examination Board (NABTEB) according to Olatunji(1992). To further enhance your knowledge and skill in an occupation, a one year advance course is available in some Technical Colleges leading to the award of Advance National Technical Certificate (ANTC) or Advance National Business Certificate (ANBC) in various field of study.

The requisite qualification to enter Technical Colleges is a Junior Secondary School Certificate (J.S.S.C) or Vocational Training Center Certificate (V.T.C.C) in the relevant field of study. National Board for Technical Education (NBTE, 1987) stipulates that candidates going into NTC programme must not be less than 14 years of age. While the entry qualification for ANTC program is NTC or its equivalent and at least two year's post qualification cognate industrial experience.

NBTE (2001) also states that curriculum of each of the programme leading to NTC and ANTC are trendily divided into three components as follows:

1. General education, this component of the curriculum aims at providing the trainee with complete secondary education which account for 30% of the total hours required for the programme. Critical subjects like english language, physics, chemistry,

mathematics etc. These subjects enhance the understanding of tools, machines, materials of the various trade and their applications. They also provide foundation for the entry into the post secondary technical education in the university, polytechnics and colleges of education (technical).

2. The trade subjects, practical and related studies, which accounts for 65% of the total hours required for the programme. These subjects include domestic installation, cable jointing, basic electricity etc.
3. Industrial work experience, which accounts for 5% of the total hours required for the programme. This part of the course is compulsory for full-time students and may be taken in an industry or in any production unit of an organization. It is supervised to form part of the continuous assessment.

The National Policy on Education (FGN, 2004) identified five types of Technical education institutions outside the Universities. The institutions include the Pre-Vocational and Vocational schools at post primary level, Science and Technical colleges, Polytechnics and Colleges of education (technical) at post secondary level. Okoro (1993) maintained that the development of Technical colleges education was rather slow in the country with only three (3) Technical Colleges, seven (7) Trade centres and eighteen (18) Handcraft centres between 1952 to 1960.

The post-independence witnessed a rapid expansion of Technical and Vocational Education. In 1966, there were about 73 institutions (Trade-centres, Craft schools and Technical institutes) across the country with pupil enrolment of 15,509 out of which 15,907 were males while 412 were females (FGN, 1988). In 1970, the status of vocational and technical education in the country started changing appreciably. The pioneers of the first generation polytechnics were established in Ibadan, Kaduna and Auchi in the early 1970s and more attention was focused on university of technology In 1975 the government has already

established 84 post-primary institutions of vocational and technical education in all 19 States of the Federation. These institutions operated a five-year training period with emphasis placed on technical subjects and their curricula designed to allow direct transition into post-secondary technical education e.g. Polytechnic and Colleges of Technology. Within this period, Yaba College of Technology; The Technical Teachers College, Lagos and The Institute of Management and Technology, Enugu were also established. A recent record shows that Nigeria now has a total of 132 technical colleges which includes 19 Federal Technical Colleges, 110 State Technical Colleges and 3 Private Technical Colleges that are recognized by National Board for Technical Education (NBTE).

The NBTE decree 9 of 1977 Act, stipulates the functions of the Technical colleges in the country to include:

a. Provision of full time or part-time courses of instruction and training in technology, applied science and commerce. In such other field of applied learning, relevant to the needs of the development of the society.
b. To give an introduction to professional studies in engineering and other technologies.
c. Provision of training and impartation of necessary skills leading to the production of craftsmen, technicians, and other skilled personnel who will be enterprising and self-reliant.
d. Perform such other functions as in the opinion of the society as may serve to promote the objectives of the technical colleges.

National Policy on Education (2004) made the production of Craftsmen, Artisans and Sub-professional skilled personnel the responsibility of Technical College and maintained that trainees on the completion of Technical college programmes shall have three (3) options:

I. Secure employment either at the end of the whole course or after completing one or more modules of employable skill;

II. Set up their own business and become self-employed and be able to employ other;

III. Pursue further education in advance – Craft/Technical programme and in post-secondary (Tertiary) technical institution such as Science and Technical colleges, Polytechnics, Colleges of Education (technical) and Universities.

Winer (2000) described Technical education as a programme designed to develop skills, abilities, understanding, attitudes, work habits and appreciation encompassing knowledge and information needed by students to enter selected occupation of their choice. It is an integral part of the total education programme and contributes towards the development of good citizens by developing their physical, social, cultural and economic competencies. Olaitan (1997) described Technical education as part of total experience of individual whereby he learns successfully to carry on a gainful occupation and participate effectively in the national economy. In the view of Thompson (2002), Technical education aims at the development of human abilities in terms of knowledge, skills and understanding so efficiently in carrying on the activities in the vocational pursuits of his choice.

Technical institutions provide the workers and young people with vocational competencies needed in various disciplines required in the world of work. Therefore the Technical colleges in Nigeria are established to fulfil the objectives of producing skilled personnel needed for the maximum economic security (Atsumbe, 2001). It cannot be overemphasized that technical education is the engine for economic growth. No nation can fight a war without an army. In the same token Nigeria cannot develop without well-equipped technical and vocational institutions. In fact, it is the missing link in Nigeria's development policy (Dike, 2005). There are so many challenges facing the implementation of Technical education. These are: dearth in qualified vocational technical teachers, hand tools, machines and materials; poor image and

status of vocational technical education, inadequate funding, and societal preference of general education to mention but a few. However, government intervention in providing human and infrastructural resources will give vocational technical education a facelift philosophically, sociologically and psychologically.

Dike (2005) recommended that, Nigeria should begin now to take very seriously investment in technical education and skill training as no nation can compete effectively in the emerging global market place with poorly educated and unskilled workers. Nigeria can become an economic power-house (and realize its visions) only if proper attention is given to Technical and Vocational education, promotes and rewards creativity, and channel its material and human resources to productive use.

Electrical Installation Technology in Technical Colleges

National Board for Technical Education NBTE (1987) listed the following technical fields as constituting technical education.

- Agriculture and related trade
- Building and wood work trade
- Commercial studies
- Electrical/Electronic trades
- Mechanical engineering trades
- Textile and related trades
- Hospitality trades.

In line with NBTE (1987) list of courses offered in technical education which technical college is one of the technical institutions. This signifies Electrical/Electronic Technology as one of the programmes offered in all the Technical colleges in Nigeria. This is as a result of

the great work carried out by the Ashby commission in 1960, which recommended that Electrical/Electronic Technology should be taught as a subject in Technical and Comprehensive colleges to produce graduates in the various area of the trade. The acquisition of skill on electrical trades practise is given prominent attention in pursuit for manpower training in technical and applied science. Electrical/Electronic technology is identified with all level of education; It is a standard and well-established area of technical education.

Electrical Installation and Maintenance Works is the totality of all process involved in wiring a house, maintaining and repair of all the electrical and electronic equipments, machines and appliances. Electrical/Electronic craft just as all other subjects in education has a basic structure of its own and it is been organized around a specific pattern; Electrical/Electronic trades are the various areas of specialization in Electrical/Electronic equipment and appliances. The areas of Electrical/Electronic craft in technical colleges in Nigeria are Electrical Installation work (EI), Radio and Television servicing (RTV), Telecommunication Craftsmen (TC), Refrigerator and Air-conditioning (RAC).

Electrical Installation work is the only course offered in the area Electrical/Electronic technology in Government technical college, Minna and it constitutes of subjects like domestic Installation, basic electricity, cable jointing and battery charging work. Okoro (1993) affirms that the aim of technical education in technical training institution is to prepare students for entry into various occupations. An electrical installation craftsman is required to have full understanding of installation and electronic servicing techniques as well as measures to be taken to minimize electrical hazards. He should have also mastered the standard regulations, safety rules and precaution, code of practice and efficient electrical system installation provided by the Institute of Electrical Engineers (IEE).

Electrical Installation work, according to the Federal Republic of Nigeria, National Policy of Education (1988) is one of vocational courses offered at Technical colleges and at the tertiary level for the purpose of;

1. Acquiring technical skills
2. Exposing student to career awareness by exploring usable options in world of work
3. Enable youths to have an intelligent understanding of the increasing complexity of technology.

This subject exposes the student to career in both the academic field and the technical trades.

The curriculum of Electrical Installation Works in technical colleges is not different from any other technical education course, it is the same 35% of general education, 65% of trades subjects and 5% industrial training attachment (NBTE, 2001) which leads to the award of NTC, ANTC in Electrical Installation Works by (NABTEB).

According to National Commission for colleges of education (NCCE 2002), while stressing the need for electrical installation work, said it introduce student to the electrical/electronic components and the different types of active and reactive components (resistors, capacitors, diodes, transistors, inductors e.t.c), their different characteristic when applied energy act upon them and their mode of connection(Series and parallel). Electrical Installation Work acquaints students to the laws such as Ohm's law of electricity, Kirchhoff's law, Lambert's cosine law of illumination etc. which is applied during practical's. In teaching and learning of Electrical Installation, which include winding, domestic & industrial installation, cable jointing etc. semi conductor device such as diodes, transistors, rectifiers, integrated circuits etc. are needed so often for the construction and design of electrical/electronic circuits. Therefore the establishment of Semiconductor Company that can mass produce these electronic components will go a long way to enhance practical activities in technical

institutions and hence high practical content in electrical installation work programme. Students who are well developed in this course can get themselves employed in most of the modern electrical and telecommunication companies. However, UNESCO & ILO (2002) while stressing the importance of scientific and technological society stressed that, sustainable development and implored quality of live are to a large extent dependent on our ability to understand and utilize science and technology effectively.

Electrical installation work graduates often work with electrical engineers in the design of new electrical equipment, ranging from small household appliances to huge power generating plants. They perform a variety of tasks to assist the engineers, such as assembling and testing experimental electrical parts or making changes in accordance to an engineer's instructions. They may also prepare wiring diagrams, layout drawings, or engineering specifications for new equipment. Once a design for new equipment has been perfected, an electrical installation work technician may guide and direct crew of workers through the installation process. Hence, Electrical installation work technicians can be of great assistance in designing, developing, testing, manufacturing and repairing of electrical and electronic equipments.

Important Skills, Knowledge, and Abilities of Electrical Installation work students

- Troubleshooting: Analysis and correction of fault in an electrical system.
- Repairing: Restore machines or systems to good condition using the needed tools.
- Equipment maintenance: Performing routine maintenance on equipment and determining when and what kind of maintenance is needed
- Equipment Selection: Determining the kind of tools and equipment needed to do a job
- Critical thinking: Using logic and reasoning to identify the strengths and weakness of alternative solutions, conclusions or approaches to problems

- Engineering and Technology: Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.
- Computers and Electronics- Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.
- Mechanical: Knowledge of machines and tools, including their designs, uses, repair, and maintenance.

Teaching and Learning

The goal of teaching is to improve student learning by maximizing opportunities for learning in every lesson. Such improvement reduces wastage of resources such as time, effort and money by producing students with the right skills and knowledge that delight the employers. The concepts of teaching and learning are most central to education. Hornby (2004) defined teaching as a way of giving instruction to somebody or causing somebody to know or be able to do something. It is also regarded as a skill for promoting performance in learning. Sandtrock (2004) view it as a conscious and deliberate effort by a mature or experienced person to impact information, knowledge, skills etc. to an immature or less experienced person with the intention that the latter will learn or come to believe what he is taught on good ground. Nwosu (1998) sees teaching as an attempt to help someone acquire, or change some skills, knowledge, idea or appreciation. Buttressing these views, Wraser (2003) stressed that the purpose of teaching should be too assist the learner to acquire, retain and be able to use practical knowledge, understand, analyse and evaluate skills, apply skills and knowledge, establish habits, and develop desirable attitudes towards practical skills. One of the cardinal objectives of teaching is to assist the learners develop physically, intellectually, emotionally,

morally and socially in a manner that he or she will be able to exploit his potentials maximally.

Learning is a change in behaviour due to experience. It is a process by which behaviour is initiated, modified or changed. It is the process by which we acquire and retain attitudes, knowledge, understanding, skills and capabilities that cannot be attributed to inherited behavioural patterns or physical growth (Farrant, 1976). Ogwo & Oranu (2006) and Okoro (2006) defined learning as the process by which activities enable the learner acquire experience that tend to influence (change) his/her future behaviour; provided that the characteristic for the change in behaviour cannot be explained on the basis of negative response tendencies, maturation or temporary states of the learner. They further outlined some basic facts underlying how individual learn in technical education programmes, it includes the following:

a. We learn best when we are ready to learn.
b. The more often we use what we learned, the better we understand. Long disuse can result in decay.
c. Learning something new is made easier if the learning can be built upon something we already know.
d. Learning takes place by doing. Before learning can become complete, we must put into practice what we are attempting to learn.
e. Successful learning stimulates more learning. Failure to learn and understand discourages further learning.
f. Learning is best accomplished when the learning environment is well managed. The classroom environment has to be made conducive for learning to take place.
g. One learns best when the content being presented is appropriate, relevant and appealing to more than one of these senses – sight, hearing, smelling , taste and touch.

The utilization of more than one of these senses will aid memory and enhance interest in the content being presented.

h. Learning requires motivation since interest is necessary for effective learning.
i. Feeling and emotions are strong incentives for learning.

Teaching techniques are the practices and refinements of presentation, which teacher employs to make instruction more effective, more interesting and easier when using a specific method for a lesson unit. Anyakoha (1994) and Ma'aji (2003) observed that for effective teaching of any skill activities, method and materials play an important role in facilitating the learner's achievement of objectives. Skill acquisition generally requires specialized instruction techniques in order to achieve maximum objectives. Assisting learners to learn is the ultimate goal of any instructional activity in both formal and informal education. In fostering learning in the classroom, teachers bring the learners in close contact with the curriculum contents using appropriate methods and materials to play key role in ensuring effective, interesting and stimulating learning, in the same vein, teaching methods may also hinder learning Ukoha & Eneogwe (1996).

Nwosu, (1998) pointed out that the effectiveness of the teachers contact with students depends upon the efficiency of the teacher in his usage of instructional materials made available for the purpose. One important but remarkable virtue in the use of instructional material is the concretization of knowledge manifested by the adage which says "seeing is believing", the senses of hearing, touch, smell and taste also dominate in knowledge acquisition, our belief is that for intended learner, effective use of instructional materials is one way through which the teacher can be successful in the class room endeavours.

Nwosu, (1998) also maintained that in education, instructional materials are some of the most important devices, which both teachers and students can use to enhance the quality of an

instruction. This is because the materials are seen by educators as facilitators of teaching and learning activities when properly used. There are so many instructional materials the teacher can employ to improve the quality of instruction. The proper selection of appropriate instructional material depends largely on the teacher's creativity and resourcefulness. According to Okorie (1979), instructional facilities are the things or objects brought into play by the teacher to emphasis or clarify instruction. Such materials include textbooks, posters, programmed instructions, print media, models, mock-ups, slides, audio and video tapes, chalkboard, projectors e.t.c

Salami, (2003) viewed teaching aid as any device or piece of equipment used to help student understand and learn, that is the devices of improvement of instruction. And this definition is only concerned with those, which are specially constructed for teaching instruction. In contribution to the view, Gagne and Briggs, (1979) regarded instructional facilities as a component organized by teacher to promote learning. He further stressed that it can be referred to any self-supporting material, which can be used by the teacher to present a complete body of knowledge.

Gyallesu, (1992) stated that, the success of any educational system no matter how well it is planned depends largely on the quality and quantity of teachers available in the system. Puyaye, (2002) added that, the availability and use of physical facilities for training in technical colleges also enhances the vital process of practical skills acquisition. This school objective cannot be achieved without the use of qualified and competent instructors. NPE(1988) acknowledges that, no education system can be successful without considering the teachers who operate it. So, to get good quality technical education, the Teachers, instructional materials and the teaching methodologies are important consideration if effective learning of practical skills must take place.

Methods of Teaching Technical Education

- Demonstration Method
- Guided Discovery Method
- Lecture Method
- Field trip Method
- Discussion Method
- Project Method

As any good teacher knows, all students do not learn in the same way. In addition, it is common for a class of students to be at a variety of levels in any particular subject. Teachers need to use different teaching methods in order to reach all students effectively. A variety of teaching strategies, knowledge of student levels, and an implementation of which strategies are best for particular students can help teachers to know which teaching methods will be most effective for a particular instruction. Onwuegbu (1979) "identified teaching method as consisting of recurrent instructional processes applicable to various types of subject matter and useable by more than one teacher".

A teaching method comprises the principles and methods used for instilling skills, knowledge and experiences on learner. These are the strategies used by the teacher to deliver his/her subject matter to the student based on pre-determined instructional objectives so as to promote student learning. A famous quote by Bulwer states that, "And without method, there will be neither organisation nor construction". Teaching which is the interaction between teacher and students under the teacher's responsibility in order to bring about expected

changes in the student's behaviour, have to be methodical, systematic and organized to produce the desired effect.

On methodology of instruction, (Atsumbe, 2001) stressed that for effective teaching to take place, skilled teachers need to use different methods and skilled techniques of teaching at his disposal. Okorie (1979) added that a careful and intelligent analysis of the educational objective will determine the method of instruction to be employed. Okorie further stated that a carefully designed teaching methodology can work wonders in making learning effective.

Nwosu (1998), outlined that, there are so many methods that are used in transmitting and sharing knowledge with learner, some of these methods are Demonstration, Guided discovery, Lecture, Field trips, Discussion, Excursion, Role-playing, Games and simulation etc. Despite the use of these methods, research has indicated that no method is superior to the other. What dictates the choice of a particular method depends on the nature of the content that is to be taught. Teachers by their training should be able to isolate a particular method they need for adequate impartation of knowledge to the learner, which will concretize the learning and make it permanent. According to Miller (2000), "Teaching methods which place student in an active situation for learning are more likely to be effective than those which do not". The choice of teaching method or methods to be used depends largely on the information or skill that is being taught, and it may also be influenced by the aptitude and enthusiasm of the students. Some of teaching methods employed in technical education are discussed below;

Demonstration Method

The basic idea behind the use of demonstration seems to be very similar to Gabriel de Tarde's theory of the instinct of imitations. According to Gabriel de Tarde, all new cultural traits

originate from one creative individual and are imitated by the crowd. It is simply the personal influence of one human being upon another. In the context of teaching and learning situation, a demonstration refers to a display or an exhibition usually done by the teacher while the students watch. It involves performing an act in the presence of the pupils either as a means of showing them how to do it themselves, or to illustrate a principle.

Demonstration method, from the time vocational and technical courses were introduced into the school subjects, has stood out to be a valuable means of instruction in skill-type subjects because it covers all the steps student's need to learn a skill in an effective learning sequence. Aina (1999) stated that "This is an objective method of presentation in which the teacher himself conducts the operation before the class and explains what he is doing as he proceeds". Demonstration is the basic method for introducing new skills to the learner. Action speaks louder than word is a common saying, and one that is of great importance in the teaching of new manipulative skills. (Ogwo and Oranu, 2006) defines demonstration as any planned performance by a vocational/technical teacher on an occupational skill, aimed at explaining the steps of an operation. The demonstration method of instruction provides a "clear picture" of a task that must be learned. Two of the greatest gifts of communication are the senses of sight and hearing. The sense of sight accounts for approximately 75 percent of what we absorb mentally and hearing accounts for 13 percent (Cenci and Weaver, 1968). The demonstration method makes explanations concrete by showing visually what the instructor is saying. The trainee sees the skill being performed and hears the explanation at the same time. This allows the trainee to relate the principles and theories to a practical situation. It is the process of teaching through examples or experiments. For example, a technology teacher may carry out an operation for his students; this can be used to prove a fact through a combination of visual evidence and associated reasoning.

Researchers have well documented the effectiveness of Demonstration method in Technical College. Hilda, (1989), posited that demonstration method of teaching has been the most common teaching method in technical education. This is easy to understand with the emphasis that comes in an activity programme based on manipulation to fabricate and service products with the materials and tools of industry. Commenting on the role of demonstration method in teaching practical courses, Nwoke (2004) stressed that, demonstration method is one of the most effective teaching methods used in technical education courses, it is possible for students to learn how to perform manipulative operations by reading or by being told how to do them, however, they can learn faster and more effectively when they are shown how the job is done.

Okorie, (1979) supported the adoption of demonstration method in teaching skills. He noted that this method is valuable to job trainers in industries; teachers of various trades and to many other trades where people want to learn skills. Demonstration method is the most widely used and principally accepted technique of teaching technical subjects, through demonstration the students assimilate through hearing and seeing what the instructor is teaching. Students enjoy and understand a lesson more if they are actively involved, as opposed to being passive spectators.

In demonstration method, sight rather than hearing is the major means of communication. It is useful in illustrating facts, reviewing a lesson, and showing methods and technique of doing something (Olatunji 1992). However, the major function of this method is to enable pupils develop skills that can be used to perform certain responsibilities e.g. Troubleshooting a faulty radio.

Baird, (1972) acknowledges the effectiveness of Demonstration in the teaching of technical/vocational education courses, and that it shows students exactly what is to be done,

why it is done in a certain way, how to do it, and how to apply the skill or procedure that is essential to completing a given task. According to Urevbu (1990), demonstration is an approach of instruction which combines presentation and investigation. The purpose behind this approach of instruction may be outlined as follows:

- Tools and equipments are introduced to the student in such a way that he is able to understand its uses and limitations
- The student is encouraged to adopt by imitating the correct methods of use of the equipment.
- To help the teacher illustrate how a process, procedure, or experiment can be carried out so that the student will acquire the knowledge and skills involved.
- Time is saved and the number of teaching staff required to provide individual workshop instruction is reduced.
- To help a teacher teach and illustrate concepts and principles and their applications to the class.
- To serve as a standard for evaluating the performance of students as they perform an activity.

During the application of demonstration or "doing" method to teach skills, the instructor is allowed to demonstrate, step-by-step, the procedures in a job task, using the exact physical procedures if possible, while the instructor explains the reason for and the significance of each step. Barton & Glenn (1997) declared that demonstration method will be efficient if the demonstrator does the following:

- Has all the equipment and materials in place;
- Check the operation of all equipment just before demonstration starts;

- Explain the goal of demonstration at the beginning;
- Allows the learners to try out the demonstrated skill at the end of each step;
- Provide an unobstructible view for all the student;
- The instructor should plan and practice the skill that will be presented to avoid confusion;
- Encourage student to ask questions.

If all this requisite requirements is met by the demonstration, it will immensely aid in knowledge acquisition, especially electrical installation students in acquiring of practical skills. Berkey (1975) explains that a good demonstration exercise helps student to understand the lesson very clearly and draws students nearer to achieving learning objective faster, since they combine the senses of sight, hearing and touch while learning. Therefore it is a good technique for teaching concepts, principles or real things by combining oral explanation with the handling and manipulation of real things.

Ogwo & Oranu (2006) highlighted the role of the Teacher in Demonstration:

- Position the students and training aids properly to provide an unobstructed view.
- Show and explain the operation sequentially.
- Observe safety precautions.
- Give proper attention to terminology and list all the names of parts.
- Check student comprehension carefully.

According to the law of Primacy, when applying demonstration method, steps must proceed from simple to complex in a logical sequence so as to achieve the objective of the instruction. ‘Believing through seeing’ and ‘learning by doing’ accomplished through demonstrations help Electrical installation students in skill acquisition. This process arouses interest and

improves the adoption, because it is based on the principles of 'learning by doing' and 'seeing is believing'. Demonstration is a good way to show how things work, how to do the work, principles involved in an operation and to show the end results of the technology or methodology adopted. On the basis of purpose for which demonstration is conducted, it can be in the form of class demonstration, small group and individual demonstration.

Why Demonstration Method?

As technical colleges move closer to the goal of providing technical education for all children, increasing amounts of attention and energy are being devoted to developing pedagogical approaches that are appropriate in heterogeneous classrooms. The demonstration method, when properly used, may revolutionize education. According to Esomonu (1998), Demonstration is most likely to be successful in teaching;

1. manipulative and operative skills;
2. In developing understandings;
3. In showing how to carry out new practices and;
4. In securing the acceptance of new and improved ways of doing things.

Makama (1988) stated Advantages of Demonstration method as:

1. Demonstrations attract and hold attention; it simulates learner's interest in the learning process.
2. Demonstration present subject matter in a way that can be understood easily. They make clear what might otherwise be vague and meaningless.
3. They convince those who might otherwise doubt that a thing could be done, or they themselves could do it.

4. As one experiment can be demonstrated to a large number of students, thus teacher find it time saving to make use of this method.
5. The demonstration method is objective and concrete.
6. As students get opportunities to ask various kinds of questions from the teachers on basis of their observation, thus, this method promote relevant and useful discussion in the class.
7. Demonstrations permit the teaching of theory along with practice. They show by example the practical application of knowledge.

Barton & Glenn (1997) also stated some limitations in the use of demonstrations:

1. Good demonstrations are not easy to find. Considerable skill on the teacher's side is required to give a good demonstration.
2. The demonstration method is restricted to only certain kinds of teaching situations. Some leaders try to use it where other methods would be better.
3. The "result" type of Demonstration may take considerable time and be rather expensive.
4. As number of student is generally found to be very large in the classrooms, thus, all the students do not get opportunity to play an active role in learning process and a large number of them cannot even touch the apparatus, which are used by the teacher.
5. Demonstration may require a large amount of preliminary preparation.
6. When the teacher alone does the demonstration, students are denied manipulative skill and this reduces student's achievement.
7. Visibility is a problem especially in large classes.

Aina (1999) emphasized that demonstration is the teacher's greatest aid in training students in fundamental skills and practices in the shortest possible time. For example the student of

Electrical Installation technology can best learn soldering of wire joint by watching expert perform the task. The teaching will achieve it desire objective if the instructor emphasizes on correct performance, explain the processes sequentially and shows the students what to do or look for, while performing the task. Demonstration method plays a prominent role in technical training. It makes student's remember more of what they learn, trains the student's to be good observer, encourages active participation and it is very effective as an introduction to skill learning.

Guided Discovery Method

Traditional approaches to training concentrate on memorizing facts and procedures rather than actively solving problems. This tends to produce learners who know the right answers to questions but who do not understand the relevance of the facts or the underlying concepts required to solve new problems. In contrast, teaching by problem-solving aims to use real-world contexts that require the learner to actively apply knowledge. The Guided discovery method is popularly known as problem solving method. This is because it is used to develop problem-solving skills in learners. It offers students the opportunity to practice those principles and method needed for solving new problems, develop originality, apply old concepts to learn new concepts and strengthen the student ability to work independently and also build self-confidence. Guided discovery instructional method is a constructivist teaching approach that can be employed in problem solving. It enables students to use their mental process to meditate, and or find out things for themselves with subtle guidance from their instructor.

Constructivism is a theory that suggests that learners construct knowledge out of their experiences which is associated with pedagogical approaches that promote learning by doing or active learning (Afolabi & Akinbobola, 2009). This theoretical framework holds that

learning always builds upon knowledge that a student already knows; all knowledge is constructed from a base of prior knowledge. Students are not a blank slate and knowledge cannot be imparted without the learner making sense of it according to his or her current conceptions. Therefore students learn best when they are allowed to construct a personal understanding based on experiencing things and reflecting on those experiences; this prior knowledge is called a schema, because all learning is filtered through pre-existing schemata. Constructivist teaching focuses on independent learning, creativity, critical thinking and problem solving. Constructivist teaching is based on the fact that skills and knowledge acquisition are not by passive receiving of information but involves active participation of the learners through knowledge construction, hand-on and minds-on activities (Akinbobola & Ado, 2007). The purpose of learning is for an individual to construct his or her own meaning, not just memorize the "right" answers and regurgitate someone else's meaning. Constructivists suggest that learning is more effective when a student is actively engaged in the learning process rather than attempting to receive knowledge passively. Teachers role in constructivist teaching is to serve as facilitator of learning in which students are encouraged to be responsible, autonomous and construct their own understanding of each of the scientific concept, hence the activities are learner-centered, democratic and interactive. A wide variety of teaching methods claim to be based on constructivist teaching theory, this includes, Discovery method (Guided discovery and Unguided discovery); Inquiry-based method; Problem-based method; Experiential method etc. Most of these methods rely on some form of guided discovery where the teacher avoids most direct instruction and attempts to lead the student through questions and activities to discover, discuss, appreciate, and conceptualize the new knowledge.

Guided discovery was developed by Dr. Charles E. Wales at the Center for Guided Design, West Virginia University (Leutner, 1993). Guided discovery has been found to be an effective

constructivist teaching method (Veenman, Elshout, & Busato, 1994). This method stimulates group interaction and is challenging enough to force students to use resources beyond what are available in the classroom. Menn (1993) evaluated the impact of different instructional media on student retention of subject matter. It was found that students remember only 10% of what they read; 20% of what they hear; 30%, if they see visuals related to what they are hearing; 50%, if they watch someone do something while explaining it; but almost 90%, if they do the job themselves even if only as a simulation. In other words, guided discovery that are properly designed and implemented could revolutionize student's acquisition of practical skills in Electrical installation. Jooligen(1999) stated the three pedagogical aims of guided discovery method as to:

1. Promote "deep" learning;
2. Promote meta-cognitive skills (develop problem-solving skills, creativity, etc.);
3. Promote student active engagement.

Nwagbo (1999) explains that in the guided discovery mode which is an example of constructivist teaching method is an approach to enquiry, in the sense that, the teacher provides illustrative materials for students to study on their own. Leading questions are then asked by the teacher to enable the students think and provide conclusion through the adoption of scientific skills such as observing, classifying, measuring, communicating, questioning, controlling and manipulating variables, hypothesizing, formulating models, designing experiments and interpreting data.

Guided discovery is a learner–centered approach; hence it is called a heuristic method. Its various components are problem identification, learner self awareness, reasoning, method of seeking evidence and deliberation (Glaserfeld, 1996). It is characterized by convergent thinking. The instructor devises a series of statements or questions that guides the learner,

step by step, logically, making a series of discoveries that leads to a single predetermined goal. In other words the instructor initiates a stimulus and the learner reacts by engaging in active inquiry thereby discovering the appropriate response. Mosston (1972) specifies ten cognitive operations that might take place as the learner engages in active inquiry: recognizing, analysing, synthesizing, comparing and contrasting, drawing conclusions, hypothesizing, memorizing, inquiring, inventing, and discovering. By actively doing and consequently discovering facts or concepts, the learner will understand and therefore remember the subject matter. In order for students to construct their own meaning, they must be allowed to independently discover the concepts and knowledge, and then make this understanding their own. This method of discovery is well suited for teaching technical education.

Guided discovery method of teaching encourages students to look beyond the available facts, endeavour to understand the relationship between one idea and another, and to attempt to relate new ideas to what had already been learnt. It also encourages learners to search actively for how to apply rules and makes sure that the learner comes into contact with the rule to be learned (Mayer, 2003). The important consideration in this method is that the pupil ensures that each new information or knowledge that is provided makes some meaning to him or her. It discourages memorization of facts and advocates for active participation in activities that will help him to establish facts through observation.

According to Spencer (1999), key features of guided discovery are:

- A context and framework for student learning through the provision of learning outcomes;
- Learners have responsibility for exploration of content necessary for understanding through self directed learning;

- Study guides are used to facilitate and guide self directed learning;
- Understanding is reinforced through application in problem oriented, task based, and work related experiences

Jerome S. Bruner contributed immensely to the development of discovery method, according to Brunner (1961), teaching by guided discovery implies disposing the student to find out events and phenomena with the teacher giving away little information to the pupils. The teacher only initiates the approach and the students formulate hypotheses that are likely to lead to the solution of the problem. This method can enhance the learner's autonomy since appeal is made to the learner's independence in finding out things for themselves. It will also review and confirm knowledge presented to them. The discovery method is based on the notion that learning takes place through classification and schema formation (Gallenstien 2004). The three main principles that guide Bruner's development of the discovery approach are stated below:

1. Consideration should be given to "experiences and contexts" that motivate the student's interest.
2. There should be a spiral organization of the material forcing students to build upon previously acquired information.
3. The instruction should "facilitate extrapolation".

Guided discovery is strongly tied to problem solving (or learning how to solve problems under a more meta-cognitive perspective): "Learning theorists characterize learning to solve problems as Discovery learning, in which participants learn to recognize a problem, characterize what a solution would look like, search for relevant information, develop a solution strategy, and execute the choosen strategy"(Borthick & Jones, 2000)

In Guided discovery teaching approach, the instructor guides the student's thought process by posing a series question or problems designed to introduce a general concept (Mayer, 2003),

i.e. gives general principles that can lead to solving a given problem without providing the solution to the problem. This phenomenon is in contrast to the Unguided or Pure discovery where the teacher neither gives general principles nor solution to the students. In guided discovery, “Student’s act as detectives as they solve concept-attainment activities in stimulating learning environments. In doing so, they place a newly introduced object in a category that they have previously discovered or identified (Gallenstien 2004). This teaching method is believed to increase retention of material because the student organizes the new information and integrates it with information that has already been stored.

Merits of Guided discovery approach according to Brown, George & Atkins (1988) includes:

1. Supports active engagement of the learner in the problem solving process.
2. Fosters curiosity
3. Enables the development of lifelong learning skills
4. Personalizes the learning experience
5. Highly motivating as it gives student’s the opportunity to experiment and discover something for themselves
6. Builds on learner's prior knowledge and understanding
7. Develops a sense of independence and autonomy
8. Make them responsible for their own mistakes and results
9. Develops problem solving and creative skills by better understanding of concepts and ideas.

Limitations in the use of Guided Discovery approach according to Brown, George & Atkins (1988) includes:

1. Not suitable for teaching a large number of facts concisely and efficiently
2. Without proper teacher guidance students may learn incorrect info.

3. (Sometimes huge) cognitive overload, potential to confuse the learner if no initial framework is available,
4. Measurable performance (compared to hard-core instructional designs) is worse for most learning situations.
5. Creations of misconceptions ("knowing less after instruction")
6. Weak students have a tendency to "fly under the radar" and teachers fail to detect situations needing strong remediation or scaffolding.

Hint for Effective Utilization of Guided Discovery Method

Nwokocha & Osuji (2008) hinted on how Guided discovery can be effectively utilized:

1. Guided discovery method should be undertaken with small groups for proper guidance and supervision.
2. Discussion strategy to be adopted prior to the guided discovery lesson in order to sensitize the students on what to look for.
3. Free discovery should be exposed to classes that have widespread of abilities among students, that is, those pupils who are intellectually endowed or gifted.
4. The teacher should provide class discussion at the end of the discovery lesson to cater for questions based on student's activities.

A learner is active in guided discovery learning because it provides for individual differences as well as makes the process of learning to be self-sequenced, goal directed, and the pace self-determined (Ugwuanyi, 1998). Nwagbo (1999) believes that if the learner is allowed to discover relationships, make his own generations and draw conclusions, he would be better equipped to make wider application of the knowledge or skill acquired in meeting the needs of the society and country at large.

Lecture Method

The lecture method is an age long teaching method which involves talking to students about a topic or theme. According to Aguakagbu (1994), lecture belongs to the information processing models of teaching and it involves the teacher telling student facts about a particular topic and expecting the student to memorize what they are told. Lecture is the most common method of teaching in universities and colleges throughout the world in this 21st Century.

Lecture method is essentially the method of teaching outside manipulative work. It is the method whereby the teachers transmit information verbally to the students; sometime it involves writing on the chalkboard or using instructional materials. The students listen and take notes of facts and ideas that are considered important. Sometimes the students are allowed to ask questions for clarification. In vocational and technical education the lecture method is useful provided its place and function are known and appreciated. It advantages according to Okoro (1993) are as follows:

- Provide aesthetic pleasure;
- Awaken critical attitudes in student; and
- An important mode of communication both in classroom

Akinseinde (1998) is of the opinion "that the lecture method is well suited for creating students interest in a subject, helping students to clarify and gain better understanding of the subject matter, organizing and systematizing knowledge".

In the lecture method, the teacher or some other knowledgeable person supplies information to the students. There is very little student participation. Ogwo (1996) described lecture method as a method that is based on the traditional viewpoint that the teacher is an embodiment of knowledge and it is thus the responsibility of the teacher to dish out or discriminate the knowledge to the learners who are supposedly ignorant and blank. Generally

speaking students and lecturers seems to like lecture method although student do comment frequently on poor lecturing technique. Student's main dissatisfactions with lecture appear to be inedibility, incoherence, failure to pitch at an appropriate level, failure to emphasize main points, different in taking notes, reading along from notes.

According to Ogwo (1996) when using lecture method, teachers launch into monologues when giving examples, explaining concepts, pointing out relationships and as such, the method has been severally criticized by educators. He further said that the method violates the teachers and learners interaction essentially for learning to take place. The intellectual passivity and weariness of the listeners and lack of discussion have said to be a contradiction to the process of free flow of information and exchange of ideas which learning demands (Ogwo, 1996). In lecture problem solving skill appears to be taught more efficiently in small groups. However, the result depends upon the quality of lecture. The teacher should resist the temptation to give lengthy lectures since such lectures are usually dull and are incapable of stimulation and sustaining the interest of the learner.

According to Ukoha & Eneogwe (1996), the major setbacks of Lecture method are;

- Lack of discussion
- Weariness of learner
- Lack of interaction
- Lack of feedback

Shield (1996) condemned lecture method on the ground that the transfer of knowledge by didactic exchange leads to the acquisition of low level facts and knowledge which is far below what is required in this complex technological dispensation. Moreover Shield pointed out that due to the lack of quality time and understanding of the lessons, teacher often feed the students with established solutions to their problems thus making them docile. Aguakogbu

(1994) added that lecture method does not consider the learner's prior knowledge, does not facilitate recall of facts and there is sometimes no room for questioning teacher. He further identified more deficiencies of the lecture method such as student learn through memorization rather than induction, the instructional procession focused on the didactic telling.

Okoro (1999) stated that the lecture method however has its use in large classes, in advanced courses and when a lot of technical information has to be passed to the students. Ogwo (1996) added that the lecture method has been found to be suitable in teaching when the purpose of the lesson is to discriminate information; the material is scarce and cannot be readily sourced by the learners; The materials must be organized and presented in a particular way for a specific group of learners; the content of the lesson needs to be remembered for a very short period of time and when there is need to introduce contents to be executed using other methods combined with lecture.

Ukoha & Eneogwe (1996) maintained that it is very good for a large number of students, makes for easy coverage of the syllabus, saves time and that lecture method encourages self study which is essential for setting out course objectives and also develop students note taking, listening and summary writing skills. He further stressed that Practical skills are obviously taught more effectively in laboratories but the underlying methodologies and theories may be taught effectively and perhaps more efficiently with a lecture.

Field Trip Method

If students are to grasp and retain what they are being taught, they must be exposed to practical learning experiences which will broaden and deepen their understanding of a topic or topics on syllabus. One way of achieving this is by employing field trip method of teaching. This method is learner-centered where students' participation and involvement help them to gain first-hand experiences outside the classroom.

Field trips is learning-oriented which offers students opportunity to study industrial processes and relate what they learn in the school with what actually obtains in the world of work. Learning provided by field trip therefore is concrete, sensory and basic. This is because students are provided with opportunities to see and observe things, places, people and processes in real-life settings. However, it is important to note that field trip should be embarked upon only if it fully developed with a clear objective for the student. This implies that before students are taken on field trip, they should be informed of the objective of the field trip and what they are supposed to observe and learn. Furthermore, after the field trip teachers should request the student to submit report of what they have learnt and this should be discussed in the class.

According to Maduabum (1989), the field trip promises rewarding educational experiences when properly planned and organized.

1. It provides students with direct first-hand experiences. This implies that the students learn practically.
2. The experiences gained during field work are vivid, lasting and more concrete to the students because they are real-life situations.
3. It help develops in students aesthetic appreciation of nature and the attitudes they adopt towards natural events and phenomena.
4. It helps to develop an enquiring mind, by giving student opportunities to observe and study something which cannot be brought to the class.

Discussion Method

Discussion method of teaching is one of the most widely used methods of teaching in the technical education. It is a learning process which requires team work among learners. The

method is based on the principles that knowledge and ideas of many people have greater merit than that of a single person.

Discussion approach is a predominantly interactive process involving a multiple – flow of communication between the teacher and the pupils and from one pupil to another. Interaction centers on problems and questions with the teacher directing affairs towards the lesson objectives. The teacher is a facilitator who encourages the pupils to discover things for themselves. Children learn through active participation and involvement in the lesson. It provides opportunities to clarify one's own values and make informed decisions about issues.

Being an interactive process, it aids the teacher toward a better understanding of his pupils. The pupils on their own side gain knowledge and understanding as they see relationships among their learning experiences. This development of generalizations has several names in education such as insight, inquiry and discovery learning. One of the most desirable aspects of the discussion method is that it helps the pupils to develop logic through comparison with their peers. By expressing concepts, asking for clarification and engaging in argumentation, their understanding becomes sharper and more accurate, this is the real value of discussion method. It also promotes inquiry and provides good practice for problem – solving.

Discussion method is preferable to the lecture method because it entails full student participation. It gives forum to contribute their knowledge on the topic before the teacher summarizes the opinions expressed. Akinseinde (1998) agreed that discussion method as a method of instruction is an organized system of interaction between the teacher and learners for the purpose of achieving specific instructional objectives. Discussion method is for examining a problem or topic using group participation to reach a solution. It involves sharing of ideas, information, attitudes and experiences. It encourages everyone to get involve and participate in the learning. It leads to cross fertilization of ideas between teachers and among students themselves. Discussion method also provides for students involvement, which in turn

helps to stimulate and reinforce learning. He further states the merits of discussion method as a method of instruction. They include, among others:

1. Because the learners exchange diverse views and opinions, this method promotes the values and process of a democratic society;
2. It promotes critical thinking in addition to other cognitive objectives;
3. The method is effective for training learners for attitudinal changes because beliefs, feelings and dispositions are expressed freely towards a topic;
4. The method encourages problem solving through the group with bold criticisms while generating solutions. Finally the group will critically discuss the solutions one after the other and finally settles for the best solution; discussion method encourages the acquisition of communication skills.

Project Method

Project method of teaching is one of the approaches of teaching which involves purposeful learning activity that is usually based on interest and undertaken by an individual or small group. It is one of the most effective ways of arousing interest in students under the guidance of a teacher. According to the Learning Pyramid students learn a little by listening, a little more by watching but learn more by actually doing the piece of work. This method exposes the pupils to real life situation by finding facts and meaning of concepts (gaining first hand information) by themselves.

According to Hornby (2004) “project means a piece of work that is organized carefully and designed to achieve a particular aim”. Project is a learning activity selected, planned, designed and executed by learners collectively or individually to clarify facts, acquire new knowledge, skills , appreciation and to solve identified problems under the teacher’s guidance and supervision (Ukoha & Eneogwe, 1996). It is a problem solving approach to learning. The teacher assigns an individual or a small group to a specific task that involves creating, doing

or experimentation. The project method is a cooperative study of real life situation by class or little group. Project method is the teaching method also used in teaching technical subjects though it is seldom used. However it is meant to help learner to think and decide things for himself. Project could be in form of practical exercise skills and fully supervised by the teacher. It allowed a direct perception and helps the formation of concrete ideas, because almost all sense organs take part in the practical skills and habits for operating skill and equipment. They also have a moral satisfaction from the positive result (Saba, 2010).

The project method provides opportunities for pupils to carry out investigation on their own thereby providing greater understanding of how to learn. A time unit is usually given within which the pupils are expected to complete the task. The method enables the pupil take his own initiative and find out things for himself. The pupil takes up the responsibility for which he can accept success or failure. Project method provides a workable means for caring for individual differences. Group work gives opportunities for socialization and development of leadership skills in the pupil. Children acquire new skills and attitudes and those with special abilities have the opportunities to fulfil themselves.

As stated by Knoll (2004), project has four phases which includes: Proposing; planning; executing; and judging. The ideal progression is when all the four phases are initiated and completed by the students. The project is often derived from the course content to reinforce abstract learning and develop skills in the use of equipment, tools and materials. The construction of a project requires the students to apply the knowledge and skills he has learnt in the course. The teacher guides the student and provides assistance whenever it is required.

Project method has the following advantages:

1. It fosters co-operation among the learners, leading to the acquisition of co-operative work skills.

2. It unifies knowledge from the various fields of disciplines thereby enabling learners to see the relationship between them and their practical applications in life.
3. It encourages freedom of expression and creativity.
4. It is an excellent method for the acquisition of problem solving skill and rational thinking.
5. The method motivates and challenges the learner as they work toward the stated purpose.
6. It offers students first hand experiences.
7. Motivation to work is high since it is based on natural interest and ability of the student.
8. It encourages good leadership in students.

Limitations of project method

1. It is time consuming for both the instructor and the students.
2. The students often get sidetracked especially when they lack a deep grasp of facts necessary to carry out the task are above their intelligence. This may lead to frustration.
3. Instructors on their own part may be strained because of the advice and guidelines they have to offer to the pupils especially when the class size is large.
4. The project method of instruction favours the independent students more, student without independent study skills often suffer.

Retention and Academic Achievement

Students' achievement connotes academic performance in school subject as symbolised by a score or mark on an achievement test. According to Anene (2005), students' academic achievement is quantified by a measure of the students' academic standing in relation to those

of other students of his age. Atherson (2003) contended that students' achievement in teaching and learning is determined by several factors among which are teachers' attitude and enthusiasm, instructional methods, learning environment as well as students' attitude and background. Teachers with good teaching techniques challenge students to verbalize their knowledge and thinking (articulation) at higher intellectual level.

Momoh-Olle (1997) defined retention of learning as the repeat performance of a learner of the behaviour earlier acquired after an interval of time. Retention is the preservative factor of the mind (Kundu and Totoo, 2007). Whatever touches consciousness leaves trace or impression and is retained in the mind in form of images. Boyle, Duffy and Dunleavy (2003) posited that students' retention in learning is determined by factors such as teachers' ability, motivation, interest, meaningfulness of subject matter, methods of instruction, memory capacity of the learner among others. Many educators (Baryman, 1999) have discovered that sociological element of contextual learning are relevant for promoting achievement, retention and skill performance.

Britain (2006) reiterates that for successful teaching to occur, a variety of pedagogical approaches that focuses on providing activities for learners to perform either in group or individually that helps to create deeper, swifter and more effective learning should be applied in order to improve students achievement and retention. This is in line with the Learning Pyramid, which revealed that retention rate increased with the amount of student engagement in Learning Process. Learning activities built on prior knowledge, motivate students and foster their interest in their effort to executively control their own cognitive process that could lead to their academic achievement, retention and skill performance.

Gender and Academic Achievement

Gender is relative terms that stress the roles and responsibilities of males and females (Okeke, 1999). According to Lee (2001), gender is an ascribed attribute that differentiates feminine from masculine socially. Gender could therefore, be defined as a cultural or societal way of ascribing attribute which differentiates feminine from masculine. The difference in academic achievement due to gender difference is a crucial matter to the educationists.

In the last two decades, tremendous efforts have been expended in the study of the personal factors affecting academic achievement especially in sciences, technology and social sciences. Notably among these variables is the study of the phenomenon of sex or sex equity in education. A rich harvest of explanation of causes, understanding of cost to the society and possible interventions has brought about several researches, workshops, seminars and training in this area, out of which this study is one. Improvements in data collection and analysis have permitted the construction of larger and fuller pictures of educational provision, access and performance in Nigeria (Gender Training Manual, 1999). Just as improved database have provided better pictures, much research effect have illuminated a myriad of personal factors influencing the achievement of students in Electrical Installation work. Onuebunwa (2000) observed that sex related problems have contributed greatly to the creation of sex impotence in the society by providing unequal opportunities for males and females from childhood to adulthood. Sex is a term that socially imposes division between sexes and corrects the emotional and psychological attribute which a given culture expects to coincide with physical maleness or femaleness.

According to Akin-Aina (1999), discussions about inequality between man and woman are not a feature of this country. Although the arguments have been on for five centuries but the 20^{th} century definitely stands out as the water shed for the global transformation of sex relations between the sexes. This is on account of the long and impressive list of actions

taken in the service of sex equality. The needed advocacy in gender is getting girls to compete with boys in mathematics, science and technology related areas.

In the recent time the gender factor has assumed prominence in science, vocational and technical education discourse. It has been documented that disparity exists between male and female students performances in these disciplines. In some cases boys had an edge over girls in academic achievement (Achabe, 1979). Dyankor (1996) however noted that in some countries in conformity with certain traditions, technical and vocational education is regarded predominantly for boys only and that attempts are being made to facilitate girls' attendance in technical and vocational institutions. This tradition of sex biased technical education still exists in Nigeria. Women have little or no access to some programmes.

The trend now is for people to pay attention to educating the female child in Nigeria. It is now a common saying that "what a man can do, a woman can do better". Therefore, it will be fruitful exercise to look at whether sex of students has effect on their academic achievement when taught with either Demonstration or Guided discovery instructional method.

Summary of Reviewed Literature

In summary, the literatures revealed that the development of Technical education in Nigeria is slow compared to other forms of education in Nigeria and stated further the main purpose of technical education in technical college as to prepare students for entry into various occupations. The review also provided evidence that several factors are responsible for the astronomical decline in student's academic achievement in trade subjects including Electrical Installation works; in which inappropriate teaching methodology constitutes the major problem faced in technical colleges. Literature further reviewed the various methods of teaching used in technical education. The literature revealed that students graduating from

technical colleges in Nigeria are not adequately equipped with knowledge and skills necessary for them to effectively perform in workplace. This deficiency in the competence of technical school graduate in electrical installation work has contributed to unemployment in the society.

The review emphasized on the need for a change in methodology in teaching electrical installation work in technical colleges if the aim of technical education is to be achieved. The various literatures suggested the use of problem solving techniques of teaching, in which they stressed on the use of method that promotes active student engagement in class in which Demonstration and Guided discovery approach are best suited in practical skill instruction. The review provided reasons for selecting demonstration and guided discovery instructional method, it various limitations and why it should be adopted in technical college. The literatures revealed the effect of gender on student academic achievement and retention in technical education. It was noted that learning is more effective when two or more senses are involved in learning process. The review further suggests hints to effectively utilize both teaching approach discussed in this research. The various literatures reviewed failed to provide information regarding the comparative effectiveness of demonstration and guided discovery approach on student achievement in Electrical installation in technical college therefore making the research inconclusive, hence the need to carry out this study become apparent.

CHAPTER III

METHODOLOGY

This chapter deals with the method employed in carrying out this study under the following sub-headings; Research Design, Area of The Study, Population, Sample, Instrument for Data Collection, Lesson Plan Development, Validation of Instrument, Administration of Instrument And Method of Data Analysis.

Design of the study

The study adopted the quasi-experimental design. Specifically, the Pre-test and Post-test control group design with experimental and control group was used. This design implies that intact classes were used for the study. This research design was adopted because it was not possible for the researcher to randomly sample the subjects and assign them to group without disrupting the normal academic programme of the schools involved in the study (Ali, 1996). The design is presented as follows:

Ge 0_1 X 0_1 0_1

Gc 0_1 Y 0_1 0_1

Where:

Ge = Experimental group

Gc = Control group

0_1 = Pre-Test, Post-Test and Retention-Test on Students in both groups.

X = Treatment with Guided discovery method

Y = Treatment with Demonstration method

Area of the Study

The study was carried out in Niger state. According to National Board for Technical Education (NBTE), Niger state has seven (7) registered and approved Technical colleges, these includes: Government Technical college, Minna; Government Technical College, Bida; Government Technical College, Kontagora; Federal Science Technical College, Shiroro; Government Technical College, New Bussa; Mamman Kontagora Technical College, Pandogari and Suleiman Barau Technical College, Suleja.

Population

The population comprised of 158 students (153 Males and 5 Females) in Technical two (TC II) offering Electrical installation work in Government Technical College, Minna and Government Technical College, Suleja. The population is composed of 93 students from GTC Minna and 65 students from GTC Suleja. (See appendix E).

Sample

A purposive sampling technique was used to sample only two schools to be used for the study. These two schools were chosen because of their proximity to each other and also these areas posses all the necessary facilities like well equipped workshops, conducive classrooms and personnel needed for carrying out the research. Since the populations of the students in

these schools were not much, the entire students in Technical two (TC II) offering Electrical installation work were involved in the study. 93 students from Government Technical College Minna served as control group and 65 students from Government Technical College Suleja served as experimental group.

Instrument for Data Collection

The Domestic Installation Achievement Test (DIAT) was used as instrument for data collection. The Domestic Installation Achievement Test (DIAT) comprised of 40 multiple choice items for the pre-test and post-test. This instrument was developed by the researcher for data collection. (See Appendix C)

Lesson Plan Development

The lesson plans for Demonstration and Guided discovery approach were developed by the researcher through the consultation of various text books on Electrical Installation and Maintenance works in Technical College level. The curriculum and course specification provided by the National Board of Technical Education (NBTE) were also strictly adhered to in the course of developing the lesson plans. (See Appendix B)

Validation of the Instrument

The Domestic Installation Achievement Test (DIAT) was validated by lecturers from the Department of Industrial and Technology Education from Federal University of Technology, Minna and Department of Electrical Installation and Maintenance Work in Government

Technical College, Minna. Observations and comments were made on the appropriateness of the test items.

Administration of the Instrument

The pre-test was first conducted before the commencement of treatment. These exercises provided baseline data that was used to compare subjects in the both groups. The Guided discovery and Demonstration method emphasizes on student's active participation in their learning process, practical hand-on activities, connectedness of the lesson to real work situation and students assessment of themselves. The experimental group and control group was taught for six (6) lessons using the prepared lesson plans. Each lesson lasted for 60 minutes and the contact session was once a week. At the end of the treatments, a Post-test was administered on both groups with the Domestic Installation Achievement Test (DIAT) and the scores obtained from both groups were compared to determined if there was any significant difference in the achievements of the two groups**.** Furthermore, a Retention-Test was administered at a later date, to determine their retention level.

Method of Data Analysis

Research questions were analyzed by Mean and Standard deviation while Analysis of Variance (ANOVA) was used to test the hypothesis at 0.05 level of significances.

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

This chapter presents the analysis of data collected for this study. The presentations and analysis is done in tables and arranged according to the research questions and hypothesis formulated for the study.

Research Question 1

What is the difference in mean achievement of students taught Domestic Industrial Installation using Demonstration method and those taught using Guided Discovery method?

Table 1

Mean of Pre-test and Post-test Scores of Experimental and Control group in Achievement Test.

Group	N	Pre-Test Score		Post-Test Score		Mean Gain
		$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$
Experimental	65	54.86	9.15	67.71	7.65	12.85
Control	93	55.03	8.91	67.45	9.05	12.42

The data presented in table 1 indicates that the Experimental group had a mean of 54.86 with a standard deviation of 9.15 in the Pre-test and a mean of 67.71 with a standard deviation of

7.65 in the Post-test, making a Post-test Pre-test gain of 12.85. On the other hand, the control group had a mean of 55.03 with a standard deviation of 8.91 in the Pre-test and a mean of 67.45 with a standard deviation of 9.05 in the Post-test, making a Pre-test Post-test gain of 12.42. The data revealed that there is no significant difference between the groups in the pre-test; hence both groups could be treated as having equal entry behaviour before the treatments. Also, there is no significant difference in the achievement of both groups in the Post-test, hence the two groups performed equally after the treatments, hence Guided discovery and Demonstration method could be treated as having equivalent effect on student achievement in Domestic Installation.

Research Question 2

What is the difference in the retention scores of students taught Domestic Industrial Installation using Demonstration and those taught using Guided discovery method?

Table 2

Mean and Standard Deviation of the Post-Test and Retention Scores of the Experimental Group Using Guided Discovery and the Control Group Using Demonstration Method.

Group	N	Post-Test Score		Retention Score		Mean Gain
		$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$
Experimental	65	67.71	7.65	67.74	7.21	0.03
Control	93	67.45	9.05	67.82	9.02	0.37

The data in Table 2 shows that Experimental group had a mean of 67.71 with a standard deviation of 7.65 in the Post-test and a mean of 67.74 with a standard deviation of 7.21 in the Delayed Post-test (Retention test), making a mean gain of 0.03. On the other hand, the control group had a mean of 67.45 with a standard deviation of 9.05 in the Post-test and a mean of 67.82 with a standard deviation of 9.02 in the Delayed Post-test, making a mean gain of 0.37. On retention, the mean gain of the control group is slightly higher than that of the

experimental group, but this difference is insignificant. It is clear that there is no significant difference between the retention score of students taught Domestic Installation using Guided discovery and those taught using Demonstration method. Hence, both methods can be concluded to have retention ability for student offering Domestic Installation in Technical colleges.

Research Question 3

What is the difference in the achievement of male and female students taught Domestic Industrial Installation using Demonstration and Guided Discovery method?

Table 3

Mean of Pre-Test and Post-Test Scores of Male and Females of the Experimental and Control Group.

	Guided Discovery				Demonstration		
Gender	N	Pre-Test	Post-Test	Mean Gain	N	Pre-Test	Post-Test	Mean Gain
Male	62	54.89	67.71	12.82	91	55.11	67.47	12.36
Female	3	54.33	67.67	13.34	2	55.50	67.50	12.0

Analysis of the data in Table 3 indicated that in the Experimental Group (Guided Discovery), the Males had a mean of 54.89 in the Pre-test and a mean of 67.71 in the Post-test, making a Post-test Pre-test gain of 12.82 while the Females had a mean of 54.33 in the Pre-test and a mean of 67.67 in the Post-test, making a Post-test Pre-test gain of 13.34. On the other hand the Control group (Demonstration), the Males had a mean of 55.11 in the Pre-test and a mean of 67.47 in the Post-test, making a Post-test Pre-test gain of 12.36 while the Females had a mean of 55.50 in the Pre-test and a mean of 67.50 in the Post-test, making a Post-test Pre-test gain of 12.0. The mean gains of males in the experimental group is slightly higher than that of the control group. Also the mean gains of the females in the experimental group is slightly

higher than their counterpart in the control group. Although these differences are not high enough to be deemed significant. The differences in their gains could be attributed to sampling error. It is however clear that there is no significant difference between the Post-Test mean scores of males and females in both the Experimental and Control Group. Hence, these findings afforded us the premise to conclude that gender differences has no effect on students achievement in the use Guided discovery and Demonstration method in teaching Domestic Installation in Technical colleges.

HO_1

There is no significant difference in the mean achievement of student taught Domestic Industrial Installation using Demonstration and those taught with Guided Discovery method.

Table 4

Analysis of Variance of the Mean Scores on the Post-Test of the Experimental Group and Control Group.

Sources of Variation	df	Sum of Squares (SS)	Mean Squares	F-cal	Critical Value of F	Significances	Decision
Between Groups	1	3.93	3.93	0.0546	3.91	0.05	Accept
Within Groups	156	11225.63	71.96				HO_1
Total	157	11229.56					

Table 4 shows that F-cal (0.0546) does not equal or exceeds F-critical value of (3.91) necessary for rejection of null hypothesis at 0.05 level of significance; therefore the null hypothesis is accepted. Hence there is no significant difference in the mean achievement of student taught Domestic Industrial Installation using Demonstration and those taught with Guided Discovery method.

HO_2

There is no significant difference in the retention scores of students taught Domestic Industrial Installation using Demonstration and those taught using Guided discovery method.

Table 5

Analysis of Variance of the Retention Scores of the Experimental Group and Control Group Taught Domestic Industrial Installation.

Sources of Variation	df	Sum of Squares (SS)	Mean Squares	F-cal	Critical Value of F	Significances	Decision
Between Groups	1	0.33	0.33	0.00476	3.91	0.05	Accept HO_1
Within Groups	156	10818.35	69.35				
Total	157	10818.68					

Table 5 shows that F-cal (0.00476) does not exceed F-critical value of (3.91) necessary for rejection of null hypothesis at 0.05 level of significance. The therefore the null hypothesis is accepted. Hence, there is no significant difference in the retention scores of students taught Domestic Industrial Installation using Demonstration and those taught using Guided discovery method.

HO_3

There is no significant difference in the achievement of male and female students taught Domestic Industrial Installation using Demonstration and Guided Discovery instructional method.

Table 6

Analysis of Variance of the Post-Test Scores of Males and Females in the Experimental Group and Control Group.

Sources of Variation	df	Sum of Squares (SS)	Mean Squares	F-cal	Critical Value of F	Significances	Decision
Between Groups	1	0.005	0.005	0.000071	3.91	0.05	Accept HO_1
Within Groups	156	11108.729	70.31				
Total	157	11108.734					

Table 6 shows that F-cal (0.000071) does not exceed F-critical value of (3.91) necessary for rejection of null hypothesis at 0.05 level of significance. Therefore, the null hypothesis is accepted. Hence, there is no significant difference in the achievement scores of male and female students taught Domestic Industrial Installation using Demonstration and Guided Discovery instructional method.

Findings

1. The student's achievement in the Post-test was much better when compared with their initial achievement in the Pre-test before treatments were administered.
2. There was no significant difference in the mean achievement of student taught Domestic Industrial Installation using Demonstration and those taught with Guided Discovery method.
3. There was no significant difference in the retention Scores of students taught Domestic Industrial Installation using Demonstration and those taught using Guided discovery method.
4. Gender difference has no effect on the use of Demonstration and Guided discovery method in teaching Domestic Industrial Installation in technical colleges.

Discussion of Findings

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

The findings from table 1 of this study shows that both the Experimental and Control groups were compared based on the mean scores of the Pre-test and the Post-test. The Pre-test results provided basis on which it could be reasonably assumed that both the Experimental and Control group had equivalent entry knowledge at the commencement of the treatment. The results also afforded premise to justify the comparison of the achievements of the Experimental and Control groups on an equal level. The Post-test result indicated that the students of the Experimental and Control groups improved on their achievements after been subjected to Guided Discovery and Demonstration method respectively. This result agreed with the findings of (Artherson, 2003) who found out that Demonstration and Guided Discovery are good in teaching practical skills as well as problem solving skills because they enables students relate the principles and theories being taught to a practical situation thereby making learning concrete. The Post-test result revealed that the difference in the achievement scores of the student taught Domestic Installation when taught with Demonstration and Guided discovery method is insignificant. Hence, the experimental and control group achievements in the Post-test can be treated as equivalent.

The findings in Table 2 show that the mean achievement of the Experimental and Control group in the Delayed Post-test (Retention-Test) is not significantly different to their achievement in the Post-test. This finding is in consonant with Yilmaz et al(2009). who reported that visualization and student active participation in laboratory practical's aided retention in secondary school students' knowledge in physics in Turkey. This also agrees with the findings of Mayer (2003) who found out that Demonstration and Guided discovery method have the capacity to aid students retention in science subjects. Britain (2006) reiterates that for successful teaching to occur, a variety of pedagogical approaches that focuses on providing activities for learners to perform either in group or individually that helps to create deeper, swifter and more effective learning should be applied in order to

enhance their retention ability. Specifically, the provision of an active learning environment where students can put more than one sense into learning process, especially the sense of seeing and hearing will leads to the concretization of learning, thereby making it permanent.

Findings from Table 3 shows that the achievements of the male and female students when taught Domestic Installation with Guided discovery and Demonstration method can be treated as been equivalent. Although the mean gains of males in the experimental group is slightly higher than that of the control group. Also the mean gains of the females in the experimental group is slightly higher than their counterpart in the control group. These differences are not high enough to be deemed significant. These findings showed that gender differences has no effect on the use of the methodologies.

Findings of Table 4 of this study show

s that there is no significant difference between the mean scores of Post-test of the Experimental group and that of the Control group. Thus the null hypothesis indicated that there is no significant difference in the mean achievements of the Experimental and Control group when Guided discovery and Demonstration was used to teach Domestic Industrial Installation to the students was accepted at 0.05 level of significances. This is in compliance with what was reported by Miller (2000), “Teaching methods which place student in an active learning situation are more likely to be effective than those which do not”, Both Guided discovery and Demonstration method engages students actively, therefore they improve student achievement. Hence, the achievements of students of Experimental and Control group in the Post-test could be treated as equivalent.

Findings from Table 5 of this study shows that the retention scores of both the students of the Experimental group and those of the Control group is almost equivalent to the scores obtained in the Post-test. Their achievement scores in the Post-test indicate there were no significant

differences in their retention level when taught Domestic Industrial Installation using Guided discovery and Demonstration method. Thus, the null hypothesis that there will be no significant difference in the retention score of students taught Domestic Industrial Installation using Guided Discovery and Demonstration method was accepted at 0.05 level of significances. Okorie (1979) stressed that, there is a great diversity in teaching methods and techniques, there is no one of them that can be regarded as the best. Two or more methods can be effective in teaching a particular subject. Hence, the study has revealed that both Guided discovery and Demonstration method has positive effect on student's academic achievement and could be considered as having equivalent effect on student's retention level when used to teach Domestic Industrial Installation in Technical College.

Findings from Table 6 of this study indicates that there were no significant differences between the Post-test mean scores of male and female students in the Control and Experimental group. Thus, the null hypothesis that there will be no significant differences in the achievements of male and female students taught Domestic Industrial Installation using Demonstration and Guided Discovery instructional method was accepted at 0.05 level of significances. Hence, there were no significant differences on the basis of gender in respect to the two teaching strategies. This finding is in agreement with Oloyede (2004) who found no significant difference on students' science achievement by gender. This study has however revealed that gender difference has no effect on the use of Guided discovery and Demonstration method in teaching Domestic Industrial Installation in Technical College.

The overall result of this study indicates that Demonstration and Guided discovery as an instructional method have the capacity to stimulate interest and curiosity among students, prepares learners for problem solving and aids retention ability of students. It also motivates students to learn and increases their personal responsibility for learning thereby leading to increase in students' achievement.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary of the Study

This study was designed to compare the effect of Demonstration and Guided Discovery instructional methodology on student's achievement in Electrical Installation Work in Technical Colleges in Niger State. The purpose of the study were: (1) To determine the difference in mean achievement of student taught Electrical Installation using Demonstration Method and those taught using Guided Discovery method; (2) To find out the difference in retention level of students taught Electrical Installation using Demonstration and those taught using Guided discovery method; and (3) To determine the difference in the achievements of male and female students taught Electrical Installation using Demonstration and Guided Discovery instructional method.

The following null hypotheses were tested: (1) There is no significant difference in the mean achievement of student taught Domestic Industrial Installation using Demonstration and those taught with Guided Discovery method; (2) There is no significant difference in the retention scores of students taught Domestic Industrial Installation using Demonstration and those taught using Guided discovery method; (3) There is no significant difference in the achievements of male and female students taught Domestic Industrial Installation using Demonstration and Guided Discovery instructional method.

Year two (TC II) students of two Technical Colleges in Niger State studying Electrical Installation Work constituted the population of the study. 93 students of Government Technical College Minna served as the Control group while 65 students of Government Technical College, Suleja served as the Experimental group.

The Demonstration and the Guided discovery were the two treatment patterns that were applied during the experiment. The Control group were taught with Demonstration method while the Experimental group were taught with Guided discovery approach. During the experimental period, the Control group and Experimental group was taught six (6) lessons using the prepared lesson plans for each treatment. Each lesson lasted for 60 minutes and the contact session was once a week. At the end of the treatments, a Post-test was administered on both groups and at a later date a Retention-test was also administered with the developed instrument for data collection and the scores obtained from both groups were used to measure the achievements and retentions of the students constituting the sample of this study.

The achievement scores of the study was obtained from the pre-test and post-test. Research questions were analyzed by Means and Standard deviations while Analysis of Variance (ANOVA) was used to test the hypothesis at 0.05 level of significances.

Analysis of data revealed that the retention level of students taught Domestic Industrial Installation using Guided discovery method and those students taught Domestic Industrial Installation using Demonstration method has no significant difference. The analysis also indicated that gender difference has no effect on the use of the two methodologies. For this reason both Guided discovery and Demonstration method were found equally effective for both male and female students.

Implications of the Study

The findings of this study have implications for Electrical Installation Work teachers, educational researchers, examination bodies and Electrical Installation Work students. Having compared the effect of Demonstration and Guided discovery instructional method and both found to have a positive effect on students' achievement, Electrical Installation Work teachers' are free to adopt any of the two approaches.

From the findings of the study, examination bodies should be able to develop appropriate assessment instruments that will facilitate the evaluation of student practical and manipulative skills based on the instructional approaches (Guided discovery and Demonstration) instead of the present methods which is based mainly on achievement tests. Finally, educational researchers should use the findings of this study as a base to plan and conduct further researches.

Conclusion

Based on the findings of the study the following conclusions were drawn. It is clear that the use of both Demonstration and Guided discovery has improved student academic achievement in Domestic installation works; it is therefore safe to conclude that its adoptions in Technical Colleges will improve students' cognitive performance in Domestic installation work and other technical subjects. Teachers should therefore be encouraged to utilize the methodologies for instruction.

Recommendations

In the light of the findings revealed and conclusions drawn from the study, the following recommendations are necessary:

1. Technical teachers, especially those teaching Electrical Installation Works, should adopt problem solving techniques (Demonstration and Guided discovery) to actively engage students in teaching and learning process.
2. Teachers should be trained on the effective utilization of Demonstration and Guided discovery instructional methods through organized workshops and seminars.
3. Curriculum developers should make provision and include the usage of Demonstration and guided discovery method in the curriculum.
4. School administrators should ensure the availability of instructional aids that would facilitate the teaching of Electrical Installation works in Technical College.

Suggestion for Further Research

The following suggestion has been made for further research:

1. The Effect of Cooperative Learning on Student Retention in Electrical Installation and Maintenance Works in Technical Colleges in Niger State.

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APPENDIX A

APPENDIX B

LESSON PLAN (1) USING GUIDED DISCOVERY

SCHOOL: Government Technical College Suleja.

CLASS: T.C.2 Electrical Installation and Maintenance Work (EIMW).

SUBJECT: Domestic Industrial Installations.

TOPIC: Electrical Working Diagram

DURATION: 60 minute

INSTRUCTION MATERIAL: Drawing Scale Rule, Working Drawing, Flip-chart, Chalk Board

PERFORMANCE OBJECTIVE:

On completion of this lesson, the students should be able to:

1. Identify symbols used in electrical engineering drawing of an electrical installation.
2. Interpret scale used in working drawing.

ENTRY BEHAVIOUR: The students have been taught about simple electric circuit.

S/No	Teacher Activities	Student Activities
1.	The instructor displays a flip-chart containing several standard electrical symbols on the chalkboard and asks the students to identify any of the symbols they have come across before.	The student's identifies the symbols they have come in contact with on the flip-chart.

2.	The instructor explains the meaning and uses of each electrical engineering symbol been displayed on the flip-chart.	The students demonstrate the use of scale-rule on sample working diagram with subtle guidance of the instructor.
3.	The teacher guides the student on the use and application of scale-rule on a sample working drawing.	The students ask questions when confused.

EVALUATION:

1. Draw and explain the use of any ten (10) electrical engineering symbol?
2. Locate the position of the following accessories on a working drawing?
    - Ceiling fan
    - Socket outlets
    - Lighting systems

ASSIGNMENT: Draw any 30 electrical engineering symbol?

LESSON PLAN (2) USING GUIDED DISCOVERY

SCHOOL: Government Technical College Suleja.

CLASS: T.C.2 Electrical Installation and Maintenance Work (EIMW).

SUBJECT: Domestic Industrial Installations.

TOPIC: Drawing a Electrical Working Diagram

DURATION: 60 minutes

INSTRUCTION MATERIAL: Drawing Scale Rule, Working Drawing, Flip-chart, Chalk Board

PERFORMANCE OBJECTIVE:

On completion of this lesson, the students should be able to:

1. List all the electrical accessories required for a job from the working drawing.
2. Interpret the distribution system from a drawing.
3. Draw a complete electrical working diagram, with all necessary symbols incorporated.

ENTRY BEHAVIOR: The students can identify standard electrical symbols and their uses.

S/No	Teacher Activities	Student Activities
1.	The teacher asks series of questions based on the student's prior knowledge in electrical working drawing.	The students place symbols on working drawings.
2.	The teacher displays an electrical working diagram on	The students highlight the use

	the chalkboard and guides the students through the process of placing symbols on a working drawing plan.	and meaning of each accessory on the working drawing.
3.	The teacher explains each item of accessories on the working drawing.	The students ask questions when confused.
4.	The teacher guides the students step by step on how to appropriately position the distribution units for single phase, poly phase and neutral on the working drawing.	

EVALUATION:

1. The teacher calls the students randomly to identify the various symbols on the working diagram.
2. The teacher asks series of questions to evaluate the student's knowledge.

ASSIGNMENT: Draw a complete electrical working diagram with all necessary symbols incorporated.

LESSON PLAN (3) USING GUIDED DISCOVERY

SCHOOL: Government Technical College Suleja.

CLASS: T.C.2 Electrical Installation and Maintenance Work (EIMW).

SUBJECT: Domestic Industrial Installations.

TOPIC: Domestic Surface Wiring

DURATION: 60 minutes

INSTRUCTION MATERIAL: Surface wiring materials and Basic tools.

PERFORMANCE OBJECTIVE:

On completion of this lesson, the students should be able to:

1. Fix cable to a surface.
2. Identify cable types and sizes used for lighting, heating, cooker and socket outlets.
3. Explain cable rating, maximum load demand and ambient temperature.
4. Use plumb line, chalk line and spirit level.

ENTRY BEHAVIOR: The students have been taught how to draw a complete electrical working diagram, with all necessary symbols incorporated.

S/No	Teacher Activities	Student Activities
1.	The teacher displays the clips, gimp pins, rawl drill, clipping hammer and plug, and asks the students to	The students go through the IEE chart.

	write down the use of each item in surface wiring.	
2.	The teacher displays assorted cable types e.g. PVC, MICC, Armored etc. The teacher instructs the students to consult the IEE chart for the standard sizes of the cables, the cable ratings, the maximum load demands and the ambient temperatures.	The students demonstrate the use of plumb line, chalk line and spirit level while fixing a cable to a surface with the help and supervision of the instructor.
3.	The teacher guides the students step by step through the application of plumb line, chalk line and spirit level when fixing cable to a surface.	

EVALUATION:

1. Identify the various cable types, sizes and their uses?
2. The teacher evaluates the student on the usage and handling of surface wiring materials.

ASSIGNMENT: List various cable types, stating the cable ratings, maximum load demands and ambient temperatures of each under listed cable in a tabular form?

LESSON PLAN (4) USING GUIDED DISCOVERY

SCHOOL: Government Technical College Suleja.

CLASS: T.C.2 Electrical Installation and Maintenance Work (EIMW).

SUBJECT: Domestic Industrial Installations.

TOPIC: Domestic Surface Wiring (continuation)

DURATION: 60 minutes

INSTRUCTION MATERIAL: Chalkboard, Flip-chart, IEE regulations, chalk board, IEE and NEPA regulations

PERFORMANCE OBJECTIVE:

On completion of this lesson, the students should be able to:

1. Carry out simple, surface wiring of building (residential) using appropriate tools.
2. State relevant statutory regulations regarding surface wiring.
3. Apply the regulations of the regulatory bodies on surface wiring job.

ENTRY BEHAVIOR: The students have been taught how to fix cable to a surface.

S/No	Teacher Activities	Student Activities
1.	The teacher engages the class in active discussion, using questions and answer technique to explain the concept of surface wiring and statutory regulations	The student's carries out simple surface wiring with step by step guidance from the teacher.

	regarding surface wiring a building.	
2.	The teacher asks the students to state the advantages and disadvantages of surface wiring. The teacher later provides a complete list of the advantages and disadvantages of surface wiring in a building (residential).	The students go through the flip-chart for the Institute of Electrical Engineers (IEE) regulations and NEPA regulations.
3.	The teacher guides the students step by step through the process of carrying out simple surface wiring.	

EVALUATION:

1. The teacher evaluates the students by asking oral questions.
2. The students are asked to perform in groups, simple surface wiring on a piece of plywood connecting two (2) 13 amps sockets in parallel.
3. The teacher assesses the neatness of the job carried out by the student.

ASSIGNMENT: State any five (5) IEE regulations in respect to surface wiring?

LESSON PLAN (5) USING GUIDED DISCOVERY

SCHOOL: Government Technical College Suleja.

CLASS: T.C.2 Electrical Installation and Maintenance Work (EIMW).

SUBJECT: Domestic Industrial Installations.

TOPIC: Domestic Conduit Wiring

DURATION: 60 minutes

INSTRUCTION MATERIAL: Steel conduit, PVC conduit, Flexible conduit, Hacksaw, Stocks, Model, Chalkboard, Flip-chart, IEE regulations, Taps and Dies.

PERFORMANCE OBJECTIVE:

On completion of this lesson, the students should be able to:

1. Explain the meaning of Conduit wiring.
2. State the advantages and disadvantages of Conduit installation
3. Identify types of conduits, Steel conduits, Flexible conduit and PVC conduit.
4. State the use and application of stocks, hacksaws, taps and dies.

ENTRY BEHAVIOR: The students have been taught how to carry out simple surface wiring in a building

S/No	Teacher Activities	Student Activities
1.	The teacher uses a model to explain conduit wiring, stating the main advantages and disadvantages of conduit wiring in a building (residential).	The students consult their textbook for further explanation of the concept of conduit wiring.
2.	The teacher displays the various types of conduit (Steel conduits, Flexible conduit and PVC conduit) and states the area of application of each conduit in a building.	The student's displays the use of conduit wiring tools supervised by the teacher.
3.	The teacher guides the students through the use and application of conduit wiring tools (stacks, hacksaw, taps and dies) used during conduit installations.	

EVALUATION:

1. Explain conduit wiring and states its advantages
2. Identify the various types of conduits.
3. Identify any three (3) tools used in conduit wiring.

ASSIGNMENT: The students are to read about the procedures involved in conduit wiring?

LESSON PLAN (6) USING GUIDED DISCOVERY

SCHOOL: Government Technical College Suleja.

CLASS: T.C.2 Electrical Installation and Maintenance Work (EIMW).

TOPIC: Domestic Conduit Wiring (continuation)

DURATION: 60 minutes

INSTRUCTION MATERIAL: Fish wire, Pieces of conduit with threads and without thread, Hacksaw, Stacks, pipe threader and reamer, Chalkboard, Flip-chart, IEE regulations, Multimeter, Taps and Dies.

PERFORMANCE OBJECTIVE:

On completion of this lesson, the students should be able to:

1. Explain the appropriate procedures for preparing conduit for installation.
2. Determine set and bend permissible radial length.
3. Draw in cables using the fishing wire.
4. Test the installation as stipulated by the statutory regulations.

ENTRY BEHAVIOR: The students know how to use and apply the various conduit wiring tools.

S/No	Teacher Activities	Student Activities
1.	The teacher guides the students through the process of square cutting a conduit.	The students carry out conduit square cutting.
2.	The teacher explains the concept of setting and bending of conduit and regulations governing it.	The students perform a cable draw using a fish wire with subtle guidance from the teacher.
3.	The teacher guides the students through the process of cable draw in conduit installation using a fish wire.	The students take down the recordings arrived at from the continuity, insulation and polarity test.
4.	The teacher explains and guides the students on how to carry out continuity, insulation and polarity test.	

EVALUATION:

1. List the steps involved in conduit wiring.
2. Explain the regulations governing setting and bending of conduit.

CLASS ASSIGNMENT: Using a PVC conduit, wire two (2) lighting points, controlled by a single switch?

LESSON PLAN (1) USING DEMONSTRATION METHOD

SCHOOL: Government Technical College Minna.

CLASS: T.C.2 Electrical Installation and Maintenance Work (EIMW)

SUBJECT: Domestic Industrial Installations.

TOPIC: Electrical Working Diagram

DURATION: 60 minutes

INSTRUCTION MATERIAL: Drawing Scale Rule, Working Drawing, Flip Chart, Chalk Board

PERFORMANCE OBJECTIVE:

On completion of this lesson, the students should be able to:

3. Identify symbols used in electrical engineering drawing of an electrical installation.
4. Interpret scale used in working drawing.

ENTRY BEHAVIOUR: The students have been taught about simple electric circuit.

S/No	Teacher Activities	Student Activities
1.	The instructor displays a flip chart containing several	The students watch and listen

	standard electrical symbols on the chalkboard.	carefully to the instructor as he describes each symbol.
2.	The instructor explains the meaning and uses of each electrical engineering symbol been displayed on the flip chart.	The students demonstrate the use of scale-rule on sample working diagram.
3.	Demonstration of scale-rule application on a sample working drawing.	The students ask questions when confused

EVALUATION:

3. Draw and explain the meaning and use of any five electrical engineering symbol in their drawing book?
4. Locate the position of the following accessories on a working drawing?
    - Lighting systems
    - Socket outlets
    - Distribution board

ASSIGNMENT: Draw any 30 electrical engineering symbol?

LESSON PLAN (2) USING DEMONSTRATION METHOD

SCHOOL: Government Technical College Minna.

CLASS: T.C.2 Electrical Installation and Maintenance Work (EIMW)

SUBJECT: Domestic Industrial Installations.

TOPIC: Drawing a Electrical Working Diagram

DURATION: 60 minutes

INSTRUCTION MATERIAL: Drawing Scale Rule, Working Drawing, Flip Chart, Chalk Board

PERFORMANCE OBJECTIVE:

On completion of this lesson, the students should be able to:

4. List all the electrical accessories required for a job from the working drawing.
5. Interpret the distribution system from a drawing.
6. Draw a complete electrical working diagram, with all necessary symbols incorporated.

ENTRY BEHAVIOR: The students can identify standard electrical symbols and their uses.

S/No	Teacher Activities	Student Activities
1.	The teacher displays an electrical working drawing on	The students watch and listen

	the chalkboard and demonstrates how symbols are placed on a working drawing plan.	carefully to the instructor as he describes each symbol.
2.	The teacher explains each item of accessories on the working drawing.	The students asks questions when confused
3.	The teacher demonstrates on the working drawing, the appropriate positions of distribution units for single phase, poly phase and neutral.	The students draw simple electrical working drawing.

EVALUATION:

3. The teacher calls the students randomly to identify the various symbols on the working diagram.
4. The teacher asks oral questions to evaluate the student's knowledge.

ASSIGNMENT: Draw a complete electrical working diagram with all necessary symbols incorporated.

LESSON PLAN (3) USING DEMONSTRATION METHOD

SCHOOL: Government Technical College Minna.

CLASS: T.C.2 Electrical Installation and Maintenance Work (EIMW)

SUBJECT: Domestic Industrial Installations.

TOPIC: Domestic Surface Wiring

DURATION: 60 minutes

INSTRUCTION MATERIAL: Surface wiring materials and Basic tools.

PERFORMANCE OBJECTIVE:

On completion of this lesson, the students should be able to:

5. Fix cable to a surface
6. Identify cable types and sizes used for lighting, heating, cooker and socket outlets.
7. Explain cable rating, maximum load demand and ambient temperature.
8. Use plumb line, chalk line and spirit level when carrying out surface wiring.

ENTRY BEHAVIOR: The students have been taught how to draw a complete electrical working diagram, with all necessary symbols incorporated.

S/No	Teacher Activities	Student Activities
1.	The teacher displays the clips, gimp pins, rawl drill, clipping hammer and plug, and explains how to use the materials.	The students listen and pay attention to the instructor throughout the demonstration.
2.	The teacher displays assorted cable types e.g. PVC, MICC, Armored etc. listing the standard sizes of cables on the chalkboard and also went further to explain cable ratings, maximum load demands and ambient temperatures using IEEE chart.	The students demonstrate the use of plumb line, chalk line and spirit level while fixing a cable to a surface.
3.	The teacher demonstrates the application of plumb line, chalk line and spirit level when fixing cable to a surface.	

EVALUATION:

3. Identify the various cable types, sizes and their uses?
4. The teacher evaluates the student on the usage and handling of surface wiring materials.

ASSIGNMENT: List various cable types, stating the cable ratings, maximum load demands and ambient temperatures of each under listed cable?

LESSON PLAN (4) USING DEMONSTRATION METHOD

SCHOOL: Government Technical College Minna.

CLASS: T.C.2 Electrical Installation and Maintenance Work (EIMW)

SUBJECT: Domestic Industrial Installations.

TOPIC: Domestic Surface Wiring (continuation)

DURATION: 60 minutes

INSTRUCTION MATERIAL: Chalkboard, Flip chart, IEE regulations, chalk board, IEE and NEPA regulations

PERFORMANCE OBJECTIVE:

On completion of this lesson, the students should be able to:

4. Carry out simple, surface wiring of building (residential) using appropriate tools.
5. State relevant statutory regulations regarding surface wiring.
6. Apply the regulations of the regulatory bodies on surface wiring job.

ENTRY BEHAVIOR: The students have been taught how to fix cable to a surface.

S/No	Teacher Activities	Student Activities
1.	The teacher uses questions and answer technique to discuss the concept of surface wiring and statutory regulations regarding surface wiring a building.	The students listen and pay attention to the teacher.
2.	The teacher carries out simple surface wiring.	The students go through the flip chart for the Institute of Electrical Engineers (IEE) regulations and NEPA regulations.
3.	The teacher states the advantages and disadvantages of surface wiring in a residential building.	The students carry out simple surface wiring.

EVALUATION:

4. The teacher evaluates the students by oral questions.
5. The students are asked to perform in group, simple surface wiring on a piece of plywood connecting two (2) 13 amps sockets in parallel.
6. The teacher assesses the neatness of the job carried out by the student.

ASSIGNMENT: State any five (5) IEE regulations in respect to surface wiring.

LESSON PLAN (5) USING DEMONSTRATION METHOD

SCHOOL: Government Technical College Minna.

CLASS: T.C.2 Electrical Installation and Maintenance Work (EIMW).

SUBJECT: Domestic Industrial Installations.

TOPIC: Domestic Conduit Wiring

INSTRUCTION MATERIAL: Steel conduit, PVC conduit, Flexible conduit, Hacksaw, Stocks and dies, Model, Chalkboard, Flip chart, IEE regulations and taps.

PERFORMANCE OBJECTIVE:

On completion of this lesson, the students should be able to:

5. Explain the meaning of Conduit wiring.
6. State the advantages and disadvantages of Conduit installation
7. Identify types of conduits, Steel conduits, Flexible conduit and PVC conduit.

8. State the use and application of stocks, hacksaws, taps and dies.

ENTRY BEHAVIOR: The students have been taught how to carry out simple surface wiring.

S/No	Teacher Activities	Student Activities
1.	The teacher uses a model to explain conduit wiring, stating the main advantages and disadvantages of conduit wiring in a building (residential).	The student pays attention to the instructor during the demonstration.
2.	The teacher displays the various types of conduit (Steel conduits, Flexible conduit and PVC conduit) and states the area of application of each conduit in a building.	Students are randomly selected to demonstrate the use of conduit wiring tools in front of the whole class.
3.	The teacher demonstrates how to use conduit wiring tools (stocks, hacksaw, taps and dies) during conduit installations.	

EVALUATION:

4. Explain conduit wiring and states its advantages
5. Identify the various types of conduits.
6. Identify any three (3) tools used in conduit wiring.

ASSIGNMENT: The students are to read about the procedures involved in conduit wiring?

LESSON PLAN (6) USING DEMONSTRATION METHOD

SCHOOL: Government Technical College Minna.

CLASS: T.C.2 Electrical Installation and Maintenance Work (EIMW).

TOPIC: Domestic Conduit Wiring (continuation)

DURATION: 60 minutes

INSTRUCTION MATERIAL: Fish wire, Pieces of conduit with threads and without thread, Hacksaw, Stocks, Pipe threader and Reamer, Chalkboard, Flip chart, IEE regulations, Multimeter, Tapes and Dies.

PERFORMANCE OBJECTIVE:

On completion of this lesson, the students should be able to:

5. Explain the appropriate procedures for preparing conduit for installation.
6. Determine set and bend permissible radial length.
7. Draw in cables using the fishing wire

8. Test the installation as stipulated by the statutory regulations

ENTRY BEHAVIOR: The students know how to use and apply the various conduit wiring tools.

S/No	Teacher Activities	Student Activities
1.	The teacher demonstrates how to square cut a conduit to the entire class.	The students are selected randomly to perform a cable draw using a fish wire.
2.	The teacher explains the regulations regarding setting and bending of conduit.	The students take down the recordings from the continuity, insulation and polarity test carried out by the teacher.
3.	The teacher demonstrates how a cable is drawn into a conduit using a fish wire.	
4.	The teacher explains and demonstrates to the entire class how to carry out continuity, insulation and polarity test.	

EVALUATION:

3. The student should list the steps involved in conduit wiring.
4. The student should explain the regulations governing setting and bending of conduit.

CLASS ASSIGNMENT: Using a PVC conduit, the student should wire two (2) lighting points, controlled by a single switch.

APPENDIX C

DOMESTIC INSTALLATION ACHIEVEMENT TEST (DIAT)

PRE-TEST AND POST-TEST ITEMS

Objective Questions: Answer all questions

1. Rawl drills are used in making holes in
   A. Soft wood
   B. Concrete walls
   C. Cables
   D. Conductors
2. All the following are types of cable EXCEPT
   A. PVC cable
   B. MICC cable
   C. Brass cable

D. Armored cable

3. Ball pen hammer is used for
   A. Playing table tennis
   B. Breaking walls
   C. Nailing clips
   D. Making hole
4. The type of conduit formed from a pressed steel spiral which is used to terminate conduit in electrical machinery is known as
   A. Spiral conduit
   B. Flexible metallic conduit
   C. Fixed metallic conduit
   D. Non-metallic conduit
5. The I.E.E regulation requires that a ceiling rose may only be connected to installations operating at
   A. 250V
   B. 1000V
   C. 650V
   D. 50V

6. The bending block can be made of
   A. Wood
   B. steel
   C. plastic
   D. None of the above
7. The following instruments are used during surface wiring EXCEPT:
   A. Fish wire
   B. Clipping hammer
   C. Spirit level
   D. Chalk line
8. The instrument used in carrying out polarity test is:
   A. Ohmmeter
   B. Ammeter
   C. Test lamp
   D. Wattmeter

9. Reliability of conduit installation relative to corrosion is
    A. An advantage
    B. A disadvantage
    C. Economical
    D. None of the above
10. The electrical symbol  represents?
    A. Two way switch
    B. Smoke detector
    C. Three way switch
    D. Single pole switch
11. Which of the following is not an advantage of conduit installation?
    A. Provides protection against mechanical damage
    B. Provides earth return path
    C. It is durable
    D. It is corrosive
12. Flexible metallic conduit should be used only for short runs where
    A. Electrical damage is unlikely to occur
    B. Mechanical damage is unlikely to occur
    C. Insulation damage is unlikely to occur
    D. Installation damage is unlikely to occur
13. Which of the conductors below is used in M.I.C.C. cables?
    A. Aluminium
    B. Steel
    C. Copper
    D. Iron
14. The following can be located on an electrical working diagram EXCEPT:
    A. Distribution box
    B. Circuit breaker
    C. Junction box
    D. Fish wire
15. M.I.C.C. cables are mechanically strong but
    A. Needs no protection against sharp objects
    B. Must be protected against sharp objects

C. Need no mechanical protection again

D. Need no earth continuity conductor again

16. At what interval must a temporary installation be tested?

A. Six months or more

B. Six months or less

C. Three months only

D. Three months or less

17. The clipping hammer is made of

A. Plastic

B. Iron

C. Steel and wood

D. Rubber

18. The cables which can best withstand high temperatures are:

A. MICC cables

B. PVC cables

C. Amored cables

D. Coaxial cables

19. The main factors against which an installation must be protected is

A. Excess current, moisture and corrosion

B. Rainfall, sunrays and dew

C. Electric shock, sunshine and lightning

D. Lightning, sunshine and rainfall

20. One advantage of a steel conduit installation over PVC conduit installation is:

A. It is non-corrosive

B. May be installed more quickly

C. Offers greater mechanical protection

D. Can hold more conductors for a given conduit size

21. Which of these instruments can be used for drilling holes in walls?

A. Rawl plug

B. Rawl drill

C. Metal drill

D. Metal plug

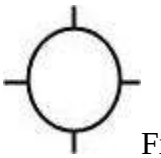
22. All the following are types of conduit used in electrical installation work EXCEPT

A. Steel conduit

B. PVC conduit
C. Flexible conduit
D. MICC conduit

23. The following instruments are used during surface wiring EXCEPT:
    E. Fish wire
    F. Clipping hammer
    G. Spirit level
    H. Chalk line

Use the following electrical symbols to answer question 25-28

 Fig.(1)

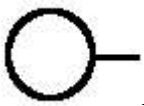
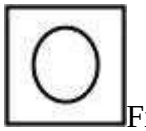
 Fig.(2)

Fig.(3)

 Fig.(4)

24. The symbol in Fig. (1) represents
    A. Duplex receptacle
    B. Vent fan
    C. Four way switch
    D. Ceiling light fixture
25. The symbol in Fig. (2) represents
    A. Wall mounted light fixture
    B. Single receptacle
    C. Smoke detector
    D. Wall junction box
26. The symbol in Fig. (3) illustrate
    A. A distribution box
    B. A fluorescent light fixture
    C. A ceiling fan
    D. Wall junction box
27. The symbol in Fig. (4) denotes
    A. A telephone
    B. A television
    C. A door bell
    D. A circuit breaker

28. One of the following is an advantages of PVC conduit over Steel conduit:
    A. It has greater mechanical strength
    B. It can be used as a circuit protective conductor
    C. It can be withstand high temperature
    D. It is non-corrosive
29. One objective of the polarity test is to verify that:
    A. Lamp holders are correctly earthed
    B. Final circuits is continuous throughout the installation
    C. The CPC is continuous throughout the installation
    D. The protective devices are connected in the live conductors
30. The type of installation recommended where many cables are required is
    A. Surface conduit
    B. Metallic conduit
    C. Plastic conduit
    D. Trunking
31. The acronym IEE denotes:
    A. Institute of Energy Economics
    B. International Electrical Engineer
    C. Institute of Electrical Engineers
    D. Institute of European Electricians
32. The appropriate voltage rating of conductors, cables and equipments in domestic installation is
    A. Low voltage rating
    B. High voltage rating
    C. Very high voltage rating
    D. Correct voltage rating
33. The test carried out to verify that all fuses, circuit breakers and switches are connected in phase is:
    A. Insulation resistance test
    B. Continuity test
    C. Polarity test
    D. Terminal test
34. I.E.E wiring regulations concerning the requirements for carrying out electrical installations is included in

A. BS 7371
B. BS 9982
C. BS 1126
D. BS 7890

35. In electrical installation, Spirit level is used for checking
    A. Length of wire
    B. Levelness of a surface
    C. Thickness of conduit
    D. Distance in-between outlets
36. Which of this cable sizes is suitable for domestic lighting points
    A. 2.5mm
    B. 1.5mm
    C. 4mm
    D. None of the above
37. The acronym PVC stands for
    A. Poor Voltage Cable
    B. Phase Voltage Connector
    C. Poly Vinyl Chloride
    D. None of the above
38. Which of the following instrument can be used for threading metal conduits
    A. Stock and Dies
    B. Taps and Plumb line
    C. Chalk line and plugs
    D. Clipping hammer
39. Length of steel conduits are typically
    A. 2.5m
    B. 1.5m
    C. 3.75m
    D. 2.8m
40. Which of the following instrument can be used to interpret scales on an electrical working drawing
    A. Flip chart
    B. Scale rule
    C. Reamer

D. Fish wire

APPENDIX D

STATISTICAL RESULT

DEMONSTRATION						GUIDED DISCOVERY				
Pupils	**Sex**	**Pre-test Scores**	**Post-test Scores**	**Retention Scores**		**Pupils**	**Sex**	**Pre-test Scores**	**Post-test Scores**	**Retention Scores**
1	M	55	63	68		1	M	55	67	71
2	M	45	77	59		2	M	66	65	64
3	M	51	75	84		3	M	60	69	62
4	M	58	66	80		4	M	54	72	75
5	M	48	65	69		5	M	58	66	55
6	M	65	65	46		6	M	65	54	66
7	M	27	44	75		7	M	62	71	75
8	M	54	65	68		8	M	36	76	67
9	M	68	65	67		9	M	45	64	73
10	M	42	65	63		10	M	58	66	64
11	M	67	64	65		11	M	47	65	60

12	M	56	65	57		12	F	44	68	76
13	M	52	67	65		13	M	45	90	66
14	M	55	62	63		14	M	67	53	50
15	M	64	71	73		15	M	35	60	55
16	M	48	77	69		16	M	51	65	68
17	M	55	67	67		17	M	60	58	62
18	M	46	77	78		18	M	70	70	57
19	M	61	79	73		19	M	49	66	78
20	M	40	55	70		20	M	62	78	63
21	M	36	60	75		21	M	55	63	73
22	M	56	65	78		22	M	67	53	69
23	M	40	85	76		23	M	45	69	58
24	M	45	65	63		24	M	54	57	65
25	M	58	55	77		25	M	50	68	55
26	M	52	78	75		26	M	54	60	73
27	M	58	60	66		27	M	41	65	60
28	M	64	67	65		28	M	59	68	65
29	M	55	78	75		29	M	60	73	68
30	M	44	68	63		30	M	45	60	71
31	M	56	78	79		31	M	60	61	76
32	M	71	56	62		32	M	54	67	70
33	F	53	66	65		33	M	45	86	74
34	M	56	43	67		34	M	49	77	73
35	M	42	78	75		35	M	55	66	69
36	M	60	75	64		36	M	68	78	64
37	M	63	72	77		37	M	47	64	65
38	M	49	40	43		38	M	46	71	61
39	M	54	57	55		39	M	58	64	60
40	M	60	72	67		40	M	55	65	78
41	M	69	75	65		41	M	60	77	69
42	M	70	77	74		42	M	35	78	73
43	M	55	65	71		43	M	56	65	77
44	M	65	78	64		44	M	66	50	75
45	M	45	58	69		45	M	51	79	66
46	M	67	80	70		46	M	40	63	65
47	M	38	71	79		47	M	48	64	65
48	M	55	60	56		48	M	65	70	70
49	M	65	78	75		49	M	44	65	68
50	M	53	55	65		50	F	56	60	59
51	M	50	68	71		51	M	67	69	68
52	M	57	61	62		52	M	68	68	75
53	M	55	86	73		53	M	59	65	82

54	F	58	69	64		54	M	55	70	74
55	M	62	66	76		55	M	59	77	58
56	M	52	63	65		56	M	66	70	65
57	M	63	75	61		57	M	54	59	68
58	M	60	63	50		58	M	70	66	76
59	M	64	75	85		59	M	53	75	58
60	M	43	69	68		60	M	42	65	87
61	M	56	68	65		61	M	58	71	66
62	M	61	65	68		62	F	63	75	68
63	M	60	73	68		63	M	62	74	70
64	M	49	54	48		64	M	45	66	77
65	M	65	76	76		65	M	68	82	70
66	M	46	56	54		**MEAN**		**54.86**	**67.71**	**67.74**
67	M	44	82	78		**SD**		**9.15**	**7.65**	**7.21**
68	M	45	76	76						
69	M	55	68	63						
70	M	49	47	55						
71	M	58	72	70						
72	M	67	76	88						
73	M	57	73	69						
74	M	65	67	70						
75	M	54	85	89						
76	M	71	72	76						
77	M	68	75	65						
78	M	54	60	55						
79	M	55	68	71						
80	M	53	73	75						
81	M	65	66	65						
82	M	51	57	64						
83	M	67	63	76						
84	M	44	70	65						
85	M	63	69	66						
86	M	35	61	78						
87	M	53	65	43						
88	M	61	60	56						
89	M	48	71	67						
90	M	50	67	60						
91	M	56	58	75						
92	M	60	66	65						
93	M	58	64	59						
MEAN		**55.03**	**67.45**	**67.82**						
SD		**8.91**	**9.05**	**9.02**						

STATISTICAL DATA

(Male Students)

DEMONSTRATION METHOD			
Pupils	**Sex**	**Pre-test Scores**	**Post-test Scores**
1	M	55	63
2	M	45	77
3	M	51	75
4	M	58	66
5	M	48	65
6	M	65	65
7	M	27	44
8	M	54	65
9	M	68	65
10	M	42	65
11	M	67	64
12	M	56	65
13	M	52	67
14	M	55	62
15	M	64	71
16	M	48	77
17	M	55	67
18	M	46	77
19	M	61	79
20	M	40	55
21	M	36	60
22	M	56	65
23	M	40	85
24	M	45	65
25	M	58	55
26	M	52	78
27	M	58	60
28	M	64	67
29	M	55	78
30	M	44	68
31	M	56	78
32	M	71	56
33	M	60	66
34	M	56	43
35	M	42	78

36	M	60	75
37	M	63	72
38	M	49	40
39	M	54	57
40	M	60	72
41	M	69	75
42	M	70	77
43	M	55	65
44	M	65	78
45	M	45	58
46	M	67	80
47	M	38	71
48	M	55	60
49	M	65	78
50	M	53	55
51	M	50	68
52	M	57	61
53	M	55	86
54	M	58	64
55	M	62	66
56	M	52	63
57	M	63	75
58	M	56	63
59	M	64	75
60	M	43	69
61	M	56	68
62	M	61	65
63	M	60	73
64	M	49	54
65	M	65	76
66	M	58	64
67	M	44	82
68	M	45	76
69	M	55	68
70	M	49	47
71	M	58	72
72	M	67	76
73	M	57	73
74	M	65	67
75	M	54	85
76	M	71	72
77	M	68	75

78	M	54	60
79	M	55	68
80	M	53	73
81	M	65	66
82	M	51	57
83	M	67	63
84	M	44	70
85	M	63	69
86	M	35	61
87	M	53	65
88	M	61	60
89	M	48	71
90	M	50	67
91	M	56	58
MEAN		**55.11**	**67.47**
SD		**8.94**	**9.04**

STATISTICAL DATA

(Female Students)

DEMONSTRATION METHOD		
Pupils	**Pre-test Scores**	**Post-test Scores**
1	53	66
2	58	69
MEAN	**55.50**	**67.50**
SD	**3.54**	**2.12**

STATISTICAL DATA

(Male Students)

GUIDED DISCOVERY			
Pupils	**Sex**	**Pre-test Scores**	**Post-test Scores**
1	M	55	67
2	M	66	65
3	M	60	69
4	M	54	72
5	M	58	66
6	M	65	54
7	M	62	71
8	M	36	76
9	M	45	64
10	M	58	66
11	M	47	65
12	M	62	74
13	M	45	90
14	M	67	53
15	M	35	60
16	M	51	65
17	M	60	58
18	M	70	70
19	M	49	66
20	M	62	78
21	M	55	63
22	M	67	53
23	M	45	69
24	M	54	57
25	M	50	68
26	M	54	60
27	M	41	65
28	M	59	68
29	M	60	73
30	M	45	60
31	M	60	61
32	M	54	67
33	M	45	86
34	M	49	77
35	M	55	66
36	M	68	78
37	M	47	64

38	M	46	71
39	M	58	64
40	M	55	65
41	M	60	77
42	M	35	78
43	M	56	65
44	M	66	50
45	M	51	79
46	M	40	63
47	M	48	64
48	M	65	70
49	M	44	65
50	M	45	66
51	M	67	69
52	M	68	68
53	M	59	65
54	M	55	70
55	M	59	77
56	M	66	70
57	M	54	59
58	M	70	66
59	M	53	75
60	M	42	65
61	M	58	71
62	M	68	82
MEAN		**54.89**	**67.71**
SD		**9.21**	**7.72**

STATISTICAL DATA

(Female Students)

GUIDED DISCOVERY		
Pupils	**Pre-test Scores**	**Post-test Scores**
1	44	68
2	56	60
3	63	75
MEAN	**54.33**	**67.67**
SD	**9.61**	**7.51**

APPENDIX E

Population of Study

School	Male Student(s)	Female Student(s)	Total
GTC Minna	91	2	93
GTC Suleja	62	3	65
Total	**153**	**5**	**158**

APPENDIX E

FORMULA

The following formulae were used in doing statistical analysis

1. Mean

$$X = \frac{\sum X}{n}$$

X = Mean

$\sum$ = the Sum of

N = the scores

II. Standard Deviation

$$SD = \sqrt{\frac{\sum X^2 - \frac{Xx^2}{n}}{n-1}}$$

III. Analysis of Variance

$$\text{Step I} = SS_B = \frac{\sum(X_1)}{n_1} + \frac{(X_2)^2}{n_2} + \ldots + \frac{\sum(X_a)^2}{n_a} - \frac{(\sum X)^2}{N}$$

$$\text{Step 2} = SS_T = \sum X^2 - \frac{(\sum X)^2}{N}$$

Step 3 = $SS_W = SS_T - SS_B$

Step 4 = $df_W = N - a$

Step 5 = $df_B = a - 1$

Step 6 = $df_T = N - 1$

Step 7 = ANOVA table

Sources of Variation	df	Sum of Squares (SS)	Mean Squares	F-cal	Critical Value of F	Significances	Decision
Between Groups							
Within Groups							
Total							

$$M.S_{\text{Within groups}} = \frac{SS_{\text{Within group}}}{\text{Degree of freedom}_{\text{within groups}}}$$

$$\text{F-ratio(F-cal)} = \frac{M.S_{\text{Between group mean}}}{\text{M.S Within group means}}$$