CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The major purpose of education is to equip recipients with knowledge and skills needed to function effectively and thus contribute to the development of the society. Education has remained an instrument for change and national development. Education is a process through which humans become useful to themselves and the society through the systematic acquisition of knowledge, relevant skills, values and attitude (Aguba, 2016). Nations currently desire economic growth, improvement in the quality of life, human rights and peaceful co-existence among communities and education is therefore an important factor in achieving them. Thus education is the foundation for sound economic development, wealth-creation, values, attitudes and knowledge acquisition for efficient utilization of human, material and financial resources to produce goods and services that satisfy societal demands (Amadi, 2011).

Nigeria is actively involved in the global deliberations on Education For All (EFA) as reflected in her policies and programmes such as Sustainable Development Goals (SDGs), which was developed, adopted and implemented since 2015. SDG has three critical elements namely; economic growth, poverty alleviation and inequalities. Also, the Federal Government of Nigeria (2014) stated that the goals of education are on the development of mental, physical and social abilities/competencies and acquisition of appropriate skills as equipment for the individual to contribute to the development of the nation. These goals of education can be easily achieveable through a well designed vocational and technical education programmes.

Vocational and technical education as a multifaceted, multi-disciplinary and pragmatic field of study is aimed at equipping individuals with requisite skills which will enhance their relevance and functionality in the society (Eze, 2010). Vocational and technical education is aimed at developing not only practical skills, but desirable work habits and attitudes that make the recipient very creative and resourceful. Furthermore, practical skill acquisition entails accumulation of different competencies and abilities that enhance task performance through integration of both theoretical and practical forms of knowledge.It makes provision for adequate training of trainee for self-employment using practical activities to enhance psychomotor skill development and practice in a conducive environment.

Psychomotor skills are those capabilities involved in a task or various tasks that learners are expected to acquire as a result of persistent practice (Ayonmike, 2014). Moreso, psychomotor skills are those skills or special abilities required by a learner in human activities which can be acquired through learning and constant practice. Additionally, Ayonmike stated that principles that guide psychomotor skill development are necessary in the education process for it to contribute to the development of a nation through effective human capital development to meet employment requirements. Supporting this view, Eze (2010) asserted that psychomotor skill development begins with practice in schools, adding that employment opportunities await graduates who possess relevant skills. However, it is common knowledge that many graduates of Nigerian educational institutions sometime lack psychomotor skills relevant for gainful employment in industries. This could be attributed to the methods of instructional delivery. Psychomotor skills are more often done through developed technical education.

Technical education at all levels of the education system emphasizes acquisition of psychomotor skills. Uwaifo (2010) viewed technical education as education and training which encompasses knowledge, skills, competencies and structural experiences for securing jobs in various sectors of the economy and even enabling an individual to become self-dependent by being a job creator. The author further stressed that if technical education instruction is delivered appropriately to facilitate acquisition of psychomotor skills, individuals could explore their environment and harness the resources which could serve them and create wealth for the society. In view of this, Dokubo and Dokubo (2013) asserted that psychomotor skill is the major distinguishing aspect of technical education which makes it outstanding from liberal arts. The authors further stressed that in teaching technical trades (electrical installation and maintenance work inclusive) instructors should adopt teaching methods which can increase interest and motivate students to improve on their academic achievement.Teaching methods employed in electrical/electronic should be able to match the programme objectives (Okoye, 2016).

Electrical/Electronic is an option in technical education programme and it is one of the trades in technical colleges which provide students the necessary skills to be self-reliant economically. The option covers electrical installation and maintenance work, appliance and repairs as well as radio and television services, including general electronic work (NBTE, 2013; UNESCO, 2016). Electrical/Electronic students of technical colleges are expected to secure employment either on completion of the entire programme or after completing one or more modules. It is also expected that they should be able to set up their own businesses, become self employed and able to employ others (FGN, 2014). To fully achieve the objectives of the programme as highlighted above, teachers should adopt effective instructional methods to adequately

equip students to be self-reliant and thus reduce unemployment and poverty. In furtherance, Okoye (2016) affirmed that electrical/electronic option of the technical education programme should equip students with salable skills and competencies to enhance their development of self-reliance initiatives.

In technical colleges, electrical installation and maintenance work is a trade in electrical/electronic option and provides learners with practical skills and knowledge required for effective electrical/electronic technicians. Such persons are needed for employment in organizations like Electricity Distribution Company (EDC), manufacturing, mining, oil and gas industries. Electrical installation and maintenance work comprises three modules namely; domestic and industrial installation, cable jointing and battery charging and winding of electrical machine, (NABTEB 2010). Additionally, graduates of this programme are expected to develop psychomotor skills in installing, operating, maintaining and repairing of electrically energized systems such as residential, commercial and industrial building. Electrical installation and maintenance work ought to be taught effectively, as anything less would not only wreck havoc to the lives of electricity users but will also worsen unemployment and poverty to the trainees (Ogbuanya and Akinduro, 2017). The authors affirmed that students can only be proficient in handling the above stated tasks in installation when teachers employ appropriate teaching methods.

Regarding the issue of appropriate teaching methods in technical colleges, Okoye (2016) asserted that since technical education programme is skill-based, teaching methods should be able to facilitate psychomotor skill in order to develop the capability and capacity of the individual to design, produce and use technological products and systems as well as assess the appropriateness of technological action.

Consequently, Okoye emphasized that there should be adjustment in the programme of technical colleges. In the same vein, Eze and Osuyi (2018) asserted that adjustment in technical education programme will affect the curricular implementation processes which are prosecuted through different learning experiences and contents. Similarly, FGN (2014) recommended that modern educational instructional methods should be increasingly used and improved upon at all levels of education system.

Additionally, the implication of the recommendation of FGN (2014) is that educators must be in constant search of teaching methods and techniques that could improve their practice, encourage learners to participate actively in the learning process and adapt more perfectly to a particular classroom situation geared towards meeting the societal and industrial needs. Several teaching methods have been documented as being effective in teaching psychomotor skills, improving students' performance and interest in technical education programmes especially electrical installation and maintenance work. These methods include discussion, demonstration, guided discovery, project-based methods, problem- solving, and field trips among others. While many instructors are aware of the existence of these instructional methods and techniques, most technical teachers simply opt to utilize the conventional (chalk-talk) method.

Over the years, the conventional method of instructional delivery has been dominantly used in Nigerian schools. This method of teaching according to Aguba (2015) is simply an act of spoon feeding learners with information or facts which has done more harm than good for courses that are skill based. Akem in Ayonmike (2014) stated that conventional method is good for large classes since much work could be

easily covered in a short time but it makes the teacher a custodian of informantion, ideas, and knowledge, thereby denying learners the opportunity to develop psychomotor skills which is needed for nation building. The resultant effect is the low achievements as evidenced in students learning outcomes portrayed both in the results of internal and external examinations. This could be the reason, Olokede and Olusanjo (2009) submitted that many researchers have adduced that low achievement in technical college public examinations is traceable to teaching methods employed by technical teachers. Futhermore, Edu, Ayang, and Idaka (2012) posited that conventional (lecture and demonstration) method cannot improve psychomotor skill development and interest of students in technical college trades.

Supporting this view, Yinusa (2014) lamented that inspite of all the important roles science and technology play in the development of the nations; their enhancement in Nigeria has been low. In the same vein Eze and Osuyi (2018) affirmed that even though the indispensability of technical education in the production of skilled trade persons for nation building and development of society has been universally acknowledged, the outcome of the implementation of technical education programme in Nigeria is still not encouraging. This is why many researchers, technical educators and other stakeholders have been searching for more effective ways to ensure effective teaching and learning of psychomotor skills in technical education for the benefit of the students and the nation.

A good number of researchers;(Omeje, 2011; Edu, Ayang, Idaka, 2012; Udofia, Udofia, 2013; Ayonmike, 2014; Amaechi and Thoman, 2016) recommended that demonstration and project-based teaching methods could be effective methods for teaching psychomotor skill in technical education because they encourage active

participation of students in the teaching and learning process and as well enhance their psychomotor skill development and interest. This could be applicable to psychomotor skill in electrical installation and maintenance work because when students understand the principles of a subject, they can construct knowledge of the subject, retain the knowledge and apply it practically in given situations. In support of this view, Abdulrahman (2012) averred that skills for practical knowledge are best learnt through demonstration and practice.

Demonstration method is a teaching technique that combines oral explanation with "doing" to communicate processes, concepts and facts. It is particularly effective in teaching a skill that can be observed. Demonstration in this study will involve the teacher and student (teacher-student demonstration performance). This is because the technical teacher is expected to demonstrate the skill to the students and observe them display what they have learnt. Demonstration method of teaching allows students to make use of all their senses- sight, smell, taste, hearing and touch (Omeje and Onaga, 2015). Students learn physical or mental skills by actually performing those skills under supervision (Edu, Ayang, Idaka, 2012). Furthermore, Daluba (2013) affirmed that teacher-student demonstration method is generally effective in teaching practical subjects, science, technical and vocational education. However, Edu stated that in using demonstration teaching method, giving students assignments/projects is inevitable for their better acquisition of needed skills. Such measures enhance the teaching-learning process.

Project-based method of teaching is one of the instructional methods used by technical instructors as it enables students' participation. According to Omeje and Onaga (2015), project-based teaching method involves units of activities carried out

by the students in a spirit of purpose to accomplish a defined, attractive and seemingly attained predetermined goals based on their background knowledge and experience. The authors further explained that project-based teaching method is like assignment method in which a task is given to students or a number of tasks are shared to students to carry out practicals allowing a great deal of students involvement right from the planning stage, the sketching of the project, the steps of executing it, the tools, equipment and materials to be used in the project. This will enable students to conceptualize the content and put the task into practice repeatedly in order to improve their psychomotor skill development and interest for societal development.

The goal of effective teaching and learning is to enhance academic achievement and skill acquisition. Achievement is qualified by the measure of the students' academic standing in relation to those of other students of the same age (Okoro, 2013). In the school setting, academic achievement connotes performance (psychomotor skill development inclusive) in a subject or many subjects as symbolized by the score or mark obtained by students in a test or examination (Eze, Ezenwafor, Obidile, 2016). According to Eze (2006) psychomotor skill development of students includes their acquired and retained physical and mental skills through the course of study within and outside the classroom situations. Psychomotor development skills of students are quantified by a measure of the proficiency in demonstrating the skill in comparsion with other students of the same age. Students'interest in a subject could determine students' academic achievement (psychomotor skill development inclusive) (Okigbo and Okeke, 2011).

According to Okigbo and Okeke, interest is an emotionally-oriented behavioral change which determines students' vims and vigor in tackling educational

task or other activities. The authors emphasized that the choice of instructional method may impact positively or negatively on the quality of knowledge accumulation of learners irrespective of their interest in the subject. Moreso, students' interest and achievement in any learning activity is sustained by their active involvement in the teaching-learning process. Stressing on the need for teachers to stimulate and sustain students' interest in the teaching- learning process, Okigbo and Okeke affirmed that students' achievement will be minimal if they lack interest in either the subject or the teacher. It is, therefore, very essential according to the authors that the method teachers use in teaching skill courses should stimulate and sustain the interest of all students irrespective of gender.

Agbejoye and Adegbola (2017) affirmed that gender could have influence on students'achievement and interest in different fields of study. The authors further asserted that professions like engineering, arts and crafts are generally regarded as men's field while others like catering, typing and nursing are regarded as womens' trades. Generally, tasks that are regarded as complex and difficult are allocated to boys whereas girls are expected to handle the relatively easy and less demanding tasks. As a result of this way of thinking, the society tends to regard females as the weaker "Sex" and the average Nigeria girl goes to school with these fixed stereotypes.Therefore, there is need to investigate the relative effectiveness of demonstration, project-based teaching methods and gender effect in developing students'psychomotor skill and interest in electrical installation and maintenance work in technical colleges in Anambra State.

1.2 Statement of the Problem

Skill development in different trades is critical for sustainable economic growth of products of technical colleges and the society. Psychomotor skills and interest in the study of electrical installation and maintenance work among students in technical colleges have been dwindling over the years. Hassan and Babawuro (2013) reported that most of the products of vocational and technical education programmes in tertiary institutions in Nigeria are half-baked as they lack psychomotor skills and therefore, are unable to function effectively in the world of work on graduation. This is why they are unable to exhibit the technical skills required to become self-dependent especially as they lack clear understanding of the theories and principles of electrical installation and maintenance work. This ugly trend could be attributed mainly to instructional methods used by teachers since the use of instructional methods that match the objectives of the programme will increase students' interest in the study as well as equip and empower them with skills to fit into jobs in the society. The goal of electrical installation and maintenance work in technical colleges is to produce skilled craftsmen with good knowledge of working principle of domestic and industrial installation and safety practices involved in its maintenance.

The problem of this study is that performance in theory and principles of electrical installation and maintenance work of students in technical colleges in psychomotor skill test in NABTEB examinations has consistently been poor in recent times (see appendix A page 135). Although such other factors like parental and societal influence can be implicated for the ugly trend, instructional methods used by teachers could be a key factor (Eze and Osuyi, 2018). The popular use of conventional (chalk-talk) instructional methods by teachers in technical colleges may have neglected or be unsuitable for psychomotor skills development which is the main

focus of technical education programme. Researchers have recommended the use of demonstration and project-based methods but it is not clearly known whether one is more effective than the other or both are equally effective in developing students' psychomotor skills and interest in electrical installation and maintenance work. This prompted this study on relative effectiveness of demonstration and project-based teaching methods in developing students' psychomotor skills and interest in electrical installation and maintenance work in technical colleges in Anambra State.

1.3 Purpose of the Study

The purpose of this study is to determine the relative effectiveness of demonstration and project-based teaching methods in developing psychomotor skill and interest among students in electrical installation and maintenance work in technical colleges in Anambra State. Specifically, the study determined:

1. The academic achievement mean scores of psychomotor skills of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.
2. The interest mean scores of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.
3. The academic achievement mean scores of psychomotor skills of male students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method
4. The interest mean scores of male students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.

5. The academic achievement mean scores of psychomotor skills of female students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.
6. The interest mean scores of female students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.
7. Interaction effect of teaching methods and gender on technical college students' psychomotor development skills in electrical installation and maintenance work.
8. Interaction effect of teaching methods and gender on technical college students'interest in electrical installation and maintenance work.

1.4 Significance of the Study

This study will be of immense benefits to technical college students, technical teachers, Ministry of Education, Industries and government.

Findings of the study are expected to help technical students develop their psychomotor skill and interest in electrical installation and maintenance work. The active involvement of students in the teaching and learning process is expected to make the students acquire psychomotor skill, giving rise to higher academic gains. The psychomotor skill developed will place value on the students and their certificate. Also the students will be confident and will perform well at job interviews and tests. The students will be well equipped to face modern technological challenges that will make them self-reliant and successful in life.

To technical teachers, the study is expected to create awareness in their minds on how to handle the techniques to bridge the gap between students' psychomotor skill development and interest of male and female in electrical installation and maintenance work. Also the findings of the study are expected to help technical teachers to teach those saleable technology psychomotor skills that will enhance the students'performance in external examination and employment. This will help to solve the problem of instructional method in teaching and learning process. The teachers will use the instructional methods to improve skill acquisition in technology, thereby reducing unnecessary stress. This will also help teachers to be proficient and competent in psychomotor skill aspects of teaching and learning. This will improve productivity and make teaching easier and effective.

The ministry of education at both federal and state levels is instrumental to policy formulation. Thus, the findings of the study will help the ministry in making policies and reviews that will strengthen the sector as regards instructional delivery. Officials in the ministry can also organize conferences, workshops and seminars so as to communicate to teachers the appropriate methods of teaching psychomotor skills in electrical/electronic technology.

The industries are also expected to benefit from the findings of the study as the industries will have enough skilled personnel that possess relevant psychomotor skills in electrical installation and maintenance work that will make them excel and face challenges in their work place. The findings of the study will also help electrical/electronic industries to have enough technicians to take care of their work needs.

It is expected that the findings of the study will provide useful information to the government in bringing to their awareness the most appropriate teaching method suitable for producing competent graduates who will possess employable skills that will help improve their lives and that of the nation's economy. Thus, students will be interested in technology, thereby, meeting one objectives of National Policy on Education in which technology is embedded and which requires the educational setting to train people who can apply scientific knowledge to solve problem for the convenience of man.

1.5 Scope of the Study

The focus of the study is to determine the relative effectiveness of demonstration and project-based teaching methods in developing students'psychomotor skill and interest in electrical installation and maintenance work in Technical Colleges in Anambra State, Nigeria. The study is delimited to domestic installation covering wiring system, electrical installation design diagrams and interpretation of wiring diagram. These are vital aspects of electrical installation and maintenance work that lead to self-employment for products of technical college and technological development of the nation. Trunking and ducting system, underground and overhead cable installation will not form part of the study.

1.6 Research Questions

The following research questions were raised to guide the study:

1. What is the academic achievement mean scores of psychomotor skills of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method?

2. What is the interest mean scores of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method?
3. What is the academic achievement mean scores of psychomotor skills of male students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method?
4. What is the interest mean scores of male students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method?
5. What is the academic achievement mean scores of psychomotor skills of female students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method?
6. What is the interest mean scores of female students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method?

1.7 Research Hypotheses

The following null hypotheses were tested at 0.05 level of significance;

1. There is no significant difference in the academic achievement mean scores of psychomotor skills of students' taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.
2. There is no significant difference in the interest mean scores of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.

3. There is no significant difference in the academic achievement mean scores of psychomotor skills of male students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.
4. There is no significant difference in the interest mean scores of male students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.
5. There is no significant difference in the academic achievement mean scores of psychomotor skills of female students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.
6. There is no significant difference in the interest mean scores of female students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.
7. There is no significant interaction effect of teaching methods and gender on technical college students' psychomotor skills in electrical installation and maintenance work.
8. There is no significant interaction effect of teaching methods and gender on technical college students' interest in electrical installation and maintenance work.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

The review of related literature for this study is organized under the following headings;

Conceptual Framework:

Demonstration Teaching Method

Project-based Teaching Method

Psychomotor Skill

Skill Development

Interest

Technical College

Theoretical Framework

Skill development theory

Scaffolding theory of proximal learning

Theoretical Studies

Relevance of technical education to individuals and the Nigerian nation

Technical college programmes and their contents

Electrical installation and maintenance work

Classroom application of demonstration and project-based teaching methods for psychomotor skill development and interest

Teaching methods and students' psychomotor skill development and interest

Predominantly used teaching methods in technical colleges

Teaching psychomotor skill in technical colleges

Gender and psychomotor skill development

Interest as a factor in students' psychomotor skill development in technical colleges

Empirical Studies

Studies on teaching methods and psychomotor skill development in technical colleges

Gender issues on psychomotor skill development and interest in technical education

Summary of Review of Related Literature

2.1 Conceptual Framework:

Relevant concepts in the title of the study are reviewed in this section as follows:

2.1.1 Demonstration Teaching Method

Demonstration teaching method, according to Ayonmike (2014), is one of the effective methods applied by teachers in achieving objectives of learning in real-life situations. Omeje and Onaga (2015) posited that from the time vocational and technical education courses were introduced in school system the demonstration method has stood out as the most definite and valuable method of teaching skill subjects. Demonstration remains the procedure whenever it is desirable to have students learn the exact and acceptable procedures in psychomotor skills.

The success of demonstration teaching method is based on imitation, as a factor in learning; it is well- known fact that imitation is a natural instinct which figures greatly in all types of education delivery system. Supporting this notion, Ayonmike (2014) noted that demonstration usually involves a process in which the learner follows a series of planned and organized steps. These steps make teaching and learning more realistic and impressive where actual objects, models or apparatus are used. Omeje and Onaga (2015) outlined the benefits of demonstration teaching method to include the following:

1. Demonstration method of instruction helps to enlist the various senses in human being. The senses include the sense of sight, the sense of hearing, the sense of feeling and the sense of recall.

2. The participating nature of the demonstration method helps students for effective communication. No effective learning will take place unless there is a two-way traffic approach to learning.
3. It saves time and energy especially for the teachers.
4. The method helps to enhance the prestige of the teacher as the students get convinced of the teacher command of the subject.
5. There is measure of positive reinforcement in which case students respect what the teacher has demonstrated.
6. It allows process and product evaluation.

In the same vein, Igboegwu (2012) affirmed that demonstration method as performed by the teacher is unfailing in developing and maintaining interest among students for the following reasons:

1. There is an appeal to the sense of vision
2. Skillful development in hand manipulation always attracts attention.
3. A desire is around to emulate work of the teacher
4. Students see immediately progress as a result of effort.

Ayomike (2014) pointed out that for demonstration teaching method to be effective, the teacher should;

Plan the Demonstration: Carry out the demonstration process and re-state the important points connected with it.

In Preparing Students for the Demonstrations, Demonstration method is divided into classes namely; class demonstration, group demonstration and individual demonstration. Class demonstration is a type of demonstration given to the entire

class at one time in one subject. The use of class demonstration that involves the entire class saves the teacher time.

However, Omeje and Onaga (2015) pointed out that for successful use of demonstration in teaching, the underlisted factors are important:

1. The class should feel a need for the demonstration. It may be the task of the teacher to use some artificial means to produce such an attitude, but in most cases, the need for information about work which students are eager to do can be the determined factor for the time of the demonstration primarily because they had been planned in advanced for a certain date.
2. Confine the demonstration to single unit of work: Teachers often fail to make the instructional material into sufficiently small units. As consequences, the demonstration becomes long and uninteresting; teachers should emphasize a small unit and enable the class to practice as quickly as possible after proper interest has been aroused in the unit taught.
3. Having equipment and material in readiness: All devices to be used in a demonstration must be at hand, which the teacher goes to the tool room or send students to bring instrument elsewhere during the demonstration, attention is diverted and emphasis on the unit of instruction is weakened or destroyed if practical materials are not available.
4. Make demonstration accessible to learners: During demonstration in the school workshop, teachers should assume a position that will enable all the students to see in detail and hear the oral explanation.
5. Use oral explanation: Oral explanation and discussion are needed for effective demonstration but must hold attention upon the work being performed.

6. Use acceptable trade method: The teacher should use the acceptable procedure necessary for carrying out the task in a trade to facilitate the understanding of the unit of lesson.
7. Do not quit too soon: it is better for the teacher to give a longer demonstration carried out to a satisfactory completion than to stop short and attempt to cover the reminder through oral discussion. Cares must be taken not to stop the demonstration midway so as to present the impression the teacher is afraid to try to perform certain processes because of lack of skill.
8. The follow-up is important: The clinching feature of demonstration lies in diligent and patient checking to see that it is put into operation. At best, there will be need for correcting wrong impression, assisting in establishing correct habits, and encouraging those who lack confidence to go on.

Nothwithstanding the discrepancies in the definitions, demonstration teaching method is the process of teaching someone how to make or do something in a step by step process. As you show how, you "tell" what you are doing. The teacher may be called a demonstrator. He demonstrates the activity before students that is to be developed.

2.1.2 Project-Based Teaching Method

The project-based method is also one of the methods which are predominantly used in the technical colleges. The project-based method at the same time is one of the standard teaching methods in vocational and technical education. Project-based method of teaching is suitable for large group; small group and individual instruction. Udofia and Udofia (2013) explained that the project-based method originated in the early twentieth century. It was greatly influenced by Dewey's problem-solving

method of teaching and it is an original work of W.H. Kill who advocated purposeful activity (Nwachukwu 2006).

Project-based teaching method, according to Nwachukwu implies that a practical problem is present which a student and the teacher plan to solve. The planning and the solution must be concrete in nature and should involve the design, arrangement of materials, availability of equipment, tools and a good environment for the activities. The teacher should have an excellent understanding of the individual student at the end of the learning activity.Udofia and Udofia (2013) stated that project-based teaching method is a learning activity selected, planned, designed and executed by the learner. According to the authors, these are done collectively or individually to clarify facts, acquire new knowledge, skills and appreciation and to solve identified problems under the teacher guidance and supervision. Furthermore, Nwachukwu (2006) asserted that whether the project is group or individualized, it involves four phases, namely; purpose, planning, executing and judging. The ideal progression is when all the four phases are initiated and completed by the students. Nwachukwu maintained that the role of the teacher in project-based teaching method is to provide guidance and direction to the students for effective performance.

Project-based teaching method therefore, is a teaching method in which students actively explore real-world problems and challenges and acquire a deeper knowledge.

2.1.3 Psychomotor Skill

Technical education progrmme is generally known as a programme which leads to the acquisition of psychomotor skills through work-experience. The term "Psychomotor skill" has variously been defined and interpreted by experts in the field.

First, the oxford dictionary of current English defines “Skill” as the ability to perform expertly, facility in performance, dexterity and tact. In adding the “Psychomotor” gives it a comprehensive definition. Psychomotor skill is concerned with muscular skills and coordination. Various terms have been used to refer psychomotor skill as motor skill, manual skills, and technical skills among others. Eze (2010) defined psychomotor skill as those skills that require the subject to have the capacity to co-ordinate sensorial information and muscular response in order to perform a determined task. Futhermore in the view of Nwachukwu and Okoye (2016) psychomotor skill domain emphasize motor skill as manipulation of materials or objects or an act which require neuromuscular coordination. According to the authors these skills are involved in controlling muscles signaled by the brain and motor neural pathways resulting in purposeful movement.

Psychomotor skill as a well-established habit of doing something involves the acquisition of skill and capabilities in the most economical way. This means that in psychomotor skill development, skill is a level of proficiency achieved on a specific task or group of tasks through practice. Eze (2010), went further to explain Psychomotor skill as the ability to bring about some end result with maximum certainty and minimum out lay of energy or of time and energy. Psychomotor skill in technical education involves activities that need the coordination of the finger and hand movement as a result of cognitive planning. The activities might include several tasks in electrical installation as installing, maintaining, wiring and drawing.

2.1.4 Skill Development

Skill development according to Ferris and Aziz (2005) refers to the explicit physical activities/actions or the outcome of a task. This means the capability of the

individuals to understand the processes and outcomes required, leading to permanent changes in their performance.

Therefore, psychomotor skill development is the ability to learn a skill and perfect in that skill when put to test. Psychomotor skill development can be proficiency in installing, maintaining or operating a machine. In the view of Ombugus and Umaru (2016), skill development is best defined from the point of view of the learner, as the process of obtaining knowledge of technical ability from an individual, group, or institution and in turn imparts such knowledge to others. Ombugus and Umaru further stated that psychomotor skills are usually aimed at practical purposes. Psychomotor skill development is aimed at ensuring self-reliance for the end products and thus practice must be emphasized over theory. Bello and Aliyu (2012) emphasized the need for practical training is to make psychomotor skills more functional. The authors further stressed that if theory takes a higher proportion of a psychomotor skill training scheme, the outcome may not meet the expectations of either the trainees or the society.

The FGN (2014) stated that technical and vocational education shall be self-reliant economically. Contributing, Ombugus (2015) asserted that techncal education philosophy was built on the production of graduates who will be equipped with necessary skills and knowledge that will not only enable them fit into already existing job opportunity in the society, but will also empower them with skills that will enable them establish on their own and create job opportunity for others. Skill training in technical education and particularly in electrical/electronic technology should emphasize psychomotor skill development over cognitive and effective skills. In view of this Okeme (2011) stated that psychomotor skill development is central in technical education. Okeme asserted that psychomotor skills have cognitive action, the

receiving and the use of perceived symbols, the aid of a value system, and physical action or movement. Teachers of technology are therefore, expected not only to possess relevant production skills but also are required to know the process of developing psychomotor skills. This will enable teachers to select appropriate teaching methods and techniques that will guide them in teaching students most effectively and efficiently.An understanding of the process by which psychomotor skills are achieved is a basic condition for effective technical education (electrical/electronic inclusive) and training. This process has been acknowleged by different social scientist such as Gall, Padelford, Stalling, Gague, Singer, Hammond and Lamar in Nweke (2010).

The studies in skill development theories have culminated into the six levels of psychomotor skill developments. These levels are perceiving**,** motivation**,** imitation**,** performing**,** adopting and innovation**.**

Perceiving: The first step in the process of developing psychomotor skill is to perceive the wanted skill or describe action. Hammond and Lamar in Nweke (2010) stressed that the teachers should develop in the students a strong desire to possess the manipulative ability. They should be genuinely interested in their skill development. It may be desirable to have students see a product that has been produced by a skilled person or in some cases, see a skill performance while it is in progress. The authors then concluded that teachers should see that the students have a clear and correct picture or (perception) of what is to be achieved otherwise, not much improvement can be achieved.

Motivation: Motivation or incentive is crucial to the process of developing psychomotor skills. Setting goals and/or solving problem must be the first step in creating motivation in the learner or trainee. According to Stallings in Nweke (2010),

motivation involves satisfaction of needs, rewards and/or punishment. Initial arousal of an intention seems to be a pre-requisite which operates as a trigger for further action. There are indications that engaging in an activity and practising are meaningful only when the learner shows an appropriate indication of motivation or incentive seems to be the activator and sustainer of action or thought when developing psychomotor skills. Gague in Nweke (2010) pointed out that various kinds of external stimulation and positive feedback make possible a high level of development in psychomotor skills. In teaching and learning process both internal and external sources of motivation should be employed. Without effective motivation or incentive psychomotor skills would not be developed or may be poorly attained.

Imitation: Imitation is the stage where the learner is involved in mental manipulation of the formed pattern or sequence and/or mimicking a series of events, patterns or procedures.The role of the learner, according to Singer in Nweke (2010) is to first combine the appropriate movements in correct sequence or order. In psychomotor skill development, the learner receives the necessary cues, mentally manipulates cues and organizes them into series of set before attempting to perform the function. Thus the author recommended that before embarking on any action, the performer ideally should have knowledge about the goal of the act together with some understanding of the steps through which the goal can be accomplished. It is expected then that the learner should manage the series of events as they unfold at every aspect of development.

As a practical way of assisting to imitate, Gall in Nweke (2010) advised that the teacher should ask the students to name the important steps in doing what they are now ready to do. Gall further stated that the teachers should demonstrate the procedure if it is difficult for the students to understand. This implies that teachers

should show and explain how to perform each operation step by step. The students should be made to go through the process, each trying their hands on it. Performing the operation is necessary in developing psychomotor skill.

Performing: Following the internalization of the mental picture of the steps or sequence required by the performer, the learner must engage in repeated practice. Padelford in Nweke (2010) described practice as a movement of the body according to the pattern the mind has been organized. Practice is a necessary pre-requisite for learning a task. Students of vocational and technical education (electrical/electronic inclusive) need to be given enough opportunities to practice what they have learnt in theory lessons. Udofia, Ekpo, Nsa and Akpan (2012) observed that in teaching a motor or assembling skill, the experience in the actual task itself is the critical variable. Eze (2018) commensurate this by stating that work experience will be effective in proportion to the specific experience for training habits of doing and thinking through repetitive performance.

Adapting: According to Padelford in Nweke (2010), adapting involves diagnosing and problem solving and the added dimension of creativity. The author recommended that certain psychomotor skills should be adaptable to new situations. Electrical/electronic technology education teachers should emphasize adaptive learning. This stems from the fact that transfer of learning is often required in problem-solving situation, which is a typical characteristics of production industry.

Innovation: This is the highest level of psychomotor skill development which emphasizes the ability to experiment and create new forms of learned skills. Singer in Nweke (2010) stressed that the opportunity to express feelings and to gain a feeling of

self-actualization are inherent in the innovation act. Innovation posed a challenge and an opportunity for fulfillment of positive self-concept.

For effective psychomotor skill development, the instructor should expose the learner through the following steps in the classroom or laboratory class demonstration.

A whole – part – whole technique

1. Requires that the skill be demonstrated 3 times as follows:

a. WHOLE: The instructor demonstrates entire skill from the beginning to the end, while briefly explaining each action or step.

b. PART: The instructor demonstrates skill again, step by step explaining each part in detail.

c. WHOLE: The instructor demonstrates the entire skill from beginning to end, without interruption and usually without commentary.

2. This technique provides an accurate example of the skill done in repetition.

a. If the students were not completely focused on the skill demonstration first time, there are two other opportunities for them to watch the presentation.

3. This technique may or may not be allowed to entertain questions as the demonstration is going on, but generally, discussion is allowed during the middle, step by step 'part' demonstration.

4. This technique works well for both analytic and global learners.

a. Analytic learners appreciate the step by step presentation and global learners appreciate the overview.

b. Learning styles have more information on analytic and global.

Progressing through the psychomotor skill domain level of skill development requires the following.

A. From novice to expert.

1. Allow students to progress at their pace.

a. If you move students too quickly they may not understand what they are doing and will not acquire good thinking skill.

2. Although the demonstration may provide information on the performance of the entire skill from start to finish, students should be allowed to learn the individual parts of the skill before putting it all together and demonstrating the whole skill.
3. Students should master individual skill before placing them in context of a scenario.
4. Student should be allowed ample time to practice a skill before being tested.
5. The need for constant direct supervision should diminish as practice time and skill level increase.

B. From novice to mastery level.

1. Demonstrate the skill to students.
2. Students memorize the steps of the skill until they can verbalize the sequence without error.
3. Students perform the skill stating each step as they perform it.
4. Students perform the skill while answering questions about their performance.
5. Students perform the skill in context of a scenario or actual project situation.

The steps in providing feedback during psychomotor skill development are as follows.

a. Interrupt and correct the wrong behavior in the beginner, to prevent mastery (muscle memory) of the wrong technique.
b. Practice session should end on a correct performance or demonstration of skill.

c. Allow advanced students to identify and correct their own mistakes under limited supervision.

d. Adult learners need encouragement and positive feedback to reinforce the correct behaviors.

1. Adult learners need good role models of correct technique.

a. Primary instructors, secondary instructors, skill instructors, department workshop attendants, instructor and preceptors are all important in developing psychomotor skills in students, and these individuals should be carefully selected for suitability to their individual role.

2. Allow adults to develop their own style of the standard technique after mastery has been achieved.

There are numerous ways to do things right namely:

a. Focus on what is considered professionally acceptable instead of demanding rote performance or parroted skills.

b. Spend time helping students to develop high level thinking skill so they can differentiate between options and adequately solve problems.

In improving psychomotor skill development during a skill session, the following steps will help to improve skill development (Nwachukwu& Okoye, 2016).

a. Have all necessary tools/equipment set up before session begins.

b. Use realistic and current tools/equipment that is in proper working order.

c. Allow ample practice time in class, at breaks and during other times.

d. Always model correct psychomotor skills behaviour.

e. Keep students active and involved.

f. Insist that students respect tools/equipment and that they are using the right tool for the right job.

g. Ensure competence in the individual skill before using scenarios.

h. If available, video tape and audio tape may also be helpful.

Satisfactory development of psychomotor skill is expected within the daily routine and is embedded within the integral components of work and life-related developments. It is essential to incorporate various styles of teaching and learning psychomotor skills, as well as to document mastery through the use of specific behavioural objective. This paradigm provides a practical approach to instruction in psychomotor skill development and competence (Olson, 2008).

One of the key factors militating against full utilization of the employment opportunities in the various sectors of the economy is lack of relevant skills (Eze & Oguyi, 2018). Eze further noted that no nation experiences development above the skill level of its human resources. Hence the shortage of appropriately skilled labour across many industries is emerging as a significant and complex challenge to Nigerian economic growth and future development skill, in all ramifications. Eze also noted that to a large extent the development of a nation depends on the caliber, organization and motivation of its human resources. Skill, according to Eze denotes expertise or ability developed in the course of training and experience. Thus it includes not only trade and crafts skill developed by apprenticeship as corroborated by Kayode (2009), but also, high-grade performances in many field, such as professional practice in the arts games and athletics. Notwithstanding some slight discrepancies in the definition above, recent professional literature in technology has stressed more and more on psychomotor skill development to include mental and physical abilities to accomplish a task.

2.1.5 Interest

Students' interest is very paramount in learning. According to Imoko and Agwagah (2006), interest plays a major role in any undertaking as it influences devotion to duties, fairness, firmness, honesty, endurance and discipline. Okigbo and Okeke (2011) defined interest as the attraction which forces or compels school children to respond to a particular stimulus. According to Abdulahi (2007), effective disposition of the student has direct consequences on the academic achievement. Abdulahi further posited that interest of children has direct bearing to the quality of work they do and their educational attainment. Okoro (2013) defined interest as a particular class of attitudes which are always positive, satisfying and pleasurable to the group. Ezeh (2006) affirmed that interest is indispensable for learning and that there can be no real education without interest.

According to Oviawe (2010), interest is the motive which serves as important influence in producing both activities and attitudes that are favorable to learning. In the same vein Igboegwu (2012), stated that interest can be seen as the cause of certain actions. Abdulahi (2007) opined that interest acts as a drive or motivation for people to act in certain ways. Also, the author further stated that interest is a type of attitude which shares in the same characteristics namely the cognitive (knowledge) component, affective (feeling) component, and action (behaviour) component. Akensete (2006) advised that in studying learners' interest, care must be taken to identify those undesirable interest areas; learner interest has to be guided so that educational objective might be directed towards eliminating undesired activities.

Okoro (2013) stated that the learner interest is very important in the study of any subject because the interest of a learner is in many ways the reflections of the

deeds. Therefore, it is pertinent to say that the interest of a student in a particular trade or career goes a long way in the psychomotor skill development of such students. Ochi and Atagher (2010) indicated that there is a very close relationship between students' interest and the academic achievement.The authors further explained that individual interests have personal significance and are usually associated with high levels of knowledge and value. Ali and Muhammad (2012) submitted that, it is up to a teacher to make a subject or course interesting. The author further stressed that the teacher can help in setting up certain conditions which will enable the students to take or create interest in the subject or course. Also, Ezeh (2006) in his study revealed that teaching methods significantly increased academic achievement, interest and retention of learning of students.

From the above assertion, interest plays a meditational role in academic achievement, especially between instructional and academic outcomes. Possessing the knowledge alone may not ensure successes if the interest is lacking. However, interest of student in any subject is born out of motivation and attitude exhibited by the teacher in the course of the teaching. In the context of this study, interest means drives that motivate students to act in certain ways.

2.1.6 Technical Colleges

Technical Colleges in Nigeria are geared towards producing crafts men in various disciplines. Their existence, as stated by Eze (2018) is to stimulate technological and industrial development by developing and utilizing technologies for industrial and economic advancement. Technical college is an integral part of the total educational system. It contributes towards the development of good citizenship by developing the physical, social, civic, cultural and economic competencies of the

individual (Okoye, 2016). In technical colleges students are trained to acquire relevant knowledge and skills in different occupations for employment in the world of work (NBTE, 2013).

The Federal Ministry of Education (2014) stated that Technical College is a segment of technical and vocational education (TVE) designed to produce craftsmen at the secondary school level and master craftsmen in advance craft level. The goals of technical colleges as stated by FME (2014), are to provide trained manpower in the applied sciences, technology and business, particularly of craft, advanced craft and technician levels; provide the technical knowledge and vocational skill necessary for agriculture, commercial and economic development and give training and impact the requisite skills to individuals who shall be self-reliant economically and in tune with latest technology. Technical colleges are the principal vocational institutions in Nigeria. They give full vocational training intended to prepare students for entry into various occupations.

Technical colleges also train craftsmen in auto mechanics, plumbing, carpentry and joinery, cabinet making, painting and decoration, welding, electrical installation, radio and television repairs, building construction and a few other areas. On completion of the course of training an individual can obtain job in industries or establish personal business. These programmes in the colleges were designed to train craftmen and artsans for the economy. The programmes were also designed to produce individuals who would not only be craftmen and artisans, but also knowledgeable about the role of technology and the environment in which they live.

2.2 Theoretical Framework

The theoretical framework of this study is based on Hubert and Stuart Dreyfus theory of skill acquisition and scaffolding theory of proximal learning. These theories are reviewed in this section as follows:

2.2.1 Hubert and Stuart Dreyfus Theory of Skill Acquisition

Theory of skill acquisition was propounded by Hubert and Dreyfus in 1980. The theory holds that human beings acquire skill through instruction and experience. They do not appear to learn suddenly from rule-guided to experience-based. Hubert and Dreyfus believed that there is a gradual process involved for a student to go through in order to reach the stage of expertise or knowing how. This theory metamorphosed into a learning model. The Hubert and Dreyfus skill acquisition model shows that a person goes through at least five stages of different knowledge of a specific task and ways of decision-making as the individual improves in the skill. Hubert and Dreyfus categorized the model into five stages namely novice, advanced beginner, competence, proficiency and expertise. These stages are further discussed below;

Novice: Here, the instruction begins with the instructor decomposing the task environment into context free features which the beginner can recognize without previous experience in the task domain. The beginner is then given rules for determining actions on the basis of these features. The characteristics of these stages are rigid adherence to taught rules or plans, little situation perception and no discretionary judgment. This stage is a stage of "just tell me what I need to do and I will do it".

Advanced Beginner: As the novice gains experience actually coping with the need situations, he begins to note or point out instructions, examples of meaningful and additional aspects of the situation. At this stage, the situational perception is still limited and all aspects of work are treated separately and given equal importance.

Competent: Competence develops when the number of rules becomes excessive or organizing principles need to be developed and information sorted by relevance. At this stage, the individual partially sees action as part of longer term goals and there is conscious and deliberate planning and formulation of routines.

Proficient: At this stage, a proficient performer perceives situations as wholes rather than in terms of chopped up parts or aspects, he sees what is most important in a situation, perceives deviation from the normal pattern and employs maxims for guidance, with meanings that adapt to the situation at hand.

Expert: At this stage, the learner transcends reliance on rules, guidelines, and maxims, has intuitive grasp of situations based on deep; tacit understanding, has vision of what is possible and uses analytical approaches in new situations or in case of problems.

Becoming an expert means being a master of a particular situation or skill. The expert operates from deep understanding of the total situation. The individual uses enormous background of experience in every new situation or in solving problems.

The model of skill acquisition by Dreyfus thus reduced the problems associated with the use of trial and error method of skill acquisition or learning by imitation. It also makes possible the stages of skill development as explicit as possible and considers the case of student developing psychomotor skill through instructional methods. The model in use is assessing progress in the development of skills, helps to define a desired level of competence, support the improvement in psychomotor skill

development, by understanding the learning of different levels of skill acquisition and helping to determine when a learner is ready to teach others.

The skill acquisition theory by Hubert and Dreyfus (1980) is relevant to the present study as it describes such stages which help the student perfects in psychomotor skill development through instructional methods. Technical college students are beginners and have no experience of the situations/task in which they are expected to perfect especially in electrical installation and maintenance work. They are taught rules to help them perfect in the specific task through the use of demonstration and project-based teaching methods. As the teaching progresses in using demonstration and project-based methods, the students mature into advanced beginners demonstrate certain acceptable performances. They make use of the rules given to them base on experience. At the level of competence, the students can make deliberate plans, achieve efficiency and organization. Students are helped with the use of demonstration and project-based teaching methods to perfect in psychomotor skill development. The students also approach the stage of "proficiency"they can recognize when the expected normal picture does not materialize. They understand situations as a whole. This holistic understanding will help them in decision-making.

Also through the use of demonstration and project-based teaching methods, the students'psychomotor skill improves and then become experts. Becoming an expert here means performing difficult task without supervision or support of any instructor.

The scaffolding theory of proximal learning was introduced to the study because the scaffolding aspect which is the support the student needs to attain to the zone of proximal learning is not contained in the Hubert and Stuart Dreyfus theory of skill acquisition hence the scaffolding theory.

2.2.2 Scaffolding Theory of Proximal Learning

Scaffolding will be considered from the perspective of Lev Vygotsky (1978), according to Vygotsky for students to develop skill then there is need for an instruction to bring the student to the level of what a student can do with and without help. This implies supporting learner's active participation in their learning and assisting them in becoming self-regulated learners. According to the author, appropriate instruction delivery is the scaffold which the student needs to achieve what alone would have been too difficult to achieve. The author further stated that the zone of proximal development (ZPD) is that field between what the learners can individually do and what can be achieved with support (instruction). Scaffolding according to Vygotsky, helps student to develop autonomous strategies thus promoting their own psychomotor skill learning and knowledge.

Vygotsky (1978) in the Scaffold theory stated that scaffolding can be used to develop:

a. Skills that students cannot perform.
b. Skills that the students may be able to perform.
c. Skills that students can perform with help.

Furthermore, in developing psychomotor skill through instruction Vygotsky stated that for an instruction to qualify as scaffolding then it must (a) Enable the learner to carry out task which they would not have been able to manage on their own. (b) Be intended to bring the learner to a state of competence which will enable the learner eventually to complete such a task on their own and (c) Be followed by evidence of the learners having achieved some greater level of independent competence as a result of the scaffolding experience (instruction experience).

The theory of scaffolding by Vygotsky is relevant to this study as it states categorically the importance of support and assistance. The use of demonstration and

project-based teaching methods is the support and assistance which a learner needs for psychomotor skill development. Delivery of lessons by demonstrating the skill and giving students project/assgnment can help control frustration level of the learner especially in developing psychomotor skill in electrical installation and maintenance work. These supports like teachers using demonstration and project-based teaching methods with the right resources will assist learners perform psychomotor skill which would have been too difficult for them to achieve. This implies that technical colleges should adopt scaffolding theory to provide all necessary support that will enable students develop psychomotor skills perfectly. It is the support and assistance given in any learning situation especially when teachers provide temporary structures that will assist the learners' performance and understanding of skills, concept and ability. As the learner gains the control of this new learning, the teacher withdraws gradually while the learner becomes increasingly able to control the task alone.

2.3 Theoretical Studies

Related theoretical studies to this study are reviewed in this section as follows:

2.3.1 Relevance of Technical Education to Individuals and the Country

Technical education has been an integral part of the national development strategies in many societies because of its impact on productivity and economic development. In other words, it is an education designed to develop occupational skills. Technical education as stipulated in the Federal Ministry of Education (2014) is a type of education designed to lead individual to the acquisition of applied skills and basic scientific knowledge. In addition to developing students' technological and creative capabilities with relevant knowledge and understanding, technical education

also offers wide range of context within which interested individuals learn how to control or modify the environment to meet specific needs.

According to Ayonmike, Okwelle and Okeke (2015) technical education is a planned prgramme of course 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. It also provides skills to become productive entrepreneurs as it stimulates creativity and innovative ideas, enlarges the economic pie and increase personal freedom. Okoye and Okwelle (2014) stated that technical education assists its recipients to be self reliant which invariably can result into self-sustanenace in future. Technical education equips one to be gainfully employed as a skilled worker. It also gives instruction in appropriate occupational skills, knowledge and attitude necessary for effective employment. Okoye and Okwelle further, emphasized that technical education is a type of education given to those who need it, want it and can profit by it. The transformation in economic, social and political life-style of people world over has been traced to technical development which in itself is a product of technical education (Ekponyong, 2008). The author further explain that the development is associated with a number of factors which include

1. Rate of employment generation.
2. Level of economic growth
3. Level of development in productive and management skills.
4. Level of development in commerce, science and technology.

Considering these factors, technical education as a field of learning has enabled individual to successfully use his brains and hands to earn a living in the society he

belongs to. It is based on this note that Ayonmike, Okwelle and Okeke stated that Nigeria is a fast developing nation blessed with abundance human and natural resources, opportunities and capabilities to create wealth and render efficient services that would improve the welfare of the citizens. Ayonmike et al further opined that technical education has immense contributions that will help in improving the quality of life of an average Nigerian. Nigeria, as a developing country has a myriads of problems. Apart from policies leading to political assassination and post-election crisis, the frightening dimension is youth restiveness. Nigerian youth are restive because, most of them are unemployed, they engage in criminal activities.

Therefore, with technical education, the situation can be checked as it is a programme geared towards empowerment. The youth should be empowered with technical education which would make them self –reliant or become employable in different sector of the economy and this will lead to security and peaceful co-existence within the country

2.3.2 Technical College Programmes and their Content

According to Ekpenyong (2008) every qualitative technical education programme has objectives which may be expressed in dimensions namely; general, affective and vocational. These dimensions or objectives are reflected in the NBTE (2013) programmes for technical colleges. The general education objectives is usually expected to be met through the introduction of general education which courses includes biology, chemistry, physics, entrepreneurship, and mathematics. The inclusion of general education courses is intended to show the relationship between academic and technical components and also between theory and practice as in junior secondary school (JSS) pre-vocational and general subject.

On this, FGN (2014) emphasized on the need to give incentives and equal career prospects to students of technical education and other vocational courses such as home economics, fine and applied arts, and agriculture which also represents the way of emphasizing the affective objectives. The third dimension, which is vocational objective, appears to be most pronounced since its focus according to FGN is on education and training in specific areas of commerce and technology such as catering craft, textile, painting craft and service machines which are needed by the economy. The FGN goes further to state goals for technical colleges as;

1. Developing individuals who will be properly equipped with requisite knowledge and skills for productive work-life.
2. Developing individual who will be capable of meeting the modern technology challenges
3. Developing a pool of competent and reliable technical manpower capable of being mobilized in times of national economic emergency
4. Developing in youths the right attitudes and skills towards work
5. Equipping the individual with the requisite knowledge and skills for paid or self-employment
6. Preparing the youths for meeting community, state and national manpower needs
7. Enabling the youths to choose and perfect on those areas of technical education for which they have interests and attitudes
8. Enable individuals to develop skills for making rational economic decisions either as producers or consumers.
9. Enable the youths to relate their expertise to needs of their local communities.

10. Preparing business and industrial managers who will be capable of meeting technological and managerial complexities of modern industry.
11. Establishing and maintaining liaison between the school and industry on matters affecting technical education and the world of work.

To achieve the stated goals as outlined by FGN, the NBTE (2013) listed the following programmes and their contents for technical colleges as:

1. Automobile Trades**:** These trades comprised auto electric work, motor vehicle mechanics, vehicle body building and agricultural implement mechanics.
2. Building and Woodwork Trades**:** These trades covers block laying, bricklaying and concreting, carpentry and joinery, craftsmanship and craft practice, furniture design and construction, machine wood working, painting and decorating.
3. Business Trades**:** Consist of business studies, parts merchandising, typewriting and steriography.
4. Computer Trades**:** Contain computer maintenances, GSM repairs and computer studies.
5. Electrical/Electronic Trades**:** Encompass appliances maintenance and repairs, electrical installation and maintenance works, instrument mechanics, radio, television and electronic work.
6. Hospitality Trades**:** Contain catering craft practice.
7. Mechanical Trades**:** Embrace fabrication and welding, foundry craft, marine engineering, mechanical engineering, craft practice, plumbing and pipe fitting, refrigeration and air-conditioning work.
8. Printing Trades**:** These are ceramic, graphic arts and printing craft.
9. Textile Trades**:** Comprised garment making, leather trades, textile trades.

10. General Education Courses**:** Includes: biology, chemistry, entrepreneurship education, ICT, mathematics, physics, economics, technical drawing.

To fully achieve the objectives of the above programmes in technical colleges' effective teaching of technical courses would help produce people who can be self-reliant and thus reduce unemployment in the country by opening self-employment ventures. This calls for the necessity of acquiring high quality psychomotor skill through the use of appropriate instructional design with competent and experienced teachers, well-equipped workshops, adequate supply of teaching materials and proper linkage between technical colleges and industries.

2.3.3 Electrical Installation and Maintenance Work

Electrical Installation and maintenance work (EIMW) is an occupation that has been affected by the change in technology and industrial standards. Current trends in EIMW are the challenge to repair, residential and industrial wiring, maintenance and installing. Because of the advanced and continuously evolving, technology will require students of EIMW in technical colleges to have greater knowledge in the area of repairs, wiring, services and maintenance, since individual student of EIMW needs advanced knowledge to deal with the changes brought about by the latest technology in the electrical industry. The advancement of technology in electrical industry will somehow affect the knowledge for carrying out maintenance on both residential and industrial installation.

The challenges facing students of electrical installation and maintenance work, after graduation is more or less in the world of work up to the end of early eighties. This was due to the known fact that almost all the electrical industries in the country do send their employees to training after employment. Due to the recent advanced

technology in the electrical industries, there have been radical changes which have been observed in the trend towards system of wiring in residential and industrial installation. The introduction of advance wiring in conduit, ducting and trucking into wiring system is commendable. In of view this, Adeyemi (2008) explained that the general evolution of the society has placed additional demands upon product performance. The author further explained that electrical/electronic is a field of study that is both science and technology related. It is concerned with the ways in which the movement of electron through space is controlled and manipulated. It application features in cables and other related equipment, the basic concept are principle of electrical, cable jointing and battery charging, wiring of electrical machines, develop skills in wiring of residential, commercial and industrial building. Also prepare students adequately for further work in electrically energized systems.

There is no doubt that electrical installation and maintenance work as found its niche in economic development of a nation. The advancement of technology in electrical/electronic in the developed and developing countries at least to the fact that electrical/electronic technology has greatly become a central focus of many countries economic policies most especially in the advanced countries. According to Ogbunanya and Akinduro (2017) the study of electrical installation and maintenance work is therefore very important to the technological growth of a nation like Nigeria as any other technological subject. However, the need for competent craftsmen becomes imperative considering the fact that the latest development in Electricity Distribution Company (EDC) are made from recent technology. Electrical installation and maintenance work in technical colleges include the following: domestic and industrial installation, cable jointing and battery charging, and winding of electrical machines. These modules were designed to produce craftsmen. Unlike that of colleges

of educations, polytechnics and university which are expected to produce technician, technologist and engineers respectively.

2.3.4 Classroom Application of Demonstration and Project-based Teaching Methods for Psychomotor Skill Development and Interest

Technical education is education for work. The programme is all about psychomotor skill development. Therefore, there is need to assist people to learn and develop appropriate knowledge, habits, thought, conduct and psychomotor skill as well as other qualities of character that will enable them to develop intellectually, socially, physically, emotionally, morally, spiritually and economically (Eze 2018). Psychomotor skill development is one of such ways of learning. Ferris and Aziz (2005) described psychomotor skill learning as a process by which individuals are exposed to the learning and continuous practice in a particular task till the learner becomes proficient in the operation and can perform them when required. Psychomotor skill is, therefore, learnt through observation and practice.

The basic method of instruction for teaching skill type subject is demonstration (Omeje and Onaga, 2015). This is a situation where the learner performs certain operations. The demonstration- performance method of instruction which Obeka (2010) stated that it is recommended for psychomotor skill development because it covers all necessary steps in an effective learning order. According to the author, demonstration steps give trainees the opportunities to see and hear details related to the skill being taught. Those details include the necessary background knowledge, the steps or procedures and the safety precautions. In the same vein, Ferris and Aziz (2005) stated that safety precaution help students to develop psychomotor skill in vocational and technical courses such as electrical/electronics,

metal work, building technology among others. The authors further added that demonstration has a long history of usage and it basically entails showing how certain operational principles to a given concept. Again the author submit that opportunities should be provided for them (students) to practice the skills they are taught in an environment that is relevant to the job skills.

In support of the above assertion, Omeje and Onaga (2015) stated that demonstration involves the teacher or the students showing activities in front of the classroom and explaining it as he proceeds. For students to develop psychomotor skill, demonstration must essentially be a teacher activity aimed at showing how a skill procedure or process work is done. The purpose is to help students acquire or develop requisite skills or procure related knowledge in technical education. In classroom, demonstration may be subjected to giving students task that requires a solution or illustration in order to ensure a quick arrival at the solution.

However, in the light of the above, Omeje and Onaga listed the following as classroom application of demonstration method of teaching for improvement in psychomotor skill development.

1. Task Analysis: Here the teacher/instructor is expected to outline the objectives of the demonstration to serve as a guide on where to emphasize during the teaching/learning process. Also, the teacher is expected to prepare and plan every step and perform it in proper order. That is step by step of the sub-ordinate skills which if perform by learners' will result to the achievement of the instructional goal (Main task). The sequential sub-skills to be performed must be enumerated in the chronological sequence. Also the instructor/teacher

must not lose sight of the pre-requisite knowledge or skills which learners may have prior to being exposed to the psychomotor skills or tasks to be learned.

2. Prepare Explanation Material: Here the instructor/teacher makes sure that all the require materials for the demonstration are available and are placed in position for easy access. Stopping at the middle of a demonstration is not the best option as it interrupts the flow of the understanding of the whole ideas. Also, preparation of instructional materials, tests and teaching steps, for instance, in demonstrating the construction of five lighting points controlled by three separate switches using joint box system of wiring, the instructor has to assemble the tools, materials, the wiring diagram and wiring board, which the learner has to read and comprehend before performing the task. Another example using the joint box, the teacher first demonstrates the entire psychomotor skills with the tools and materials from the beginning to end while briefly explaining each action or step. For example in surface wiring: the teacher uses the cable available to demonstrate the psychomotor skill in surface wiring and step by step explaining each part in detail especially in clipping and bending cables in joint box system. The teacher demonstrates the entire skill, from beginning to end without interruption from students usually without commentary especially in linking the cables from different terminals of the joint box to the switches and the lighting points.
3. Rehearsal of the Demonstration. The instructor/teacher is expected to give the demonstration a trial run. This will help to determine the clarity of procedure and will give more ideas. Also the instructor decides on the best sequencing strategy for presenting the instruction.

4. Prepare an Outline: Here the teacher/instructor should divide the demonstration into logical steps or stages. Also the instructor has to specify what skill to be taught or demonstrate. Again are the objectives stated measurable? This question will help equip the instructor to state categorically the specific skills to be learned, the condition under which they must be performed that is given tools and materials.
5. Prepare the Environment: Here the instructor/teacher is expected to make sure that everybody stays in a position where he sees and hears what is going on and what is been said. This may be enhanced by dividing the class into small groups. In this step the teacher must ensure safe work condition. It must also be added that teachers must prepare for possible question to ask students and those that may be asked by students. He must also anticipate probable areas of difficulty with respect to the concepts and principle that relate to the demonstration. It is on this note that Obeka (2010) stated that instructors should employ the teacher-student type of demonstration in teaching psychomotor skill as it affords students the opportunities of trying their hands on the job. In preparing the learning environment personnel the teacher also selects resources which include logistics such as facilities and tools, equipment and services needed to support the successful demonstration.

For demonstration method to be effective for psychomotor skill development Eze (2010) listed three factors considered effective for classroom application of demonstration. They include: Imitation, repetition and participation.

1. To imitate implies to mimic or copy the behavior or acts of teacher by students. As they watch the teacher performs certain acts. They consciously or unconsciously follow and practice the examples of the teachers.

2. Repetition involves the performance of an act many times to master the act. Eze highlighted that after performing a skill, the learner must repeat the action many times before he attains any degree of readiness.
3. Participation in technical education involves the learners practicing under the actual production condition or situation.

Eze adduced that both the imitation of a master and frequent practice, fall short of complete preparation for skilled vocational and technical practice, hence the need for practice by the learner in the actual production conditions. In the same vein, Okoye (2010) stated that the process of psychomotor skill development under demonstration learning environment involves Observation, imitation, manipulation, performance and perfections. The author further explained that for psychomotor skill to be developed in an occupation then performance is required and this could be taught through demonstration.

The benefits of psychomotor skill development in electrical installation and maintenance work (EIMW) cannot be over stressed. People who have developed psychomotor skill in EIMW through excellent performance are sure to be either self-employed or they secure related employment in government agencies or in private business organization. Okoye and Okwelle (2014) pointed out that the purpose of vocational and technical education is not reducing people's need for work but rather to make it more pleasant and productive. Psychomotor skill development in technical colleges remain the major goal of vocational and technical education and this will help to satisfy the personal work needs of both the individual and society.

In view of the above assertion, Beart, Beunens&Dekeyser in Okoro (2013) recommend the use of project-based method which is a learner-centered approach in

teaching technical college students. This is because project-bsed method of teaching is based on the concept that students learn better when they are not passive recipient of knowledge. Okoro asserts that students may not be challenged to gain a deeper understanding of what is learnt or to apply the content to real situation without actively engaged in activities. By assigning a project or task to students to accomplish, it empowers them to learn outside the classroom lessons and develop contextual situation in which they can transfer the knowledge with the above principles. Project- base method of teaching will be very effective for psychomotor skill development in technical colleges as the major goal of vocational and technical education is to help individual satisfy personal work needs.

For Project-baesd method to be effective in psychomotor skill development Omeje and Onaga (2015) listed the following steps for classroom application of project-based method.

1. Project Selection: Here the instructor/teacher should avail opportunity to know what project entails, the goals and objectives taken before the topics can be drawn up for the class. This means that it is the duty of the teacher to help the students select topic. It could be individual, grouping or the entire classroom. For example in electrical installation and maintenance work specifically in wiring, students could be given a project to construct a joint box wiring using three separate switches to control five lighting point. This project is specific and will help students develop psychomotor skill in installing and wiring through the development.
2. Project Planning**;** Here, the instructor/teacher is expected to answer some question which makes it possible for students to learn the project. In doing this, it will help students achieve certain goals and objectives. These questions

well answered will guide the students into assuming intelligent responsibility for their learning activities. The teacher should be able to answer the under listed questions;

What skills, ideas and understanding will be achieved through the project works?

Will the above points when achieved contribute to the improvement in psychomotor skill development of the students?

Will the chosen project activities be suitable for the psychomotor skill development of the students?

Is the interest of the student going to be captured by the project?

Are the students well equipped with material, resources and knowledge for successful completion of the project?

Supporting this view Okoro (2013) stated that throughout the planning of the project the student imitative should be stimulated by a positive and constructive attitude. This will help boost the students' interest in the project

3. Conducting of the Project: Here the teacher is expected to be present in the class especially where students are new in project work. The teacher must make sure there is order in the class and allow the students who failed the project to join group who will help them out. Also, the teacher should advice the students to prepare their work for final presentation as the project is coming to conclusion.
4. Evaluation of the Project: Here, during the project process, the student evaluates himself; he finds out where he is failing, he tries to revise his steps

to make sure he achieves his goals. Also the teacher and student try at the end of the project to find out some modifications that will help to improve the project next time.

Furthermore, Udofia and Udofia (2013) opined that to select a project in technical education there are certain requirements that should be met on the bases of the project's contribution to the desired change in behavior. The wisdom and knowledge of the teacher is important at this stage as he/she must ensure that students embark on projects that will help in achieving the desired educational objectives. The authors stated some requirements that may come in form of questions to the teacher thus;

1. Does the project promote the desired behavioral change in the students?
2. Does the project involve processes which are related to skillful methods and techniques?
3. What is the cost and value of the project?
4. Does the project present challenges?
5. Can the project be completed within a reasonable length of time?
6. Is the project well design?

Supporting this view Omeje and Onaga (2015) asserted that when such criteria are involved in the choice of a proposed project a majority of affirmative answers are achieved.

The researcher will follow the above techniques critically and logically and will validate the practical application of the project-based teaching method in psychomotor skill development of students in electrical installation and maintenance work.

2.3.5 Teaching Methods and Students' Psychomotor Skill Development and Interest

Teaching is a process of impacting knowledge which involves many activities on the part of the teacher and the learners (students). Teaching methods therefore, include these various means and activities of the teacher and learner in the learning process geared towards acquiring ideas, knowledge, skills and values that are built within the educational aims and objectives. According to Ajibade (2009) teaching methods describes various ways information is presented to the students specifying the nature of the activities in which the teacher and the learner will be involved during the teaching and learning process. Oludipe (2012) from another perspective defined teaching methods as the framework in which what learners need to learn is conveyed to them by the teacher. In view of these definitions teaching methods can be asserted as primarily the description of learning objective oriented activities and the flow of information between teacher and students in the teaching and learning processes.

Teaching methods involve different activities of the teacher and the learner such as questioning, explanations, demonstrations or directions. These activities can be referred to as skills or techniques. Thus teaching method involves different techniques. The use of these techniques vary with different teaching methods and depend on many factors such as learning objectives, nature of subject, age of students, number of students among others. Hence, there are different types of teaching method, discussion demonstration, recitation, lecture/discussion, games and simulations, problem-solving role-play, scaffolding, inquiry learning, project among others. These different teaching methods are grouped by some educators (Shawnee,

State University, 2001: Sawa, 2002 and Campbell, 2006) into two approaches; teacher-centered and student-centered.

Teacher-Centered Approach:

Teacher-centered approach includes all the teaching methods that the teacher dominates in the lesson procedure and takes the lead in coordinating the classroom activities as regards to what to be done. Sawa (2002) stated that teacher-centered method includes all the teaching methods grounded in behaviorism such as lecture, some form of demonstration, discussion and recitation. Teacher-centered classroom is thus rigidly structured and only factual information is conveyed to learners. For instance in lecture method, the instructor presents facts and principles orally. In view of this, the lecture method has been criticized to be a poor method of teaching hand-on skills in science and technology including electrical installations and maintenance work although it provides for effective use of time and manpower especially in presenting ideas to a large group of people. Considering other teacher-centered approaches Campbell (2006) described demonstration "as a teaching method that involves the teacher showing students a process or procedure involved in learning process. The demonstration method has some advantages over the lecture method in skill acquisition. This makes it effective for technical education teaching.

Student-Centered Approach

Student-centered approach include all teaching methods that underscore the teacher as a decision maker and problem solver in the classroom but rather see teachers as guides, facilitators, mentors, coach or consultants in the teaching and learning process. In the educational sector the term 'student-centered' 'child-centered' or learner-centered' are interchangeably used to refer to teaching methods that allow students to share some degree of responsibility and decision making in the classroom. The student-centered approach is opposed to the teacher-centered approach that

characterizes the traditional teaching methods which rests classroom decisions solely on the teachers. Nevertheless, in today's educational discussions the term student-centered approach is a broad term that includes all teaching methods that are usually activity oriented, where learners are expected to observe, analyze, synthesize and evaluate ideas or phenomena using materials of previous knowledge. Teaching methods emphasizing this approach include discovery, problem solving, project-based method, role play, simulations and games. Inquiry method and constructivism related method (concept mapping, cooperative learning among others).

The student-centered is relevant to technical education teaching because in technology teaching, creating an environment that will encourage students to interact with materials and tools enable students to construct meaningful knowledge and learn technology first hand. In view of the relevance of student-centered approach to technical education many researchers in technical education for example Ayonmike (2014) and Omeje and Onaga (2015) recommend the demonstration teaching method in the teacher-centered approach and the project-based method in the student-centered approach in improving psychomotor skill development, acquisition of practical skills and in promoting scientific literacy among technical education students. Nevertheless these studies did not investigate the relative effectiveness of demonstration and project-based teaching methods in developing psychomotor skill and interest among students which is the objective of this study.

2.3.6 Predominantly Used Teaching Methods in Technical Colleges

Teaching in technical education programmes basically is meant to impact the basic scientific knowledge, attitudes and practical skills necessary for self-reliance and national development. The practical skills and knowledge are to make the

recipient (individual) to be creative and productive in order to function as a performing member of the society. In essence the goals of teaching technical education in Nigerian technical colleges are to prepare students for the world of work and the acquisition of theoretical and practical skills. This implies that the technical colleges are expected to train and produce graduates who are equipped with practical rudiments of their chosen trades. This means that the rationale for training students in these trades is for acquisition of knowledge, attitudes and practical skills that are marketable and lucrative for sustainable development.

Therefore, to impart these skills in any individual effective teaching method must be employed during teaching process. Teaching in general context has often been referred to as an occupation, enterprise and an act of explaining reading and writing (Suleiman &Nuhu, 2009). According to Sawa (2002) Teaching and Learning are considered as two sides of a coin, because for teaching to be meaningful, it must be effective in promoting knowledge, skills and values. Though, these basic definitions of teaching also apply to regular classroom setting in technical colleges. But, in the teaching of practical skills, there are various teaching methods and teaching techniques to be adopted, just as in other fields. The most appropriate teaching methods to adopt in teaching technical and vocational skills in technical colleges should be that which can motivate students and sustain their interest in the course of instruction (Yinusa, 2014). Furthermore, the author stated that in terms of practical skills acquisition, it is very appropriate to adopt a teaching method that can bring out the manufacturing process and exploration of materials in the classroom situation. Effective teaching method is believed to be a source of critical thinking or inspirational disposition on the part of the students. (Yinusa, 2014). According to Okoye (2010) teaching methods utilized by teachers in technical colleges must also

improve in line with the changing needs of the contemporary society. Therefore,a good teaching method for technical skills acquisition lessons in technical colleges must possess certain qualities capable of bringing the lesson student-centered activity. The following characteristics of teaching methods are outlined by (Onuegbu andObiwus, in Okoye, 2010) are as follows:

1. It should progress from simple activities to the more complex tasks.
2. It should posses qualities capable of arousing the interest and enthusiasm for active participation of the students.
3. It should be flexible to accommodate individual differences of the learners.
4. It should be structured in such a way that will satisfy the basic needs of the students.
5. It should be motivating for achievement without boredom
6. It should link classroom activities with real life activities.
7. It should be able to put into action five senses (hearing, seeing, feeling, testing and touching) for effective transfer of skills acquired.

In the same vein Baturay (2008) stated that in technical colleges, teaching methods used should;

1. Develop students' psychomotor skill: Teachers should build the subject program around psychomotor skill development process by (a) selecting context and adopting curricular to address students learning needs, interest and prior knowledge. (b) Developing activities and assessment that promote students depth of understanding. (c) Working as colleague across disciplines and class level.

2. Facilitate learning: Teaching should guide and facilitates learning with a variety of strategies such as:
    a. Helping students focus on the psychomotor skill development through performance.
    b. Requiring students to share responsibility for their own learning.
3. Provide learning environment that;
    a. Provide time for practical activities for skill development.
    b. Are safe but flexible and supportive of students' activities and actions.

From the above assertion the technical college teachers are expected to possess adequate and sufficient practical experience necessary for imparting the skills to learners through the use of appropriate teaching methods. In Nigeria, the FME (2014) places considerable emphasis on vocational technical education practical skill acquisition and lifelong learning. It emphasizes on the study of technologies and related sciences and acquisition of practical skills, attitudes and knowledge relating to occupation in various sectors of the economy and social life. In view of the above, Okoye (2010) maintained that teachers and schools teaching technical courses should emphasize on the practical aspects of different specialities for technical education programmes. Therefore the need for learning practical skills in technical colleges cannot be overemphasized.

Though there is no one best method of teaching psychomotor skill practical instructions in technical colleges but a combination of different methods may be more desirable to use, there are already known methods of teaching practical skills that can be adopted to facilitate the acquisition of psychomotor skills in technical colleges. According to the recommendation of Ajubade,Olokede and Olusanjo in Yinusa (2014) include (1)Demonstration Method (2) Discussion Method (3)project-based

method (4)Discovery method (5)field trip method (6)Assignment and electronic learning method (7)Enquiring method and problem solving method. The technical teacher can select among these methods to be used in teaching of practical skill instructions in technical colleges in Nigeria.

2.3.7 Teaching Psychomotor Skill in Technical Colleges

The acquisition of psychomotor skill is essential to technical education. Teaching as a systematic activity should be designed in technical colleges to facilitate psychomotor skill teaching in order to enable learners construct worth-while knowledge and skill. Ferris and Aziz (2005) listed procedures that will help the technical instructor to teach psychomotor skills in technical institutions (Technical colleges inclusive)

1. Recognition of tools and materials.
2. Handling of tools and materials.
3. Basic operation of tools.
4. Competent operation of tools.
5. Expert operation of tools.
6. Planning of work operations.
7. Evaluation of outputs and planning means for improvement.

The psychomotor skill teaching procedures as proposed require elaboration to enable meaningful interpretation of the researcher's intent.

1. **Recognition of Tools and Materials:** The most basic level of practical skill competence involves the ability to recognize the tools of the work or trade and the material. This level of skill requires that one learns what the tools are, so that when presented with a sample of a particular tool one has the ability to recognize it as such. In technical work or field (electrical/electronic inclusive),

there is need to use certain materials to work upon as the subject matter of the practical work in the field. Recognition of both tools and materials is important for both effectiveness in work and safety. Recognition is necessary as the first step towards being able to make effective use of the tools or materials. Safety depends on recognition because once the tools and materials are recognized; it is possible to associate the tools and materials with particular safety information associated with them.

2. **Handling of Tools and Materials:** Tools and materials are appropriately handled in certain ways. This particular processes for picking up, moving and setting down tools and materials must be learned. The processes are required in order that the objects can be handled without damage to either the object or other objects in its environment or hazard to any person either the person moving the object or someone else. Therefore, it is necessary to have linking in wiring system and wiring diagram, so that the student will be able to appropriately correlate information concerning tools and materials needed for the completion of the task. This criterion of learning is necessary for handling of the objects with awareness of the potential problems of handling so that the risks associated with handling of the objects can be recognized and pre-empted.
3. **Basic Operation Tools:** The basic operation of tools concerns the ability of the student to hold the tool appropriately for use, to set the tool in action and to perform elementary tasks. The tasks that can be performed at this level are the specific detail tasks which, when assembled into a sequences, result in the completion of a piece of significant work. This level of competence concerns

teaching the students how to operate the tools and how to attend to the fundamental operational characteristics of the tools.

4. **Competent Operation of Tools:** At this level, the student becomes able to appropriately use the tools for performing a range of task of the kind for which the tool was designed. This level is distinguished from the proceeding by the student being able to assemble a significant sequence of tasks which, when brought together enable the completion of designed work associated with the use of the tool. The work produced will be a sound standard that could be delivered as part of a finished product. Examples of such work in electronics would include the ability to clip and bend cales on a wiring board or the ability to consistently mount wiring accessories on wiring board.
5. **Expert Operation of Tools:** The ability to use tools with ease to rapidly, efficiency, effectively, and safely perform work tasks on a regular basis. The expert user of the tool is able to produce the right outcome with attention being placed on the broader context of the work that is being done rather than the harrow context of the tasks being performed to do the work.
6. **Planning of Work of Operations:** At this level of competence the student is able to take a specification of a work output required and perform the necessary transformation of the description of the finished outcome in a sequence of tasks that need to be performed on the material in order to achieve the desired outcome and bring to fruition the finished product intended. The process of planning work operation in the required repertoire and the ability to discern matters such as the order of operations to efficiently and effectively produce the desired output product.

7. **Evaluation of Outputs and Planning Means for Improvement.** At this level of competence, the practitioner is able to look at a finished output product and review that product based on quality manufactured, with the ability to identify particular deficiencies and the actions which could be taken to either correct the faults or to prevent the faults through appropriate planning of the manufacturing/construction operations.

To help the students acquire these skills to meet the demand of the time. Sullivan (2010) outlined the sequenced steps of psychomotor skill learning that may assist instructors in teaching skills in technical colleges as;

Preparation: Whether it is in the workshop or in the classroom, it is important that the instructor is fully prepared to teach the skill. This process includes familiarity with the procedure, tools and equipment. In, addition, it is important to become familiar with the skill level of the learner. Questions about prior performance of the same or similar skill, graduate level, and prior rotations is useful to provide targeted instruction.

Conceptualization: During this step the learner is provided with all of the cognitive techniques of the skill. Information about the specific task, pitfalls, common errors and safety rules/regulations are necessary for the learner to understand the overall goal of the task. In addition, knowledge to the specific procedural skill, such as cable clipping, surface wiring and interpretation of installation design diagrams. If the task is on wiring, steps of the procedure are important to review. An introduction of the cognitive skill is essential for learners to acquire the procedural rule. In this stage, learners learn “what” to do and not necessarily “how” to do it.

Visualization: The learner sees the skill performed in its entirety from beginning to end by an expert. This step is often omitted but is significant as it provides the basis

for imitation and gives the learner a model of expected performance. It is important to note that visualization does not have to be done live, a videotape will frequently be a more feasibly way to accomplish this step. Advantages of video visualization include the ability to use techniques such as slow motion, close-up detail display and stopping to ask question. Whether done by video or live demonstration, the sequential steps of the procedure and explanation of "how" each step is performed and a focus on difficult steps will augment skill acquisition.

Verbalization: The instructor provides a narration of the steps of the procedure. It is helpful to divide the procedure into subtasks. This method helps the learner to identify and follow the key steps in the correct manner and order. The learner should then be able to correctly describe the steps, this helps ensure that the learner is able to narrate the steps of the skill before demonstrating it, and there is greater likerlihood that the learner can correctly perform the skill.

Practice: Practice is a fundamental aspect of learning and perfecting in psychomotor-skills. Complex skills, such as performing a surgery, are refined over long periods of time involving deliberate practice. Delibrate practice is concentrated, highly structured and comprised of activities that have been found to be most effective in improving performance (Borich, 2008). However, the author, stated that the number of hours spent in deliberate practice determines the level of expertise; therefore, it is generally agreed that expertise takes 10 or more number of hours to develop (Borich, 2008).

Feedback: Feedback is essential to help learners achieve proficiency in technical skills. Without it, mistake go uncorrected and become part of the trainees everyday performance. Once faulty skills be automated, it is difficult to retrain the learner to the

correct technique. The best feedback is specific and timely. Morealso, feedback should focus on actual observations and should not be given prematurely. A constructive feedback conveys an attitude of concern regarding progress and is valued by most learners. To reinforce learning, each task or operative procedure can be followed by a brief session.Video recording followed by a review of the recording by both instructor and trainee can cement performance, identify mistakes, and help move learners towards competency.

Mastery: Mastery is the ability to routinely perform a sequence of skills in practice situations without error. To facilitate mastery of a skill, department can arrange for contiguity and repetition. When possible, the departmental instructor may arrange to work with the same group of students every day in order to facilitate repetition and provide opportunities for practical work. The instructor can observe performance and offer feedback by reinforcing what is right, correcting errors and teaching fine or best points of the skill.

Autonomy: The last step of psychomotor skill learning is autonomy. Autonomy is reached when a trainee demonstrates the ability to regularly perform the skill in real life situation without error.

In technical colleges, it is necessary for practical work to be designed and taught in a coherent way to provide experiences that will lead to targeted levels of competences in a particularskill. Coherent design of practical work instructional method will enable more efficient and effective use of equipment and instructional resources. In teaching practical aspect in technical education programmes, the teaching objectives should be targeted to gain the maximum effect for the input required. This will definitely result in improvement of proficiency, gaining a higher

competence per unite of resources. A further benefit of planning the practical component of technical education programmes around some set of objectives as suggested in this research will be the possibility of designing assessment of the practical skill performed by the students in a manner that reasonably assesses the capability of the students in the tasks.This matter so much in the practice of the profession.

2.3.8 Gender and Psychomotor Skill Development and Interest in Technical Education

Gender is a socio-culturally constructed concept of ascribing some characteristics and roles to sex such as male and female within the society. The concept of gender is equivalent to class and race and has many social construct just as class and race (Ojobo, 2008). In Nigeria the issue of gender and gender stereotyping permeate every aspect of human endeavor. Dania, (2014) observed that the circumstances of gender have strongly interacted with culture to produce sex role-stereotypes which cut across social, economic political and educational development especially in the areas of science and technology. Omoiya (2013) explained sex role – stereotypes as the socio-cultural classification of human activities by sex in line with what the society considers as appropriate for male and female.

The arbitrary assigning of roles and expectations to different sex (male and Female) with the society has given rise to such misconception of perceiving technical education as "Musculine" and Male domain only. Agbejoye and Adegbola (2017) observed that in Nigeria that certain vocation and professions have traditionally been assigned to different sex. Nevertheless Akpotohwo and Ehimen (2014) reported that although there is a gap in gender difference in students' performance in science and

technology education, but female representation in technology education is still low in comparison with their male counterparts.

Gender issues and its effects on psychomotor skill development and interest in technical education has persisted over the years with contradicting results and stands out as a controversial issue in technical education due to varying reports from different research. Some researchers; Akpotohwo&Ehimen (2014) and Ogbunanya&Akiduro (2017) are of the view that there is gender disparity in psychomotor/acquisition of technical and vocational skills. Whereas some other educators: Olufunke& Adebayo (2014) and Agbejoye&Adebola (2017) are of the view that both males and females achieve equally in science and technology when given equal opportunity and facilities. Furthermore, Okoro (2013) specifically maintained that some teaching methods that involves students' competition such as individual methods favors' male students more than female. Teaching methods that encourage group work such as co-operative learning favors females more than males.

However, this report is in line with the observation of Okoro (2013) which stated that males tend to be dominating in physical and competitive activities while female show no interest and are always shy and prefer working in group or under male counterparts. In view of the inclusive issues of gender effects on psychomotor skill development and interest and some reports that teaching methods influence gender, skill development and interest in technical education. This study therefore intends to contribute to the ongoing academic argument and controversy on the effects of teaching methods on psychomotor skill development and interest relating the effectiveness of demonstration and project-based teaching methods to determine the interaction effects of these methods and gender on students' psychomotor skill development and interest in electrical installation and maintenance work

2.3.9 Interest as a Factor for Psychomotor Skill Development in Technical Education

Many variables had been identified by Abdulahi (2007), Ezeh (2006), Okoro (2013) and Ayonmike (2014), as responsible for students' low interest and poor performance in vocational and technical education. Such variables include curriculum, examination bodies, teachers, students, environment and textbook. Imoko and Agwagah (2006) identify poor primary school background, lack of interest on the part of the students, incompetent teachers in primary schools. Female students not having interest in science subject (technical education inclusive), perception that technical courses are difficult, psychological fear of technical courses, poor method of teaching and lack of qualified technical teacher are causes of poor performance in vocational and technical education.

Interest is an important variable in learning because when one becomes interested in an activity, he/she is likely to be more deeply involved in that activity (Okigbo and Okeke, 2011). Interest is a subjective feeling of concentration or persisting tendency to pay attention and enjoys some activity or content. (Imoko and Agwagh, 2006).Though some children may be intellectually and physically capable of learning. They may never learn until their interest is stimulated, they will continue as long as the teacher is capable of sustaining their interest in the subject matter. This is because interest is a mother of attention, once there is direct interest, attention is guaranteed and learning is assured (Okigbo& Okeke, 2011). Also, interest can be expressed to simple statements made by individuals of their likes, dislike and one is likely to do well in a discipline of interest.

The low interest in technical education emanated from the society perception of the programme. Nwachukwu and Okoye (2016) observed that technical education is seen as a programme for low academic achievers. Again, it is common knowledge that the perception of average Nigerian student is that technical education is a course that is dominated with practical and is majorly meant for students that are intellectually incapacitated. The way and manner students perceived the course, arise from the fact that instructional methods adopted by teachers both in the classroom and in the field during teaching and learning process are not impressive the effect of this is lack of interest and poor performance. This has caused many to look down on the programme. It is in the light of the above that Okoye (2016) stressed that teachers of technology should fashioned the technical education especially electrical/electronic programme to be attractive to the society. According to the author this could be achieved by redesigning the instructional method to consider prior cultural beliefs which seem to have contributed to the poor concept formation and poor students' interest in technical education.

This view of Okoye is in line with recommendation of Fafunwa, Macaulay and Sokoya in Adekunle (2012) that the mother tongue approach based on the success of a programme in the western part of Nigeria in which students were taught science using the local language. The programme was found to boost students' interest and performance in science education. When a learner is not psychologically ready for a task he loses interest or benefit nothing from a learning process (Okigbo&Okeke, 2011). Also a learners attention span determines the extent of learning and this is highly connected to the age of the learners this implies that the teacher must organize learning activities in such quantities that those he teaches are able to cope and have interest in the course.

Currently, researchers around the country are calling for change in the method of teaching technical education which is the foundation for manpower development and economic growth. The lecture/demonstration method currently used in technical colleges could be re-designed to follow its approach properly to keep students interested. This implies that if the approaches of demonstration and project are appropriately utilized in classroom instruction thus involving hands-on and minds-on exercise that will arouse and sustain students' interest. When technical education is taught with materials and demonstration, the learners tends to learn better and their interest sustained this is because it keeps the learners actively involved. According to Akensete (2006) as students actively construct and direct their own learning experience, they no longer memorize definition but are able to incoperate new information into cognitive structure. To achieve this, the role of the teacher is more of a facilitator which should give students room for personal performance. This will enhance psychomotor skill development.

2.4 Empirical Studies

Empirical studies that are related to the current study are reviewed in this section as follows:

2.4.1 Studies on Teaching Methods and Psychomotor Skill Development in Technical Colleges

Omeje (2011) conducted a study on the effects of project-based method of teaching on the academic achievement, interest and retention of low ability students in carpentry and joinery in technical colleges in Enugu State. Four research questions were used for the study and four hypotheses were tested. The design employed was

the quasi-experimental pre-test, post-test non-equivalent control group design to ascertain the effectiveness of project-based and conventional teaching methods. A purposive sampling technique was used in selecting 40 low ability carpentry and joinery NTC II students in two technical colleges in Enugu State. The instrument for data collection was the Carpentry and Joinery Achievement Test (C& JAT) developed by the researcher and validated by three experts in vocational teacher education and measurement and evaluation.An interest and attitude inventory scale was also design to test students' interest and attitude.

Kudar Richardson 20 (k-R20) was used to determine the internal consistency of the instrument which yielded reliability coefficient of 0.83. The instrument for data collection was the pre-test and post-test on the two groups (experimental and control groups) before and after four weeks of teaching by the regular carpentry and joinery teachers. Mean was used to answer the research questions while the analysis of covariance was used to test hypotheses at 0.05 level of significance.Findings of the study revealed that students taught with project-based teaching method performed better than those taught with the conventional method. Also the performance and interest scores of male and female students in the experimental group taught carpentry and joinery with project-based teaching method were greater than those of their counterparts taught with the conventional method. The researcher therefore, recommended project-based teaching method as an operational plausible strategy for teaching carpentry and joinery at the technical college level in Nigeria.

This study of Omeje (2011) is related to the present study based on the purpose and design. However, the teaching methods and areas of specialization covered in the two studies as well as location are different. While Omeje used the conventional teaching method to compare with the project-based method, the present

study used the demonstration teaching method to compare with the project-based teaching method. Also, Omeje's area of specialization was carpentry and joinery while that of the present study is electrical installation maintenance and work. Furthermore, Omeje's study was conducted in Enugu State while the present study was conducted in Anambra State.

Udofia and Udofia (2013) conducted a study on the effect of project-based and e-learning teaching methods and skill acquisition in electrical installation and maintenance work in technical colleges in Akwa Ibom State. Four research questions were used for the study and four hypotheses were tested. The design employed was the quasi-experimental pre-test, post-test non-equivalent control group design to ascertain the effectiveness of project-based and e-learning teaching methods. Purposive sampling technique was used in selecting 90 NTC 2 students from two technical colleges in Akwa Ibom State. The instrument for data collection was Skill Acquisition Test (SAT) developed by the researchers and face validated by experts.

Pearson Product Moment Correlation Coefficient was used to determine the internal consistency of the instrument which yielded reliability coefficient of 0.84. The instrument for data collection was the Pre-test and post-test on the two experimental groups (EG1 and EG2) before and after a period of seven weeks by the regular electrical installation and maintenance work teachers. Mean was used to answer the research questions while the analysis of covariance (ANCOVA) was used to test hypotheses at 0.05 level of significance. Findings of the study revealed that male and female students taught with project-based teaching method performed better than those taught with e-learning. Again, the male and female taught with project-based teaching method showed evidence of greater performance in skill acquisition than those taught using e-learning teaching method. The researchers, therefore,

recommended that the project-based teaching method should be compulsorily used in technical colleges to promote active participation of students in the teaching and learning of important skills and concept to solve problem in real world situation and develop students' psychomotor skills in line with modern demand.

This study of Udofia and Udofia (2013) is related to the present study as both are concerned with the effects of teaching methods on skill acquisition in electrical installation and Maintenane work in technical colleges. However, the two studies differ in content and location in the sense that Udofia and Udofia's study used project-based and e-learning in Akwa Ibom State while the present study used demonstration and project-based teaching method and covered Anambra State.

Okoro (2013) conducted a study on the effects of project-based teaching method on secondary school students' academic achievement, interest and retention in home economics in Enugu State. Four research questions were used for the study and four hypotheses were tested. The design employed was the quasi-experimental pre-test, post-test non-equivalent control group design to ascertain the effectiveness of project-based and conventional teaching methods. A multi-stage sampling technique was used in selecting 160 Js1 students from four co- education secondary school in Nsukka local Government area of Enugu State. Three instruments were used for data collection the Home Economics Achievement Test (HEAT), Home Economics Interest Test (HEIT) and Home Economics Retention Test (HERT) developed by the researcher and validated by three experts in vocational teacher education and measurement and evaluation.

The cronbach alpha was used to determine the internal consistency of the HEIT instrument which yielded reliability coefficient of 0.84 while KudarRicharson

(K-R20) was used for HEAT and HERT which yielded reliability coefficient of 0.86. The instrument for data collection was the pre-test and post-test on the four groups (2 experimental and 2 control groups) before and after four weeks of teaching by the regular Home Economics teachers. Mean and standard deviation was used to answer the research questions while the analysis of covariance was used to test hypotheses at 0.05 level of significance. Findings of the study revealed that male and female students taught with project-based teaching method performed better than those taught with the lecture method. Also male and female students in the experimental groups taught with project-based teaching method showed greater interest in Home Economics than those taught with the lecture method. Similarly, the study also revealed that there was no significant difference in the achievement and interest of male and female students in Home Economics. The researcher therefore, recommended that project-based be used in teaching Home Economics in Nigerian schools.

This study of Okoro (2013) is related to the present study based on the purpose and design. However, the teaching methods and areas of specialization covered in the two studies as well as location are different. While Okoro used the lecture teaching method to compare the project-based teaching method, the present study used the demonstration teaching method to relate the project-based teaching method, while Okoro's area of specialization is Home Economics, the present study is on electrical installation and maintenance work while Okoro's study was based in Enugu State and the present study was conducted in Anambra State.

Ayonmike (2014) conducted a study to determine the effect of lecture, demonstration and blended teaching methods on students' psychomotor performance in brick/block-laying and concreting in Delta State technical colleges. Nine research

questions guided the study and twelve hypotheses were tested. A quasi-experimental pre-test, post-test non-equivalent control group design was used. The population of the study was 215 year one students of brick/block laying and concreting in the six governments technical colleges in Delta State. No sampling was done in the study. Test re-test method was used to ascertain the reliability of the modified Brick/Block-laying and Concreting Competency Assessment Instrument using data collected from 20 brick/block-laying and concreting vocational year one students from technical college Edo State.

Pearson Product Moment Correlation was used to analyse the reliability coefficient which yielded 0.96. The instrument for data collection was the modified Brick/Block-laying and Concreting Competency Assessment Instrument (BCCAI) which was validated by three experts from technology and vocational educational department and measurement and evaluation. Pre-test and post-test instrument was used on three groups (2experimental groups and 1 control group) before and after a period of sixteen weeks treatments by the regular brick/block-laying regular teachers who taught in the schools. Mean and standard deviation were used to answer the research questions and analysis of covariance (ANCOVA) for testing the hypotheses at 0.05 level of significance. Findings of the study revealed that students of experimental groups 1,2 and 3 that were taught brick/block-laying and concreting with lecture, demonstration and blended teaching methods improved in their post-test psychomotor performance when compared with their pre-test. Again, the finding revealed that there were significant differences in the mean psychomotor performance scores of male and female students taught brick/block-laying and concreting with demonstration teaching method in Delta State Rural Technical Colleges but there was no significant difference in the Urban Technical Colleges. It was concluded that

lecture, demonstration and blended teaching methods have significant effects on students' psychomotor performance in brick/block-laying and concreting. The researcher therefore, recommended that government should adequately provide the required training materials and human resources for effective implementation of brick/block-laying and concreting in particular and other technical trade courses in Delta State technical colleges. Again government should organize training and re-training programme for brick/block-laying teachers in particular and other technical trade courses teachers of Delta State technical colleges to enable the technical teachers develop audio-visual instrumental aid for teaching psychomotor skills in technical trade courses. Finally the researcher recommended that technical teachers generally and brick/block-laying and concreting teachers in particular should adopt variety of teaching methods to make a good blend for the purpose of improving students'psychomotor performance.

This study of Ayonmike (2014) is related to the present study based on the purpose and design. However, the teaching methods and areas of specialization covered in the two studies as well as location are different. While Ayonmike used three teaching methods, the present study used two, while Ayonmike's area of specialization is brick/block-laying and concreting the present study is on electrical installation and maintenance work while Ayonmike's study was based in Delta State, the present study was conducted in Anambra State.

Datom (2015) conducted a study on the effectiveness of demonstration and guided discovery teaching methods on interest and achievement of upper Baic science students in Wukari Educatiion Zone in Taraba State, Nigeria. Four research questions were used for the study and four hypotheses were tested. The design employed was

the quasi-experimental pre-test, post-test non-equivalent control group design to ascertain the effectiveness of demonstration and guided discovery teaching methods. Random sampling technique was used in selecting 159 JS2 students from 3 public junior secondary schools in Wukari education zone. The instrument for data collection was the Basic Science Concept Achievement Test (BSCAT) developed by the researcher and validated by three experts from the department of science and measurement and evaluation.

Kudar Richardson 20 (k-R20) was used to determine the internal consistency of the instrument which yielded reliability coefficient of 0.75. The instrument for data collection was the pre-test and post-test on the two experimental groups and 1 control group (2experimental and 1 control groups) before and after five weeks of teaching by the regular basic science teachers who taught in the selected schools. Mean was used to answer the research questions while the analysis of variance (ANOVA), scheffe's post Hoc tests as well as Kruskal-wellis interest analysis was used in testing the hypotheses at 0.05 level of significance. Findings of the study revealed that students taught with guided discovery teaching method EG2 performed best followed by demonstration teaching method EG1 and lecture teaching method CG performed low. Also interest level of participants showed significant difference after exposure to demonstration teaching method while there was no significant difference in interest level of participants after exposure to guided discovery and lecture teaching methods.Based on the findings relevant recommendations were made. A major hightlight of the recommendation is that stakeholders in the education sector should make concerted effort to see that government at all levels should encourage the use of guided discovery teaching method by sponsoring teachers to attend in service training, seminars or workshops be acquainted with this activity-

oriented teaching strategy in teaching and learning of Basic Science in junior secondary schools.

This study of Datom (2015) is related to the present study based on the purpose and design. However, the teaching methods and areas of specialization covered in the two studies as well as loction are different. While Datom used the demonstration teaching method to compare the guided discovery, the present study used the demonstration teaching method to relate the project-based teaching method, while Datom's area of specialization is basic science; the present study is on electrical installation maintenance and work while Datom's study was based in Taraba State, the present study was conducted in Anambra State.

Ogbuanya and Ogundola (2014) investigated the effect of inquiry technique on students' psychomotor achievement of technical college students in Motor Vehicle Mechanic Work. Three research questions guided the study and three hypotheses were tested. A quasi-experimental pre-test, post-test non-equivalent control group design. Random sampling technique was used in selecting 195 year two students in Motor Vehicle Mechanic Work drawn from four technical colleges in Ekiti State. 94 of the subjects were assigned to experimental group A (guided discovery) and 101 were randomly assigned to experimental group B (structured inquiry). The instrument for data collection was Motor Mechanic Psychomotor Achievememnt Test (MMPAT) which was face validated by three experts.

Pearson Product Moment Correlation Coefficient was used to determine the internal consistency which yielded 0.83. Pre-test, post-test was the instrument used data on the two experimental groups (A&B) before and after a period of ten weeks of treatment by the regular Motor Vehicle Mechanic Work who taught in the selected.

Data were analyzed using mean and standard deviation to answer the research questions and analysis of covariance (ANCOVA) for testing the hypotheses at 0.05 level of significance. Findings of the study revealed that students in both experimental groups performed well, but the students taught with guided inquiry technique performed significantly better than the students in the structured inquiry experimental group. Again, the finding revealed that, there was a significant gender difference in the students' psychomotor performance in MVMW. Based on the findings some recommendation were made which included that technical teachers of motor vehicle mechanic work should prepare their lessons in such a way that students are allowed ample opportunity to freely interact with one another in guided inquiry space so as to improve their psychomotor performance.

This study of Ogbuanya and Ogundola (2014) is related to the present study based on purpose and design. However, the teaching methods and areas of specialization covered in the two studies as well as location are different. While Ogbuanya and Ogundola used guided inquiry and structured teaching methods, the present study used project-based and demonstration, while Ogbuanya and Ogundola's area of specialization is motor vehicle mechanic work; the present study is on electrical installation and maintenance work while Ogbuanya and Ogundola's study was based in Ekiti State, the present study was conducted in Anambra State.

Ishaya and Halliru (2016) conducted a study to identify strategies for improving students' acquisition of practical skills in electrical installation and maintenance work in technical colleges in Kano State. Three research questions guided the study and three hypotheses were tested. A descriptive survey was used as the design for the study. The random sampling technique was used in selecting 24 school administrators, 22 trade teachers and 208 final year students making total of

254. Furthermore, 28 item structured questionnaires was the instrument used for data collection which was validated by experts.

The cronbach alpha was used to determine the internal consistency which yielded a reliability coefficient of 0.80. The data was analyzed using mean, standard for answering research questions and t-test for testing the hypotheses at 0.05 level of significance. Findings of the study revealed that technical teachers and students believed that adopting practical teaching strategies will definitely improve students' acquisition of practical skills in electrical installation and maintenance work in technical colleges. Also taking attendance by teachers at the beginning of every practical session, guiding the students in selecting of tools and materials for practical session, encouraging students to be open minded in selection of tools and be creative about application of techniques to their challenges during practical session to make sure student are provided with the needed material at the beginning of every practical session will also improve students practical skill acquisition. Finding of the study also revealed that, Making sure students are systematically assessed during and at the end of every practical session, enforcing safety rules and regulation with regards to use of workshop facilities will improve practical acquisition of students. Finally the researchers recommended that EIMW in technical colleges is all about skills that help students for employment and wealth creation therefore, in order for students to acquire practical skills, teachers are required to teach relevant skills to students by adopting appropriate teaching, supervisory and assessment strategies.Again, Government should motivate technical teachers so that they put in their best in teaching practical skills to students in technical colleges.

The study of Ishaya and Halliru (2016) is related to the present study as both are concerned with practical skill acquisition of studentsusing appropriate teaching

method. However, the two studies differ in content and design in the sense that Ishaya and Halliru's study did not take into consideration in comparing teaching methods to determine the effectiveness of each on students' psychomotor skill development and interest while the present study compared the effectiveness of demonstration and project-based teaching methods on students' psychomotor skill development and interest.

Bassey, Amadike, Nsikan and Segbara (2016) carried out a study to investigate the relationship between workshop safety compliance and student's psychomotor skill acquisition in electrical installation and maintenance work in technical colleges in Akwa Ibom State, Nigeria. Three research questions guided the study and three hypotheses were tested. A descriptive survey was used as the design for the study. The random sampling technique was used in selecting 120 NTC 11 electrical installation and maintenance work students in six technical colleges in Akwa Ibom State. Furthermore, the researchers developed two instruments for data collection. The Workshop Safety Compliance Inventory (WSCI) and Practical Tests in Electrical Installation (PTEI) which was validated by three experts. It was pre-tested on two private technical college students who did not take part in the actual study. Cronbach's alpha estimated was used to establish the reliability of 0.74 for WSCI and 0.73 for PTEI respectively

Pearson Product Moment Correlation was used for testing three hypotheses at .05 alpha level and 199 degree of freedom. Findings of the revealed that, there was a high positive significant relationship between safety compliance in wearing approved safety clothing and their psychomotor skills acquisition in electrical installation and maintenance work in technical colleges in Akwa Ibom State. Also there was a high positive significant relationship between safety compliance in proper use of

appropriate tools and students' psychomotor skill acquisition in electrical installation and maintenance work in technical colleges in Akwa Ibom State. The researchers concluded by saying that the level of safety compliance in technical colleges in terms of wearing approved clothing, storage of materials, physical facilities of electrical equipment, house-keeping practices, first-aid kits and workshop design is generally poor. The non-compliance result is students' poor psychomotor skill acquisition in electrical installation and maintenance work. The researchers therefore, recommended that teachers of electrical installation and maintenance work in technical colleges in Akwa Ibom State should teach the students to comply with safety rules and regulations to acquire psychomotor skills. Students should acquire enough safety rules and regulations alongside adequate psychomotor skills before graduation this will enable them to be self-reliant, self-employed, job creator, self-actualizer and employers of labour in Akwa Ibom State, finally the researchers recommended that teachers of electrical installation and maintenance work should make use of good and proper instructional techniques in the teaching of electrical installation and maintenance work to impart safety compliance and psychomotor skills to students before graduation.

The study of Bassey, Amadike, Nsikan and Segbara (2016) is related to the present study as both studies are centered on psychomotor skill development in electrical installation and maintenance workof technical college students. However, both studies differ in content, design and location in the sense that Basseyetal study centered on workshop compliance and skill acquisition while thepresent study considered the relative effectiveness of demonstration and project-based teaching methods on psychomotor skill development and interest of students in electrical installation and maintenance work.

Similarly, Ombugus and Umaru (2017) conducted a study to identify strategies for improving metalwork technology in technical colleges for economic recovery in Nasarawa State. Two research questions guided the study. A descriptive research design was adopted for the study.Random sampling technique was used in selecting 180 metalwork teachers and students in four technical colleges in Nasarawa State. The questionnaire was the instrument used for data collection which was validated by experts.

The cronbach alpha was used to determine the internal consistency of the reliability coefficient which yielded 0.73. Mean was used to answer the research questions. Findings of the study revealed that Problems hindering students' skill acquisition in metalwork technology include inadequacies in the availability of equipment which makes it difficult for students to acquire the needed skills in metalwork technology.The study also revealedthatmethods of teaching might demotivate students' skill acquisition in metalwork technology courses.The researchers concluded that technical teachers need to expose students' to strategies and techniques that will assist them to acquire life skills and competencies to maximize their potentials for successful employment and self-reliance. The following recommendations were made by the researchers: Technical teachers teaching metalwork technology should adopt teaching methods that can impart the needed skills and knowledge to the students; Metalwork practical classes should be funded by the school to motivate the student. Finally, Metalwork articles produced by students should be exhibited to encourage parents and motivate students.

The study of Ombugus and Umaru is related to the present study because it sought to determine students' improvement in practical skill development. However, both studies differ in content and location in the sense that Ombugus and Umaru's

study was based in Nasarawa State while the present study was conducted in Anambra State.

Further more, Ogbuanya and Akinduro (2017) conducted a study on the effect of floating facilitator and peer tutor instructional approach on student's psychomotor achievement in electrical installation and maintenance work in technical colleges in Ondo State, Nigeria. Three research questions guided the study and three hypotheses tested. The design used for the study was quasi-experimental pre-test, post-test non-equivalent control group design. A purposive sampling technique was used to select 171 students from four technical colleges. An electrical installation and maintenance work psychomotor test (EPT) was developed by the researchers which was face validated by experts.

Pearson Product Moment Correlation Coefficient was used to determine the internal consistency of the reliability coefficient which yielded 0.74. The instrument was the pre-test, post-test of the two experimental groups (G1&G2) before and after a period of eight weeks of treatment.The data obtained were analyzed descriptively and inferentially. The mean and standard deviation were used to answer the research questions while the hypotheses were tested at 0.05 level of significance using analysis of covariance (ANCOVA) statistics and partial eta square for the effect size.

Findings of the study revealed that floating facilitator and peer tutor instructional methods were both effective in enhancing students' psychomotor achievement in electrical installation and maintenance work although, peer tutor had stronger effect.The study also revealed that peer tutor instructional method is more effective in enhancing student's psychomotor achievement in electrical installation and maintenance work. Finally, the findings revealed that gender had small influence on psychomotor achievement and no significant interaction effect. The researchers

concluded that given that electrical installation and maintenance work in technical colleges equip graduates with skills to install, operate, maintain and repair electrically energized systems in residential, commercial and industrial buildings, the need to find out the best approach of teaching to assist technical college electrical installation and maintenance work students to learn and improve their skills is paramount. The researchers therefore, recommended that curriculum planners should develop appropriate curriculum that will make provision for the adoption of the floating facilitator and peer tutor instructional methods for teaching electrical installation and maintenance work in technical colleges placing more emphasizes on peer tutor instructional method. Again, electrical teachers as well as other technical teachers should adopt the use of peer tutoring in technical colleges in order to improve students' psychomotor achievement. Finally, the researchers also recommended that female students should be encouraged to study electrical installation and maintenance work like their male counterpart.

The study of Ogbuanya and Akinduro (2017) is related to the present study in purpose and design as the two studies focus is on students' psychomotor achievement in electrical installation and maintenance work. However, the two studies differ in content and location in the sense that Ogbuanya and Akinduro's study compared the effect of floating facilitator and peer tutoring approach in Ondo State while the present study is on the relative effectiveness of demonstration and project-based teaching method in developing students' psychomotor skill and interest in electrical installation and maintenance work in technical college in Anambra State.

2.4.2 Gender Issues on Psychomotor Skill Development and Interest in Technical Education

Akpotohwo and Ehimen (2014) investigated the cause of gender disparity in the acquisition of technical and vocational skills in Delta and Edo State senior secondary school system. Two research questions guided the study. The researchers adopted a survey design. Purposive sampling technique was used in selecting of 370 (250 male and 120 female students) respondents. Furthermore, A 20 item questionnaire was used to elicit information from the respondents which was validated by experts in vocational and technical education.

Cronbach alpha was used to determine the internal consistency which yielded reliability coefficient of 0.73.The information obtained were analyzed using mean and standard deviation to answer the research questions. Findings of the study revealed that career in technical and vocational skills have negative effect on female marriage opportunity and it is incompatible with mother's role or care at home. Again, the study revealed that unconscious influence of the society and parental guardian opinions were responsible for gender disparity in the acquisition of technical-vocational skills.However, the researchers made recommendations that, vocational guidance in schools should be strengthened to guide and encourage female students' participation in technical skills acquisition programmes.

The study of Akpotohwo and Ehimen (2014) is related to the present study in purpose as both studies sought to determine the effect of gender on students' skill acquisition/achievement in technical education. However, both differ in design, location and content as Akpotohwo and Ehimen's study is a descriptive design and made use of questionnaire as instrument for data collection while the present study is

a quasi-experiment design involving pre-test and post-test as instrument for data collection.

In the same vein, Olufunke and Adebayo (2014) conducted a study to determine the moderating effect of Generative Instructional Strategy (GIS) and Predictive Observe Explain (POE) and gender in improving primary pupil basic science practical skill in Ondo State. Two research questions were used for the study and two hypotheses were tested. Random sampling technique was used in selecting 90 pupils in two schools, 51 males and 39 females from chosen Local Government Area of Ondo State. The quasi-experimental pre-test, post- test non-equivalent control group design was used.The researcher's made test titled "Basic Science Practical Skill Test (BSPST)" were used for data collection which was face validated by experts

Cronbach alpha was used to deermine the internal consistency of BSPST which yielded reliability coefficient of of 0.83. The instrument was the Pre-test and post-test on two experimental groups (A&B) before and after a period of six weeks of treatments by the regular basic science teacher in the sample schools. The study used mean and standard deviation to answer the research questions and the t-test and ANCOVA to test the null hypotheses at 0.05 level of significance. The findings revealed that gender has no significant moderating effect on pupil's practical skills in basic science when taught with GIS and POE. The study concluded that practical skills should be constantly developed in male as well as in female pupils so as to improve basic science practical skills of primary school pupils. The researchers therefore, recommended that female pupils should not be exempted or marginalized since they have equal chances of excelling as their male counter-part in practical activities. The researchers also recommended that practical skills should be constantly

be developed in male as well as female pupils by the use of activity-oriented form of instruction such as POE instructional strategy.

The study of Olufunke andAdebaye is related to the present study in purpose and design. However, differ in content and location in the sense that Olufunke and Adebayo's study used the Predictive Observe Explain (POE) and the Generative Instructional Strategy (GIS) to determine the moderating effect of gender on basic science practical skills in primary school pupils while the present study used demonstration and project-based teaching methods to determine effect of gender on psychomotor skilldevelopment and interest in electrical installation and maintenance work.Again, Olufunke and Adebayo (2014) used the lower primary pupil the present study used senior secondary school students in technical colleges.

In same vein Molokwu and Eze (2015) conducted a study on gender effect of meta-learning teaching method on the academic performance of building trades students in South-east States of Nigeria. The study focus is on gender differential. Two research questions guided the study and two hypotheses were tested. Purposive sampling technique was used in selecting 120 NTC11 students from four technical colleges in the zone. The researchers adopted the quasi-experimental pre-test, post-test non-equivalent control group design. The instrument for data collection was the researchers made test titled "Building Trade Performance Test" (BTPT) which was face validated by three experts.

Kudar Richardson (K-R20) was used to determine the internal consistency of BTPT which yielded a reliability coefficient of 0.75. The instrument was pre-test, post-test on two groups experimental (meta-learning) and control (conventional) before and after a period of eight weeks of treatments by regular building teachers

who taught in the selected schools. Arithematic mean and standard deviation were used in answering research questions and ANCOVA to test the hypotheses at 0.05 level of significance. Findings of the study revealed that there was a significant effect of the treatment (meat-learning teaching method) on building trades students' performance. Also, the study revealed that the effect of gender on building trades performance was insignificant. Based on the findings, the researchers concluded that meta-learning teaching methodwas highly effective and recommended that, teachers of building trades and other technical subjects taught in technical colleges should adopt meta-learning teaching method to improve teaching and learning.

This study of Molokwu and Eze (2015) is related to the present study in purpose and design but differ in teaching methods, area of speciaization and location in the sense that Molokwu and Eze's study used meta-learning and conventional teaching method in building trade based in South-east while the present study used demonstration and project-based teaching methods in electrical installation and maintenance work and specifically was conducted in Anambra State.

Similarly, Agbejoye and Adegbola (2017) carried out a study to investigate gender and workshop facilities as determinant of students' skill performance in technical education in tertiary institutions in Nigeria. Three research questions guided the study and three hypotheses were tested. Random sampling technique was used in selecting one hundred and forty-eight (148) students from five tertiary institutions in Lagos State. A descriptive survey research design was used. Furthermore, the researchers used questionnaire items as instruments for data collection which was validated by experts.

Cronbach alpha was used to determine the internal consistency which yielded a reliability coefficient of 0.81.Mean and standard deviation were used in answering the research questions while the t-test and Levine's test for equality of variance were used for testing hypotheses at 0.05 level of significance. Findings of the study revealed that gender has impact on skill performance of students' in technical education. The researchers concluded that students' gender and workshop facilities are determinant of student's skill performance in technical education in tertiary institution in Nigeria. The researchers also recommended that gender equality in technical education will encourage the female to compete with their male counter parts in promoting skills needed for employment and job creation.

This study of Agbejoye and Adegbola (2017) is related to the present study in purpose as both are to determine the effects of gender on skill development of technical education students. However, both studies differ in design and location as Agbejoye and Adegbola's study used survey design while the present study used quasi-experimental design research involving pre-test and post-test.

2.5 Summary of Review of Related Literature

The review of related literature for this work was organized under conceptual framework, theoretical framework, theoretical studies and empirical studies. Under conceptual framework, key concepts on the title of the study were reviewed from the opinions of different authors and the present researcher. Theoretical framework reviewed two theories underpinning the study as skill development theory and scaffolding theory of proximal learning. Assumptions of the theories were presented and their relatedness to the study clearly highlighted. Related theoretical studies were extensively reviewed to highlight the opinions of other scholars. Again, teaching

methods in the opinion of authors reviewed provides powerful tools to support the shift to student centered learning and is capable of creating a more interactive and engaging learning environment which stimulates learners' interest and improve psychomotor skill learning. Hence, it is a generally held position that students performance in learning will improve when they are given teaching methods that allow for interactive access.

Furthermore, several related empirical studies were reviewed under two headings covered in the purpose of the study, namely studies on teaching methods and psychomotor skill development in technical colleges, gender issues on psychomotor skill development and interest in technical education. Most of the studies adopted the quasi experimental research design as the current study using research questions and/or hypotheses but focused on different areas of technical education and teaching methods. None of the empirical studies reviewed was on relative effectiveness of demonstration and project-based teaching methods in developing psychomotor skill and interest among students in electrical installation and maintenance work in technical colleges in Anambra State. This has created gaps in the body of knowledge which this study sought to fill.

CHAPTER THREE

METHOD

This chapter presents the method used in this study under research design, area of the study, population of the study, sample and sampling techniques, instrument for data collection, validation of the instrument, reliability of the instrument, method of data collection and method of data analysis.

3.1 Research Design

The study adopted a quasi-experimental research design. According to Uzoagulu (2011), a quasi-experimental design involves periodic measurement on one group before and after treatment without disrupting the normal school programme and time table. Specifically, the design involved a pre-test, post-test, non-equivalent control group with no randomization. This design is deemed appropriate for this study as the aim is to pre-test the subjects before and post-test them after treatment to determine the relative effectiveness of demonstration and project-based teaching methods in developing psychomotor skill and interest among students in electrical installation and maintenance work in technical colleges. This is because it was not possible to randomize and place subjects in groups as in pure experiment without disrupting the programme and timetable of the schools involved in this study.

Area of the Study

The study was conducted in Anambra State. Anambra State is one of the five States that make up South-east Nigeria and is located east of the River Niger. The indigenes are highly interested in education which qualified the State as one of the educationally advantaged states in Nigeria. It has six education zones and numerous

educational institutions in different communities. The choice of Anambra State as area for this study was informed by the fact that it has 12 National Board for Technical Education (NBTE) accredited technical colleges and numerous industries in major cities like Awka, Onitsha and Nnewi which require the services of skilled electrical/electronic craftsmen.

3.2 Population of the Study

The population for this study comprised the entire 343 National Technical Certificate (NTC) II students (235 males and 108 females) of 2018/2019 session in electrical installation and maintenance work in all the twelve technical colleges in Anambra State. The rationale behind the choice of NTC II students of electrical installation and maintenance work for this study is that the NTC III students may be busy preparing for the NABTEB certificate examination while the NTC I students may not have gotten enough knowledge of electrical installation and maintenance work to warrant subjecting them to an experiment. Moreover, the NTC II students will eventually replace the final year students who are at the verge of graduation and the demonstration and project-based teaching methods could enhance their psychomotor skill performance in NABTEB practical examination. The population distribution by schools and gender is presented as Appendix B on page 136.

3.3 Sample and Sampling Technique

A purposive sampling technique was used to select two intact classes of 80 (50 males and 30 females) NTC11 students in electrical installation and maintenance work from two technical colleges for the study.The two technical colleges were selected based on the number of male and female students and availability of facilitities for practical activities. Toss of a coin was used to assign one intact class

(Government Technical College, Umunze) to experimental group 1 (demonstration teaching method) and the other (Government Technical College, Utuh) to experimental group 2 (project-based teaching method).The sample distribution is presented as Appendix B on page 136.

3.4 Instrument for Data Collection

Instruments used for data collection were an achievement test and interest scale titled Psychomotor Skill Performance Test in Electrical Installation and maintenance Work (PSPTEIMW) and Interest Inventory Scale on Electrical Installation and Maintenance Work (IISEIMW). The skill performance test instruments was developed by the researcher based on the purpose of the study and insight gained from literature reviewed. It contained three practical-skill performance tests selected from NABTEB past practical examination questions in electrical installation and maintenance work. The four point likert type marking check-list was used to rate students' performance based on the scoring guide. The test items covered joint box system of wiring and electrical installation design diagram. The rationale for choosing the content is that this content area seems to constitute the major, critical and difficult areas to understand which students' avoid and shy away from during assessment or in attempting external examination questions. To achieve the stated objective for this study, the contents started from the known to the unknown is shown below:

Electrical installation tools and wiring accessories

Cables and surface installation of PVC/PVC cables

Conductor joints and terminating techniques

Wiring system

Electrical installation design diagrams

Demonstration and project-based teaching methods were used in teaching the students the entire task focusing on what they were required to know and do by the end of the treatment and also providing them with a framework for active participation. A copy of PSPTEIMW for pre-test and post-test is attached as Appendix C on page 137 and Appendix D on page 139.

The IISEIMW is a 30 item interest scale developed by the researcher. It was constructed by generating a list of statements to show the extent of students' interest in electrical installation and maintenance work and providing response options. It is a 4-point rating scale of Strongly Agree (SA)-4 to Strongly Disagree (SD)-1. Copy of IISEIMW is enclosed as Appendix E on page 141.

Both the PSPTEIMW and IISEIMW were used for pre-test and post-test for the experimental groups but items were reshuffled before they were used for the post-test.

3.5 Validation of the Instrument

The PSPTEIMW has been validated by test developers in National Business and Technical Examination Board (NABTEB) while IISEIMW was face validated by three experts; two in technical education from the Department of Technology and Vocational Education and one from Educational Measurement and Evaluation from the Department of Educational Foundations all in Nnamdi Azikiwe University, Awka. Copies of the draft instruments, together with the purpose of the study, research questions, hypotheses and the lesson plans were given to the experts and they were

requested to examine them in terms of content relevance, coverage and item clarity and made suggestions as they deem fit to ensure the validity of the instruments. The experts suggested that the five task of psychomotor skill performance test be reduced to three and the purpose be recast to match the research questions and hypotheses then the lesson plans for both teaching methods should be in tabular form. The expert's reports are enclosed as Appendices F and G on pages 154 and 156. The suggestions shown above were incorporated in the final instrument used for the study.

3.5.1 Item/ Task Analysis

Task analysis was carried out on the three task contained in the psychomotor skill performance test instrument by administering it to 30 NTC II students from government technical college Okporo, Orlu Imo State who were not part of the study population. The tasks focused on two indices; the item/task difficulty level and the discrimination index.

Item /task Difficulty Level

The difficulty index was determined by the proportion of candidates that got the task correctly. Acoording to Iwuji in Eze, Ezenwafor and Molokwu (2015) an ideal item/task is one whose index is 50 percent difficulty level. An item/ task between 25 percent and 75 percent could be allowed where the aim is to have a high proportion of the class mastery.

Discrimination index

The degree to which an item/task discriminates between high knowledge (high achievers) and (low achievers) is the discrimination power of the item/task. For effective item/task, the index is supposed to be positive and high. This implies that

more students in the upper group (high achievers) got the task correctly than those in the lower group (lower achievers). A negative discrimination index indicates a defective item/task.

Initially, there were three tasks after validation, the three tasks were trial tested but were still retained based on the values of difficulty and discrimination indices. This is presented in Appendix H on page 146.

3.6 Reliability of the Instrument

The reliability of the instruments was determined by administering PSPTEIMW and IISEIMW on an intact class of 30 NTC11 students of Electrical Installation and Maintenance Work in Okporo Technical College, Orlu, Imo State who were not part of the population of the study. Reliabilibity co-efficient of the scores was established using Cronbach Alpha formula which yielded 0.82 and 0.80 respectively. Cronbach alpha was used because the PSPTEIMW and IISEIMW involved a likert scale that was polychotomously scored. The high reliability coefficient values indicate that the instruments are reliable for the study as recommended by Uzoagulu (2011) who recommended that if an instrument is highly reliable it means that it has consistently and accurately measured what it is supposed to. Details of the analysis are shown as Appendix K on page 155.

3.7 Method of Data Collection

Data for the study were collected through pre-test and post-test. The pre-test was administered to the subjects before the treatment to provide the researcher with baseline data about the subjects while post-test was administered to them one week

after the treatment. Data collected from the two tests (pre and post) were used for data analysis.

3.7.1 Experimental Procedure

Before the commencement of the study, the researcher inquired and obtained permission from the Principals of the 12 technical colleges in Anambra State to allow the study to be carried out in their schools. Also the researcher ascertained the schools that have the required resources and number of students needed for the experimental treatment. Following the preliminary survey and information, the researcher purposively selected two schools comparatively out of the 12 technical colleges in the State. A toss of a coin was used to assign each school to experimental groups 1 and 2. The experiment lasted for five weeks. . The procedure for conducting the quasi-experiment is symbolically presented as follows:

Treatment G_1 NR X_1 Q_1

…….

Treatment G_2 NR X_2 Q_2

Key

G_1 = Experimental group 1 (taught with demostration method)

G_2 = Experimmental group 2(taught with project-based method)

NR = Non-random assignment of subjects to the groups

O_1 = Indicates the pre -test given to G_1 and G_2

O_2 = Indicates the post- test given to G_1 and G_2

X_1 = Indicates the treatment given to the experimental

Group 1 (demostration teaching method)

X_2 = Indicates the treatment given to the experimental

Group 2 (project-based teaching method)

Week 1

In the first week, the researcher went to the two schools, Government Technical College, Umunze (experimental group 1, demonstration teaching method) and Government Technical College, Utuh (experimental group 2, project-based teaching method) to introduce herself to the subject teachers. The researcher used the opportunity to explain the purpose of the study and the appropriate ways of using demonstration and project-based teaching methods which the teachers are already familiar with.

Week 2

One week training programme was organized for the electrical installation and maintenance work (EIMW) teachers in the sampled schools who assisted in the study. The necessary techniques required for using demonstration and project-based methods were clearly explained to the teachers.The EMIW teachers in each group were allowed to teach for 30 minutes each to test their competence on the different demonstration and project-based techniques before carrying out the treatment on the subjects. Furthermore, the researcher gave the teachers check-list and scoring guide to score each student. Also the researcher described how to conduct the pre-test and

post-test using PSPTEIMW and how to administer the IISEIMW to students. In the same week the pre-test was administered to determine the initial abilities of the subjects prior to the experiment.

Week 3

The treatment began in the sampled schools in the third week and lasted for five weeks of 90 minutes lesson each for the teaching and practical activities. The double period of 90 minutes was chosen to give students opportunity to practice in the workshop and drawing studio. The regular EIMW teachers in the sampled schools used the lesson plans prepared by the researcher for the teaching. The steps in the lesson plans (Appendices M and T on pages 205 and 231) were followed logically by the teachers for the treatments.

Week 7

When all teaching ended, the post- test was administered to the students in the two experimental groups (G1 and G2). The pre-test instrument was reshuffled and used for the post-test.

3.7.2 Development of PSPTEIMW and IISEIMW

The performance tests on electrical installation and maintenance work questions were collected from the past practical examination questions already standardized by the National Board for Business and Technical Examination. These questions were drawn from NABTEB past practical questions. Three PSPTEIMW test items out of five in the draft instrument were adopted and accepted by validators while the two they did not adopt were dropped. The performance test has three practical skill questions and no multiple choices because the study focus was on

psychomotor skill development of the students. Questions covered joint box wiring of five lighting points controlled by three switches using wiring boards, designing a two bedroom flat and installing a two lighting points control by two separate switches and the students were asked to answer all the three questions. In the practical performance, students were asked to use a $1mm^2$ cable and wiring accessories to construct a joint box wiring (surface wiring) making connections from joint box to different switches and to different lighting points using the wiring board. Also students were asked to make a free hand sketch of two bedroom bungalow and install relevant wiring accessories using electrical symbols. Furthermore, the students were also asked to use $1mm^2$ cables with accessories to construct a two lighting point control by two separate switches. The PSPTEIMW pre-test and post-test instruments reflected the selected three tasks in electrical installation and maintenance work during the treatment.

A marking check-list and a score guide for the psychomotor skills were prepared by the researcher with NABTEB practical test examination guide for electrical installation and maintenance work (Appendix I on page 148 and Appendix J on page 150 for check-list and score guide respectively). The pre-test instrument is called pre-test psychomotor skill performance in electrical installation and maintenance work (Pre-PSPTEIMW) while the post-test is called post-test in psychomotor skill performance test in electrical installation (Post-PSPTEIMW). During the treatment students were required to indicate their number and gender on the drawing sheets, wiring boards and questionnaire item (IISEIMW).

3.7.3 Scoring of the Instrument

The psychomotor skill performance test in electrical installation and maintenance work was scored using the marking check-list and scoring guide prepared by the researcher. The skills/task performed by students was based on the rating scale ranging from Excellent (4), good (3), fair (2) and Poor (1) as indicated in the marking check-list and scoring guide respectively.

3.7.4 Control of Extraneous Variables

For the fact that students were exposed to several activities in the course of treatment, it is assumed that they could be influenced by some external forces referred to as extreneuos factors/variables (Uzoagulu, 2011). Therefore, the following measures were taken to check and control likely extraneous variables as follows;

Teacher Variables: To control the error that might arise as a result of teacher difference on the students' psychomotor skill performnace and interest in EIMW, the regular EIMW teachers in the sampled schools were trained and used for the study.

Instructional/Situational Variable: For the purposes of ensuring homogeneity in teaching, the researcher issued instructional guides to the regular EIMW teachers (research assistants) in the two groups with the lesson plans. Both groups were exposed on the same tasks within the regular school period assigned in the school time table.

Interaction among Students in Different Treatment Groups**:** This variable was completely eliminated as schools in different locations were used to minimize the interaction of treatment groups.Two different schools were used for the experiment.

Reducing Test Wiseness by the Students: This extraneous variable was taken care of by the re-shuffling the serial numbers of the test instruments to avoid the students feeling that they were being re-tested which if they know may make their performance to be mechanical.

Experimental Mortality: Where the experiment lasts for a longer time incidence of mortality may occur. This is a situation whereby subjects used for an experiment might reduce in number before the end of the treatment. Thus the experiment mortality like death, illness, transfer of students to another school or withdrawal was taken care of by the moderate time gap of five weeks which was used for the treatment. Furthermore, the researcher used reinforcement through the subject teachers in the sample schools so that students were motivated and so did not find the programme boring.

Pre-Test and Post-Test Interaction: To avoid this extraneous variable which has to do with if the two tests are too close, the tendency for the students' performance to be influenced by remembering the performance in the pre-test, and if too long the effect of forgetting what was learnt will set in. The researcher ensured that the gap between the two tests was on the average lasting for five weeks.The rationale for choosing five weeks is to reduce the effect of history and also control the pre-test sensitization.

3.8 Method of Data Analysis

Data collected were analyzed using mean scores. In this case, the data collected from the pre-test and post-test were analyzed using the arithematic mean and standard deviation to answer the research questions and to ascertain the closeness or other wise of the achievement mean scores of the groups respectively. Participating classes were non-equivalent groups; therefore, the analysis of convariance

(ANCOVA) was used to test the null hypotheses at 0.05 level of significance. ANCOVA was used for the study to take care of the initial group differences across the groups due to the differences in the initial background.

Where the probability value associated with calculated value of F is greater than the 0.05 level of significance the null hypothesis is accepted, but where the probability value associated with calculated value of F is less than the 0.05 level of significance the null hypothesis is rejected. Details of the analysis are shown as Appendix L on pg 185.

CHAPTER FOUR

RESULT AND DISCUSSION

4.1 Results

This chapter presents statistical analysis of data according to the research questions and hypotheses as follows:

Answer to Research Questions

The answers to research questions were arrieved at using mean and standard deviation

Research Question 1

What is the academic achievement mean scores of psychomotor skills of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method?

Analysis of data in respect of this research question is presented in Table 1.

Table 4.1.1

Mean and standard deviation of academic mean scores of psychomotor skills of students taught using demonstration teaching method and those taught using project-based teaching method

Teaching Method		Pre-test		Post-test		Mean Gain
	N	Mean	SD	Mean	SD	
Demonstration Teaching	42	7.15	2.33	12.40	3.14	5.25
Project-based Teaching	38	7.77	2.24	17.20	2.61	9.43

Table 1 shows that pre-test and post-test academic achievement mean scores of psychomotor skills of students taught electrical installation and maintenance work using demonstration teaching method were 7.15 and 12.40 with mean gain of 5.25. Those taught with project-based teaching method had 7.77 and 17.20 with mean gain of 9.43 However, for each of the groups, the post-test means were greater than the pre-test means with the group taught using project-based teaching method having a

higher mean gain. This shows that project-based teaching method has more effect on students' psychomotor development skill in electrical installation and maintenance work than demonstration teaching method.

Research Question 2

What is the interest mean scores of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method?

Analysis of data in respect of this research question is presented in Table2.

Table 4.1.2

Mean and standard deviation of interest mean scores of students taught using demonstration teaching method and of those taught using project-based teaching method

Teaching		Pre-test		Post-test		Mean
Method	N	Mean	SD	Mean	SD	Gain
Demonstration Teaching method	42	2.75	.98	3.62	.376	0.87
Project-based Teaching method	38	2.62	.89	3.68	.355	1.06

Table 2 shows the pre-test and post-test interest mean scores of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-bsed teaching method were 2.75 and 3.62 with mean gain of 0.87. Those taught with project-based teaching method had 2.62 and 3.68 with mean gain of 1.06. However, for each of the groups, the post-test means were greater than the pre-test means. This shows that both teaching methods have relative effects on students' interest in electrical installation and maintenance work, with project-based teaching method having a higher mean gain.

Research Question 3

What is the academic achievement mean scores of psychomotor skills of male students' taught electrical installation and maintenance work using demonstration teaching and those taught using project-based teaching method?

Analysis of data in respect of this research question is presented in Table 3

Table 4.1.3

Mean and standard deviation of academic achievement mean scores of psychomotor skills of male students taught using demonstration teaching method and those taught using project-based teaching method.

Teaching Method		Pre-test		Post-test		Mean Gain
	N	Mean	SD	Mean	SD	
Demonstration TM	28	6.60	2.72	12.90	3.85	6.30
Project-based TM	22	7.27	2.18	17.68	2.74	10.40

Table 3 shows the pre-test and post-test academic achievement mean scores of psychomotor skills of male students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method were 6.60 and 12.90 with mean gain of 6.30. Those taught with project-based teaching method had 7.27 and 17.68 with mean gain of 10.40. However, for each of the groups, the post-test means were greater than the pre-test means with the male in the project-based group having a higher mean gain. This shows that project-based teaching method has more relative effect on male students' psychomotor development skills in electrical installation and maintenance work than demonstration teaching method.

Research Question 4

What is the interest mean scores of male students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method?

Analysis of data in respect of this research question is presented in Table 4.

Table 4.1.4

Mean and standard deviation of interest mean scores of male students taught using demonstration teaching method and those taught using project-based teaching method

Teaching Method		Pre-test		Post-test		Mean Gain
	N	Mean	SD	Mean	SD	
Demonstration TM	28	2.55	.90	3.66	.37	1.11
Project-based TM	22	2.64	1.11	3.76	.39	1.12

Table 4 shows the pre-test and post-test interest mean scores of male students taught using demonstration teaching method and those taught using project-based teaching method were 2.55 and 3.66 with mean gain of 1.11. Those taught with project-based teaching method had 2.64 and 3.76 with mean gain of 1.12. However, for each of the groups, the post-test means were greater than the pre-test means. This shows that both teaching methods have relative effects on male students' interest in electrical installation and maintenance work.

Research Question 5

What is the academic achievement mean scores of psychomotor skills of female students' taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method?

Analysis of data in respect of this research question is presented in Table 5

Table 4.1.5

Mean and standard deviation of academic mean achievement scores of psychomotor skills of female students taught using demonstration teaching method and those taught using project-based teaching method

		Pre-test		Post-test		Mean
Group	N	Mean	SD	Mean	SD	Gain
Demonstration TM	14	7.70	1.78	11.90	2.22	4.20
Project-based TM	16	8.38	2.22	16.61	2.37	8.22

Table 5 shows the pre-test and post-test academic achievement mean scores of psychomotor development skill of female students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method were 7.70 and 11.90 with mean gain of 4.20. Those

taught with project-based teaching method had 8.38 and 16.61 with mean gain of 8.22. However, for each of the groups, the post-test means were greater than the pre-test means with the female in the project-based teaching method group having a higher mean gain. This shows that project-based teaching method has more effect on female students' psychomotor development skill in electrical installation and maintenance work than demonstration teaching method.

Research Question 6

What is the interest mean scores of female students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method?

Analysis of data in respect of this research question is presented in Table 6.

Table 4.1.6

Mean and standard deviations of interest mean scores of female students taught using demonstration teaching method and those taught using project-based teaching method

		Pre-test		Post-test		Mean
Group	**N**	**Mean**	**SD**	**Mean**	**SD**	**Gain**
Demonstration TM	14	2.69	.90	3.61	.29	0.92
Project-based TM	16	2.85	.83	3.58	.37	0.72

Table 6 shows the pre-test and post-test interest mean scores of female students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method were 2.69 and 3.61 with mean gain of 0.92. Those taught with project-based teaching method had 2.85 and 3.58 with mean gain of 0.72. However, for each of the groups, the post-test means were greater than pre-test means. This shows that both teaching methods have relative effects on female students' interest in electrical installation and maintenance work than demonstration teaching method.

Test of Hypotheses

Hypothesis 1

There is no significant difference in the academic achievement mean scores of psychomotor skills of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.

The test of hypothesis 1 is presented in Table 7.

Table 4.1.7

Summary of Analysis of Covariance (ANCOVA) of academic achievement mean scores of psychomotor skills of students taught with demonstration and those taught using project-based teaching methods

Source of Variation	Sum of Squares	df	Mean Square	F	Sign.
Corrected Model	4.72726	2	236.138	28.387	.000
Intercept	1736.664	1	1737.664	208.771	.000
Pre-test	11.476	1	11.476	1.380	.244
Method	472.099	1	472.099	56.753	.000
Error	640.524	77	8.318		
Total	18636.000	80			
Corrected Total	112.800	79			

Table 7 shows the probability value associated with the calculated value of F (56.753) is 0.000. Since this value 0.000 is less than the 0.05 level of significance, the null hypothesis is rejected. It means that there is significant difference in the academic achievement mean scores of psychomotor skill of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method. The null hypothesis was, therefore, rejected. However, the direction of the difference is in favour of the project-based teaching method which had a higher post-test mean score as shown in Table 1.

Hypothesis 2

There is no significant difference in the interest mean scores of students taught electrical installation and maintenance work using demonstration teaching method and that of those taught using project-based teaching method.

The test of hypothesis 2 is presented in Table 8.

Table 4.1.8

Summary of Analysis of Covariance of interest mean scores of students taught using demonstration and those taught using project-based teaching method

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.358	2	179	1.342	.265
Intercept	189.607	1	189.607	1.4213	.000
Pre-test	.226	1	.226	1.694	.195
Group	.156	1	.156	1.171	.281
Error	18.278	137	.133		
Total	1891.278	140			
Corrected Total	18.636	139			

Table 8 shows the probability value associated with the calculated value of F (1.171) is 0.281. Since this value 0.281 is greater than the 0.05 level of significance, the null hypothesis is accepted. It means that there is no significant differences in the interest mean scores of students taught electrical installation and maintenance work using demonstration teaching method. This means that both demonstration and project-based promotes students interest as shown in Table 2.

Hypothesis 3

There is no significant difference in the academic achievement mean scores of psychomotor skills of male students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.

The test of hypothesis 3 is presented in Table 9.

Table 4.1.9

Summary of Analysis of Covariance of academic achievement mean scores of psychomotor skills of male students taught using demonstration and that of those taught using project-based method of teaching

Source of Variation	Sum of Square	df	Mean Square	F	Sig.
Corrected Model	487.581	4	121.895	14.622	.001
Intercept	1552.061	1	1552.061	186.182	.000
Pre-test	5.432	1	5.432	.652	.422
Method	452.876	1	452.876	54.326	.000

Gender	23.679	1	23.679	247.443	.000
Method*Gender	.024	1	024	0.003	.958
Error	625.219	77	8.336		
Total	18636.000	80			
Corrected Total	1112.800	79			

Table 9 shows the probability value associated with the calculated value of F (247.443) is 0.000. Since this value 0.000 is less than the 0.05 level of significance, the null hypothesis is rejected. It means that there is significant difference in the academic achievement mean scores of psychomotor skill of male students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method. The null hypothesis was, therefore, rejected. However, the direction of the difference is in favour of the project-based teaching method which had a higher post-test mean score as shown in Table 3.

Hypothesis 4

There is no significant difference in the interest mean scores of male students taught electrical installation and maintenance work using demonstration teaching method and those taught using demonstration teaching method.

The test of hypothesis 4 is presented in Table 10.

Table 4.1.10

Summary of Analysis of Covariance of interest mean scores of male students taught using demonstration teaching method and those taught using project-based teaching method

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.857	4	.214	1.627	.171
Intercept	187.782	1	187.782	1.4263	.000
Pre-test	.233	1	.233	1.771	.186
Group	.157	1	.157	1.190	.277
Gender	.053	1	.053	.404	.526
Group* Gender	.445	1	.445	3.380	.068
Error	17.779	137	.132		
Total	1891.825	140			
Corrected Total	18.636	139			

Table 10 shows the probability value associated with the calculated value of F (0.404) is 0.526. Since this value 0.526 is greater than the 0.05 level of significance, the null hypothesis is accepted. It means that there is no significant differences in the interest mean scores of male students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method. This means that both demonstration and project-based promotes male students interest as shown in Table 4.

Hypothesis 5

There is no significant difference in the academic achievement mean scores of psychomotor skills of female students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.

The test of hypothesis 5 is presented in Table 11

Table 4.1.11

Summary of Analysis of Covariance of pre-test and post-test academic achievement mean scores of psychomotor skills of female students taught using demonstration teaching method and those taught using project-based teaching method.

Source of Variation	Sum of Square	df	Mean Square	F	Sig.
Corrected Model	487.581	4	121.895	14.622	.001
Intercept	1552.061	1	1552.061	186.182	.000
Pre-test	5.432	1	5.432	.652	.422
Method	452.876	1	452.876	54.326	.000
Gender	23.679	1	23.679	247.443	.000
Method*Gender	.024	1	024	0.003	.958
Error	625.219	77	8.336		
Total	18636.000	80			
Corrected Total	1112.800	79			

Table 11 shows the probability value associated with the calculated value of F (247.443) is 0.000. Since this value 0.000 is less than the 0.05 level of significance, the null hypothesis is rejected. It means that there is significant difference in the academic

achievement mean scores of psychomotor skill of female students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method. The null hypothesis was, therefore, rejected. However, the direction of the difference is in favour of the project-based teaching method which had a higher post-test mean score as shown in Table 5.

Hypothesis 6

There is no significant difference in the interest mean scores of female students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.

The test of hypothesis 6 is presented in Table 12

Table 4.1.12

Summary of Analysis of Covariance of interest mean scores of female students taught using demonstration teaching method and those taught using project-based teaching method

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.857	4	.214	1.627	.171
Intercept	187.782	1	187.782	1.4263	.000
Pre-test	.233	1	.233	1.771	.186
Group	.157	1	.157	1.190	.277
Gender	.053	1	.053	.404	.526
Group* Gender	.445	1	.445	3.380	.068
Error	17.779	137	.132		
Total	1891.825	140			
Corrected Total	18.636	139			

Table 12, shows the probability value associated with the calculated value of F (0.404) is 0.526. Since this value 0.526 is greater than the 0.05 level of significance, the null hypothesis is accepted. It means that there is no significant differences in the interest mean scores of female students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method. This means that both demonstration and project-based promotes female students interest as shown in Table 6.

Hypothesis 7

There is no significant interaction effect of teaching methods and gender on students' psychomotor skills in electrical installation and maintenance work.

The test of hypothesis 7 is presented in Table 13.

Table 4.1.13

Summary of Analysis of Covariance of interaction effect of teaching methods and gender on students' psychomotor skills in electrical installation and maintenance work.

Source of Variation	Sum of Square	df	Mean Square	F	Sig.
Corrected Model	487.581	4	121.895	14.622	.001
Intercept	1552.061	1	1552.061	186.182	.000
Pre-test	5.432	1	5.432	.652	.422
Method	452.876	1	452.876	54.326	.000
Gender	23.679	1	23.679	247.443	.000
Method*Gender	.024	1	024	0.003	.958
Error	625.219	77	8.336		
Total	18636.000	80			
Corrected Total	1112.800	79			

Table 13 shows the probability value associated with the calculated value of F (0.003) is 0.958. Since this value 0.958 is greater than the 0.05 level of significance, the null hypothesis is accepted. It means that there is no significant interaction effect of teaching methods and gender on students' psychomotor skills in electrical installation and maintenance work. The null hypothesis was therefore, accepted.

Hypothesis 8

There is no significant interaction effect of teaching methods and gender on students' interest in electrical installation and maintenance work.

The test of hypothesis 8 is presented in Table 14

Table 4.1.14

Summary of Analysis of Covariance of interaction effect of teaching methods and gender on students' interest in electrical installation and maintenance work.

Source of Variation	Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.857	4	.214	1.627	.171
Intercept	187.782	1	187.782	1.4263	.000
Pre-test	.233	1	.233	1.771	.186
Group	.157	1	.157	1.190	.277
Gender	.053	1	.053	.404	.526
Group* Gender	.445	1	.445	3.380	.068
Error	17.779	137	.132		
Total	1891.825	140			
Corrected Total	18.636	139			

Table 14 indicates that the probability value associated with the calculated value of F (3.380) is 0.068. Since this value 0.068 is greater than the 0.05 level of significance, the null hypothesis is accepted, it means that there is no significant interaction effect of teaching methods and gender on students' interest in electrical installation and maintenance work. The null hypothesis was therefore, accepted.

4.2 Discussion of Findings

The results of this study were discussed in line with the variables as follows:

4.2.1 Teaching Methods and Psychomotor Skill Development in Technical Colleges

Findings of the study as shown in Table 1 and 7 revealed that project-based teaching method is more effective in developing students' psychomotor skills in electrical installation and maintenance work in technical colleges in Anambra State than demonstration teaching method. This finding is in line with that of Omeje (2011) that project-based teaching method enhanced the academic achievement, interest and retention of low ability students in carpentry and joinery in technical colleges. This superiority of project-based teaching method over demonstration could be due to the interaction among students which enabled them to gain competence in psychomotor

skill during the treatment. The finding also agrees with that of Udofia and Udofia (2013) which showed that technical college students taught electrical installation and maintenance work using project-based teaching method showed evidence of greater performance in skill acquisition than those exposed to e-learning. Udofia and Udofia suggested that this could be due to the social interaction and friendliness that project-based teaching method provides for the students. Similarly, the probability value associated with calculated F-value was less than the significance level of 0.05 which indicates that there was significant difference in the relative effectiveness of demonstration and project-based teaching methods in psychomotor development skills of students in electrical installation and maintenance work in favour of the project-based teaching method.

Furthermore, findings of the study as shown in Table 2 and 8 revealed that demonstration and project-based teaching methods promote students' interest in electrical installation and maintenance work but the latter is slightly more effective. This finding agrees with Okoro (2013) who conducted a study on the effect of project-based teaching method on secondary school students' academic achievement, interest and retention in home economics in Enugu State and found that the method improved students' achievement and interest in the field of study. This could be as a result of the fact that the method facilitates active participation of students in the teaching-learning process which improved their level of skill development and interest in the subjects. This is understandable because demonstration and project-based teaching methods encourage students to be deeply involved in different activities in the teaching-learning process which enhances their interest in the study or subject matter. Similarly, the probability value associated with calculated F-value is greater than the significance level of 0.05 which indicates that there was no significant difference in

the relative effectiveness of demonstration and project-based teaching methods on students' interest in electrical installation and maintenance work in technical colleges in Anambra State.

4.2.2 Gender Issues on Psychomotor Skill Development and Interest in Technical Education

Findings of the study as shown in Table 3 and 9 revealed that project-based teaching method has more relative effect on male students' psychomotor skill development than demonstration teaching method. Similarly, the probability value associated with calculated F-value of 0.000 was less than the alpha level of 0.05 (0.000< 0.05) indicating that there was significant difference in the relative effectiveness of demonstration and project-based teaching methods in psychomotor skills development of male students in electrical installation and maintenance work in favour of the group taught with project-based teaching method. This finding is similar to that of Omeje (2011) who conducted an experimental study to determine the effects of project-based teaching method on the academic achievement, interest and retention of low ability students in carpentry and joinery in technical colleges and reported that male students taught using project-based teaching method performed better in psychomotor skills than those taught using conventional method. This could be as a result of workshop safety compliance as revealed by the study of Bassey, Amadike, Nsikan and Segbara (2016) who carried out a study to investigate the relationship between workshop safety compliance and students psychomotor skills acquisition and found that there was high positive significant relationship between safety compliance in the use of appropriate tools and students' psychomotor skills acquisition in electrical installation and maintenance work.

Furthermore, findings of the study as shown in Table 4 and 10 revealed that demonstration and project-based teaching methods promoted the male students' interest in electrical installation and maintenance work with very minimal difference in favour of the project-based teaching method. The probability value associated with calculated F-value of 0.526 was greater than the alpha level of 0.05 (0.526 > 0.05 showing that there was no significant difference in the relative effectiveness of the two teaching methods on male students' interest in electrical installation and maintenance. This finding has a bearing with Ayonmike (2014) who posited that males show interest in physical and competitive activities

Findings of the study as shown in Table 5 and 11 revealed that project-based teaching method had more relative effect on female students' psychomotor skill development in electrical installation and maintenance work trade than demonstration teaching method. Similarly, the probability value associated with calculated F-value of 0.000 was less than the alpha value of 0.05 (0.000 < 0.05) showing that there was significant difference in the relative effectiveness of the two teaching methods in psychomotor skill development of female students in electrical installation and maintenance work in favour of project-based method. This finding agrees with that of Okoro (2013) who conducted an experimental study on the effect of project-based teaching method on secondary school students' academic achievement, interest and retention in Home Economic reported that the method enhanced female students' achievement in the subject. The finding is also in line with the assertion of Udofia and Udofia (2013) that teaching methods that encourage group work such as project-based teaching method favors female students. This is understandable because female students prefer working in groups in physical related activities as noted by Okigbo and Okeke (2011).

Findings of the study as shown in Table 6 and 12 revealed that demonstration and project-based teaching methods equally promoted female students' interest in electrical installation and maintenance work trade with insignificant difference in favour of project-based method. Similarly, the probability value associated with calculated –F-value of 0.281 is greater than the alpha level of 0.05 (0.281>0.05) showing that there was no significant difference in the relative effectiveness of demonstration and project-based teaching methods on female students' interest in electrical installation and maintenance work. The finding is similar with the reports of Omeje (2011) and Ayonmike (2014) that activity-based teaching methods had more positive effect on female students' interest in carpentry and joinery and in brick/block-laying and concreting respectively.

The ANCOVA analysis in Table 13 indicated that there was no significant interaction effect of teaching methods and gender on students' psychomotor skill development in electrical installation and maintenance work. The probability value associated with calculated value of F 0.958> 0.05. The null hypothesis was accepted. The insignificant interaction effect between gender and teaching methods may be due to the fact that both methods (demonstration and project-based) are activity oriented methods and enhance and promotes male and female psychomotor skill development. Though differences existed between the students taught using demonstration teaching method and those taught using project-based teaching method, but there was no interaction between methods and gender. This finding in agreement with the study of Ogbuanya and Akinduro (2017) who carried out an experimental study on effect of floating facilitator and peer tutor instructional approach on student's psychomotor achievement in electrical installation and maintenance work and found out that gender had small influence on psychomotor achievement and no significant interaction effect.

The ANCOVA analysis in Table 14 indicated that there was no significant interaction effect of teaching methods and gender on students' interest in electrical installation and maintenance work. The probability value associated with calculated value of F 0.068> 0.05. The null hypothesis was accepted. The insignificant interaction effect between gender and teaching methods on students interest may be due to the fact that both methods (demonstration and project-based) are activity oriented methods and enhance and promotes male and female interest in electrical installation and maintenance work. Though differences existed between the students taught using demonstration teaching method and those taught using project-based teaching method, but there was no interaction between methods and gender. This finding is in consonance with the assertion of Okigbo and Okeke (2011) who stated that students will continue to have interest in an activity based teaching as long as the teacher stimulates their interest.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter deals with discussion, conclusion, and implications of the findings, recommendations, limitations and suggestions for further research

5.1 Summary of the Findings

Findings from the study are summarized as follows:

1. Project-based teaching method is more effective in developing students' psychomotor skill in electrical installation and maintenance work than the demonstration teaching method.
2. Demonstration and Project-based teaching methods promotes students' interest in electrical installation and maintenance work.
3. Project-based teaching method is more effective in developing male students' psychomotor skill in electrical installation and maintenance work.
4. Demonstration and project-based teaching methods promotes male students' interest in electrical installation and maintenance work.
5. Project-based teaching method is more effective in developing female students' psychomotor skill in electrical installation and maintenance work than the demonstration teaching method.
6. Demonstration and project-based teaching methods promotes female students' interest in electrical installation and maintenance work.
7. There was significant difference in the academic achievement mean scores in psychomotor development skills of students taught electrical installation

and maintenance work using demonstration teaching method and those taught using project-based teaching method in favour of the project-based group.

8. There was no significant difference in the interest mean scores of students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.
9. There was significant difference in the academic achievement mean scores in psychomotor skill development of male students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method in favour of the project-based group.
10. There was no significant difference in the interest mean scores of male students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based.
11. There was significant difference in the academic achievement mean scores in psychomotor development skills of female students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method in favour of the project-based group.
12. There was no significant difference in the interest mean scores of female students taught electrical installation and maintenance work using demonstration teaching method and those taught using project-based teaching method.

13. There was no significant interaction effect of teaching methods and gender on students' psychomotor development skills in electrical installation and maintenance work.
14. There was no significant interaction effect of teaching methods and gender on students' interest in electrical installation and maintenance work.

5.2 Conclusion

Technological advancements in the current era have occasioned the need for teachers to use suitable teaching methods and techniques for students' psychomotor skill development in technical colleges to facilitate their performance in the industry which will lead to technological advancement in the country. This study determined the relative effectiveness of demonstration and project-based teaching methods in developing students' psychomotor skill and interest in electrical installation and maintenance work in technical colleges. It was found that the two methods improved students'psychomotor skill development and interest in electrical installation and maintenance work. However, the project-based teaching method was found to be more viable in enhancing students' psychomotor skill development and both methods promotes students interest in the trade. Also, the study found no significant interaction effects between teaching methods and gender on students' psychomotor skill development and interest in electrical installation and maintenance work. This means that the relative effectiveness of the two methods on students' psychomotor skill development and interest in electrical installation and maintenance work does not depend on their gender. It was, therefore, concluded that the use of demonstration and project-based teaching methods by teachers in technical colleges will lead to improved psychomotor skill development and interest of both male and female students in electrical installation and maintenance work.

5.3 Implications of the Study

The findings of this study have provided empirical evidence for the use of suitable teaching methods in developing students' psychomotor skills and interest in electrical installation and maintenance work in technical colleges. This has some implications for teachers and students. One obvious implication is that electrical installation and maintenance work teachers could promote students' psychomotor skill development in electrical installation and maintenance work by stimulating and sustaining their interest in the trade through the use of project-based and demonstration teaching methods. The project-based teaching method particularly has different approaches embedded in it that will encourage students of different backgrounds and gender to learn electrical installation and maintenance work effectively.

Furthermore, using project-based teaching method would assist the teacher in providing conducive environment for effective teaching and learning of technical trades. Both demonstration and project-based teaching methods were effective in reducing gender gap in student's psychomotor skill development in electrical installation and maintenance work. This implies that regular use of the two methods by electrical installation and maintenance work teachers could greatly enhance the psychomotor skill development and interest of students in electrical installation and maintenance work.

5.4 Recommendations

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

1. Teachers in technical colleges should use project-based teaching method more in order to facilitate development of psychomotor skills in learners and equip them for gainful employment on graduation as employees or self-employed and employers of labour in their respective trades.
2. Management of technical colleges should provide relevant facilities to enable teachers effectively use project-based and demonstration teaching methods in order to develop students' psychomotor skills and interest in their trades.
3. Technological institutions producing teachers of technology should update their curricular to incorporate the use of practical based teaching methods like demonstration and project-based teaching methods.

5.5 Limitation of the Study

The conclusions made with respect to this study are however subjected to the following limitations:

1.Only few number of published acticles relating to students psychomotor skill development and interest in EIMW in technical colleges were seen by the researcher.

2. If it were possible the researcher would have thought the lessons. This is because the EIMW teachers that taught their intact classesmay not have followed the researcher's instructions strictly as regards the use of project-based teaching method

5.6 **Suggestions for Further Studies**

Based on the findings of the study, the following areas were suggested for further study:

1. Determination of the relative effectiveness of demonstration and project-based teaching methods in developing students' psychomotor skill and interest in electrical installation and maintenance work
2. Determination of the relative effectiveness of demonstration and project-based teaching methods in developing students' psychomotor skill and interest in Radio and Television trade in technical Colleges.

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Appendix A

NTCE Performance Statistics on EIMW of all the Government Technical Colleges in Anambra State from 2014 – 2018.

YEAR	NUMBER OF STUDENTS	A-C6	%	P7-F9	%
2014	370	170	46.0	200	54.0
2015	223	118	52.9	105	42.7
2016	377	207	54.9	170	45.1
2017	431	225	52.2	206	47.8
2018	365	209	57.3	156	42.7

***Source**: NABTEB headquarters Benin-Edo, State*

Appendix B

Population Distribution of Government Technical College Students of EIMW in Anambra State

S/N	NAMES OF SCHOOLS	NO STUDENTS		TOTAL
1	Government Technical College Umunze	Male	Female	
		28	14	42
2	Government Technical College Umuchu	18	9	27
3	Government Technical College Onitsha	25	6	31
4	Science and Technical College Nnewi	22	8	30
5	Government Technical College Enugu-Agidi	16	9	25
6	Government Technical College Osamara	18	7	25
7	Government Technical College Nkpor	20	11	31
8	St John's Technical College Alor	17	8	25
9	Government Technical College Utuh	22	16	38
10	Government Technical College Ihiala	16	6	22
11	Government Technical College Umuneri	10	4	14
12	Federal Science and Technical College Awka	23	10	33
	Total	235	108	343

Source: *Reseacher's 2018 field survey in technical colleges in Anambra State.*

Appendix C

Pre-test on Psychomotor Skill Performance Test in Electrical Installation and Manitenance Work (Pre-PSPTEIMW).

Practical-skill Performance Test

Student Name/No
School:
Age:
Class
Time:4hrs 30mins
Instruction: Attempt all the questions.

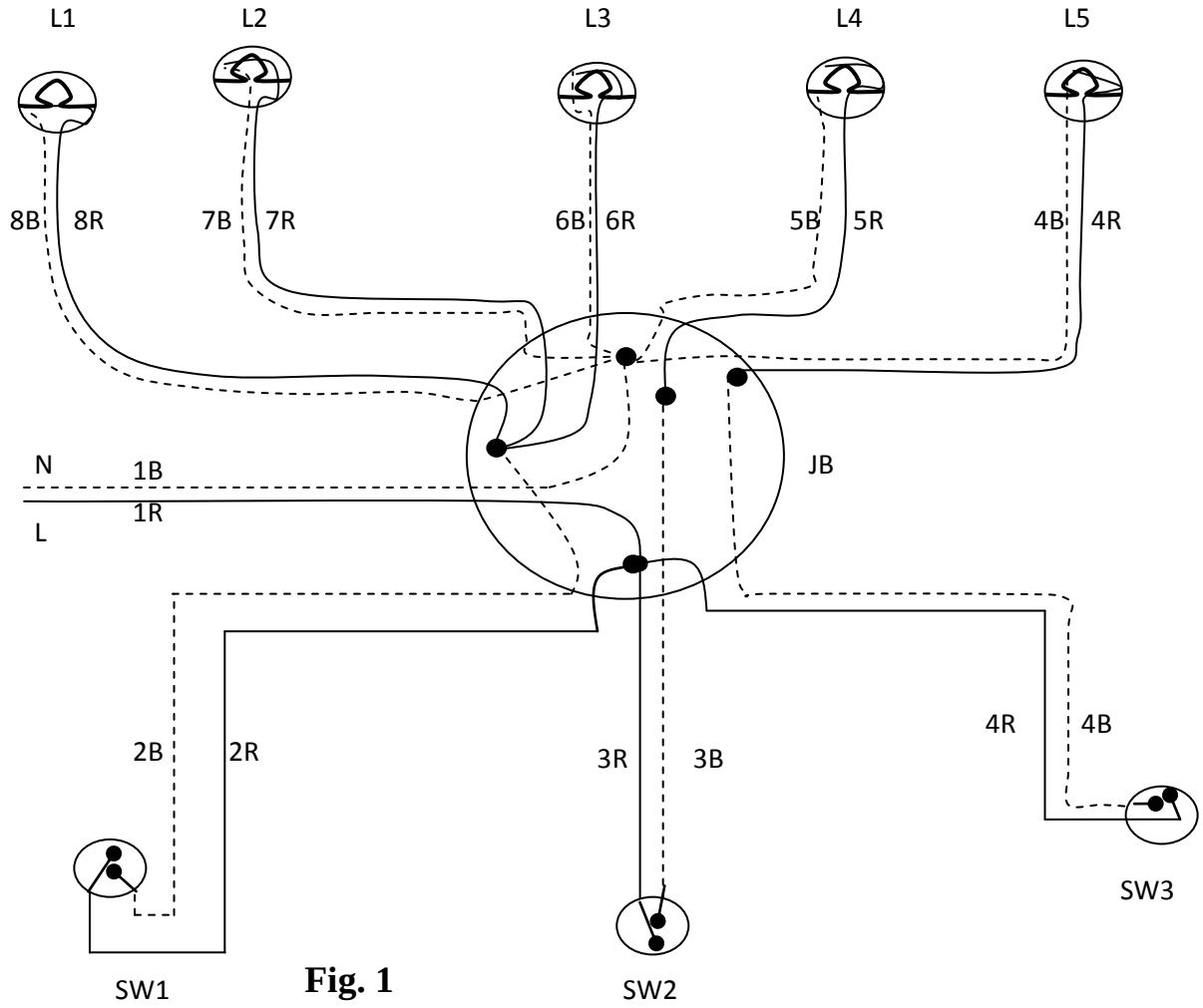


Fig. 1

1) Using 1mm^{2}twin P.V.C cable, a joint box and a wiring board install five lighting points controlled by three separate switches such that SW1 controls L1, L2 and L3, SW2 controls L4 and SW3 controls L5 as shown in diagram of fig 1.

2) Design and produce an electrical installation plan of a two bedroom flat with the following apartments

i) two bedroom, ii)1 sitting room, ii) 1 kitchen iv) 1 toilet and 1 bathroom

B) With all the necessary electrical equipment and accessories installed in the appropriate positions/locations

3) Using1mm^2 twin P.V. C cable, a joint box and a wiring board install two lightining points controlled by two separate switches such that SW1 controls L1and SW2 controls L2

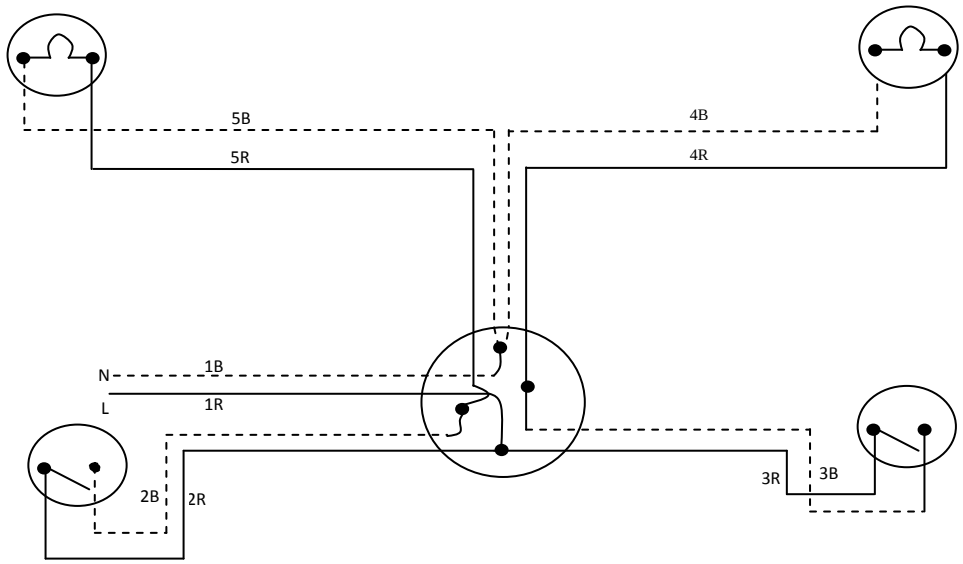


Fig. 2

Appendix D

Post-test on psychomotor Skill Performance Test in Electrical Installation and Maintenance Work (Post-PSPTEIMW)
Practical-Skill Performance Test
Student name/No
School:
Age:
Class:
Time:4hrs30mins
Instruction: Attempt all the questions.

1) Using1mm 2twin P.V. C cable, a joint box and a wiring board install two lightining points controlled by two separate switches such that SW1 controls L1and SW2 controls L2

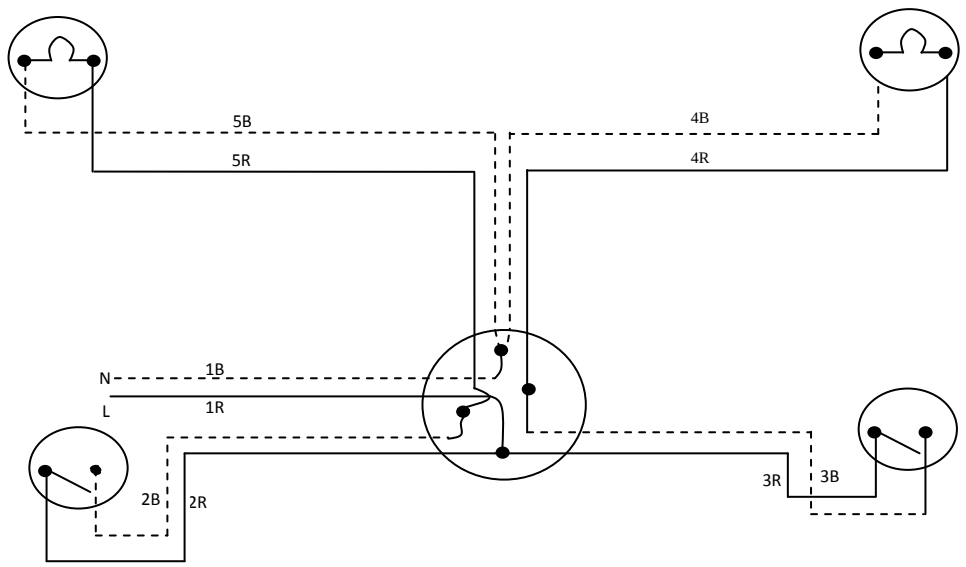


Fig.1

2). Design and produce an electrical installation plan of a two bedroom flat with the following apartments

i) two bedroom, ii)1 sitting room, ii) 1 kitchen iv) 1 toilet and 1 bathroom
B) With all the necessary electrical equipment and accessories installed in the appropriate positions/locations

3) Using 1mm^2 twin P.V.C cable, a joint box and a wiring board install five lighting points controlled by three separate switches such that SW1 controls L1, L2 and L3, SW2 controls L4 and SW3 L5 as shown in diagram of fig 2

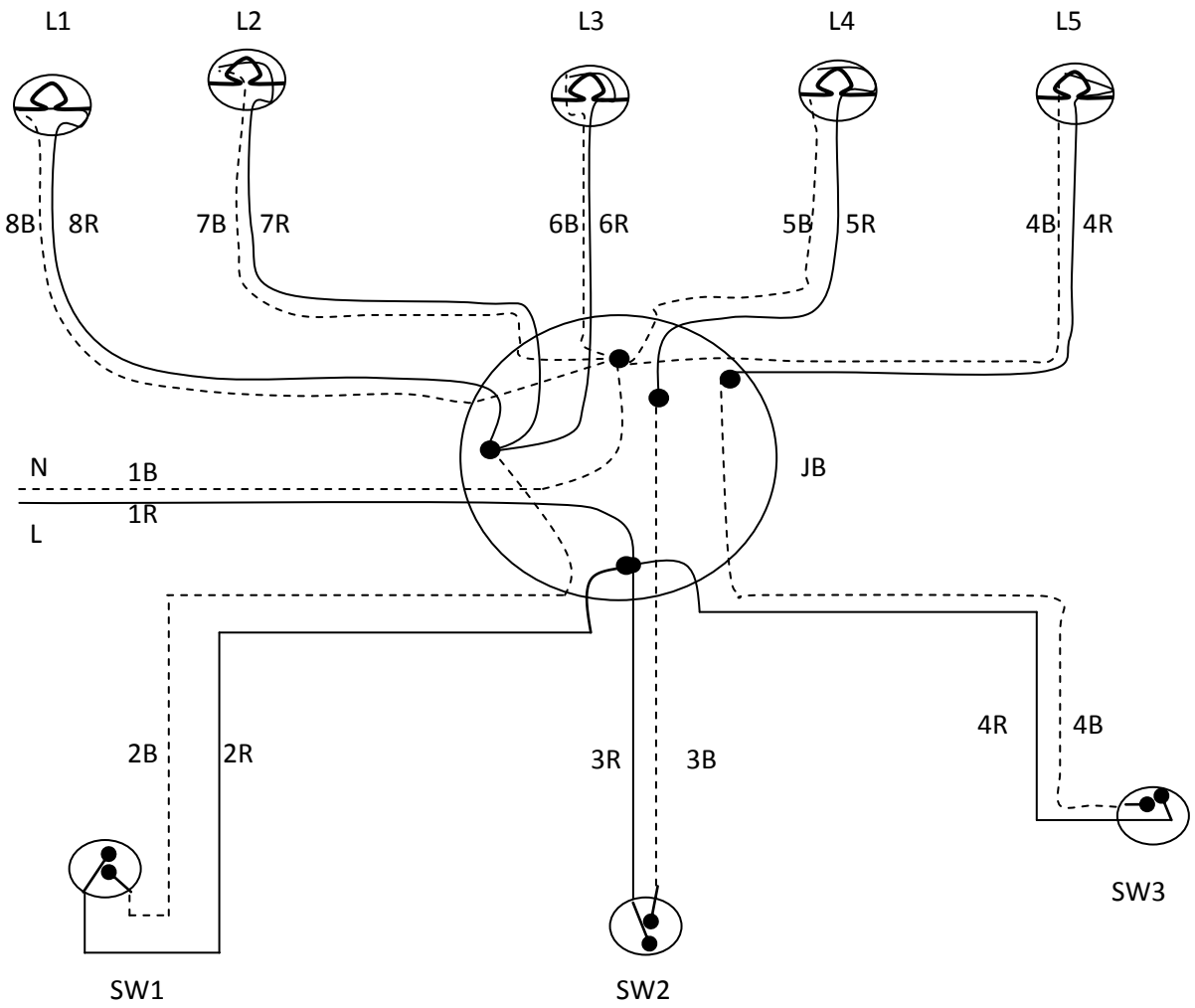


Fig. 2

Appendix E

Interest Inventory Scale in Electrical Installation and Maintenance Work (IISEIMW)

Dear students,

Below is a list of items made to investigate the degree of students' interest in Electrical Installation and Maintenance Work (EIMW). You are required to rate yourself to indicate the degree to which items are representative of you; you should be sincere in your rating.

Name of School: ……...

Gender: …….……..

Note:

SA: means Strongly Agree

A: means Agree

D: means Disagree

SD: means Strongly Disagree

S/N	Items	SA	A	SD	D	
1.	Electrical installation as a subject is simple to understand					
2.	Electrical installation is very interesting					
3.	Electrical installation is boring to me					
4.	I enjoy participating in electrical installation lesson					
5.	I attend electrical installation class regularly					
6.	It is better to use electrical installation periods for other subjects					
7.	I pay more attention in electrical installation class					
8.	I like putting on my overall during practical					

9.	I often have time for electrical installation workshop					
10.	I don't like doing assignments on electrical installation.					
11.	I always feel sleepy during electrical installation lesson					
12.	When I am alone I like observing cables and their connections					
13.	Electrical installation periods should be extended					
14.	I don't use to ask questions during electrical installation classes					
15.	I like to work in electricity company					
16.	I like to know the names of different tools, testing equipment and wiring accessories used in electrical installation					
17.	Electrical installation class increase my interest in residential and industrial installation					
18.	I take interest in studying wiring system and interpreting wiring diagrams					
19.	I do volunteer to invite electrical installation teachers					
20.	Electrical installation was my choice					
21.	I like teaching my friends electrical installation					
22.	I like to copy note of electrical installation					
23.	I use to be happy when our electrical installation teacher is absent from class					
24.	I usually complete my electrical installation assignment on time					
25.	I don't do any extra studies on electrical installation apart from the normal lessons.					
26.	I don't enjoy reading books on electrical installation					
27.	I encourage my friends to develop interest in electrical installation					
28.	Electrical installation is difficult to understand					
29.	In a group practical work I prefer watching others instead of participating in the actual task					
30.	I delight in solving pass electrical installation question papers on my own.					

Appendix F

A LETTER OF REQUEST FOR VALIDATION OF RESEARCH INSTRUMENT

Department of Vocational Education, Faculty of Education, NnamdiAzikiwe University, Awka.

1st August, 2018.

……..
……..
……..
……..

Dear Sir/Madam

Request for Validation of Research Instrument

I am a post graduate student of the above institution in the Department of TechnologyVocational Education conducting a research project titled "Relative effectivness of demonstration and project-based teaching methods in developing students' psychomotor skill and interest in electrical installation and maintenance in technical colleges in Anambra State".

Kindly validate the test items along the following considerations.

a. Suitability of language for the NTC II level students.
b. Appropriateness of the learning items for NTC II students.
c. Clarity of the questions possed.
   Please, find enclosed for your guidance.

A. Title of dissertation: Relative Effectiveness of Demonstration and Project Teaching Method in developing students' psychomotor skill and Interest in Electrical Installation and Maintenance Work in Technical Colleges in Anambra State.
B. Tasks covered in electrical ins 156 n and maintenance work (Domestic installation unit) for the Treatment.

1. Electrical installation tools and wiring accessories.
2. Cables and surface installation of PVC/PVC cables.

3. Conductor jointing and termination techniques
4. Wiring system.
5. Electrical Installation Design Diagrams

Thanks

Obi, C.O.C

Appendix G

Final Selection of Tasks

Test Items	$P = \frac{R \times 100}{1}$ Difficulty index	$D1 = \frac{R_H - R_L}{N}$ Discrimination Index	Decision
1	54.5	0.73	Good
2	72.7	0.36	Good
3	50.0	0.82	Good

Appendix H

Psychomotor Skill Development Check-List

S/N	Skills/ Tasks to be rated in PSPTEIMW	Excellent 4	Good 3	Fair 2	Poor 1
1.	Ability to select the right tools for the job/task				
2	Ability to display/use tools and accessories without damage				
3	Ability to select accessories needed for the job/task				
4	Ability to dismantle wiring accessories without damage				
5	Ability to assemble wiring accessories without damage				
6	Ability to identify cable sizes				
7	Ability to arrange tools after use				
8	Ability to fix cable neatly on the wiring board				
9	Ability to fasten cable on joint box				
10	Ability to relate connections from the joint box to the switches				
11	Ability to relate connections from joint box to lighting points				
12	Ablity to detect wrong connections of switches				
13	Ability to detect wrong connections of lighting points				
14	Ability to produce a functional five lighting points controlled by three separate switches				
15	Ability to produce a functional two lighting point controlled by two separate switches				
16	Ability to display the drawing sheet and use instrument correctly				
17	Ability to sketch electrical symbol correctly				
18	Ability to arrange/place symbol in their proper location				
19	Ability to identify electrical symbol				
20	Ability to sketch building plan				

21	Ability to interpret building plan				
22	Ability to move information from circuit diagram to wiring board				
23	Ability to differentiate wiring systems				
24	Ability to trace faults in joint box wiring system				
25	Ability to show/identify apartments in building plan				

Source: *Researcher's 2018 field survey at NABTEB Office Awka, Anambra State*

Appendix I

Psychomotor Skill Development Test Marking Guide

S/N	**Skill/Tasks to be Scored**	**Excellent 4 (Expert)**	**Good 3 (Proficient)**	**Fair 2 (Competent)**	**Poor 1 (Advance beginner)**
1	Interpretation of task/wiring diagram	Fully and immediate within 1-5 mins without support	Fully after 5 mins with little support	interprets with full support	Unable to interpret with support
2	Selection of tools	All tools	¾ of tools	½ of the tools	Less than ½ of the tools
3	Use of tools	Use of all tools for the right job	Using ¾ of the tools for the right job	Using ½ of the tools for the right job	Using less than ½ of the tools for the right job
4	Selection of wiring accessories needed	All accessories	¾ of accessories	½ of the accessories	Less than ½ of the accessories
5	Measurement of cable	Overall length	¾ of the length	½ of the length	Less than ½ of the length
6	Locations of fittings	Correct position	Correct with little support	With full support	Cannot locate position
7	Cutting insulation	All steps in correct order	Missing 1 step	Missing 2 step	Missing more than 2 steps
8	fastening cables	Successfully done	With 1-2 steps misses	With more than 2 steps	With more than 3 misses
9	Cable clipping	Successfully done	With 1-2 steps misses	With more than 2 misses	With more than 3 misses
10	Correct connection of contact in joint box	All steps in the correct order	Missing 1 step	Missing 2 steps	Missing more than 2 steps
11	Correct connection from switch to lighting point	All steps in the correct order	Missing 1 step	Missing 2 steps	Missing more than 2 steps
12	Correct connection from joint box to lighting point	All steps in the correct order	Missing 1 step	Missing 2 steps	Missing more than 2 steps
13	Switches closing	Successfully	With 1 -2 misses	With more than 2 misses	With more than 3 misses
14	Joint box closing	Successfully	With 1-2 misses	With more than 2 misses	With more than 3 misses
15	Functionality	Successful without support	Successful with little support	Successful with full support	Cannot function
16	Drawing sheet display	In correct order	Missing 1 step	Missing 2 steps	Missing more than three steps
17	Correct sketching of electrical symbol	All symbol	¾ of the symbol	½ of the symbol	Less than ½ of the symbol
18	Apartment placement	In correct order	Missing 1 location	Missing 2 location	Missing more than three locations
19	Correct location of symbol	Incorrect order	Missing 1 location	Missing 2 locations	Missing more than three locations

20	Neatness of design/diagram	Successfully without support	Successfully with little support	Successful with full support	Cannot draw and design
21	Interpretation of wiring diagram	Fully and immediate within 1-5mins	Fully after 5 mins with little support	Fully after 20mins withfull support	Unable to interpret with support
22	Transfer of information from diagram to wiring board	In correct order	Missing 1-2 step	Missing 2 step	Missing more than 3 steps
23	Arrangement of accessories	In correct order	Misplaced 1	Misplaced 2	Misplaced more than 3
24	Picking of cable size	In correct order	Misplaced 1	Misplaced 2	Misplaced more than 3
25	Neatness of construction	successfully done	Missing 1step	Missing 2 steps	Missing more than 3 steps

***Source:**, Researcher's 2018 field survey at NABTEB Office Awka, Anambra State*

Appendix J

Reliability Test Computation

```
RELIABILITY

  /VARIABLES=Item1 Item2 Item3 Item4 Item5 Item6 Item7 Item8 Item9 Item10
Item11 Item12 Item13

    Item14 Item15 Item16 Item17 Item18 Item19 Item20 Item21 Item22 Item23
Item24 Item25 Item26 Item27

    Item28 Item29 Item30

  /SCALE('ALL VARIABLES') ALL

  /MODEL=ALPHA

  /STATISTICS=DESCRIPTIVE SCALE.
```

ReliabilityTest for Electrical Installation Interest Inventory Scale (EIMWIIS)

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded	0	.0
	Total	30	100.0

Reliability Statistics

Cronbach's Alpha	N of Items
.808	30

Item Statistics

	Mean	Std. Deviation	N
Item1	3.2667	.98027	30
Item2	3.1000	1.39827	30
Item3	1.8333	.79148	30
Item4	2.2333	.43018	30
Item5	3.0333	.88992	30
Item6	2.0000	.00000	30
Item7	2.4333	1.35655	30
Item8	4.0000	.00000	30
Item9	3.0333	.88992	30
Item10	3.0333	.88992	30
Item11	3.2667	.98027	30
Item12	3.1000	1.39827	30
Item13	1.8333	.79148	30
Item14	2.2333	.43018	30
Item15	3.0333	.88992	30
Item16	2.0000	.00000	30
Item17	2.4333	1.35655	30
Item18	4.0000	.00000	30
Item19	3.0333	.88992	30
Item20	3.0333	.88992	30
Item21	3.2667	.98027	30
Item22	3.1000	1.39827	30
Item23	1.8333	.79148	30
Item24	2.2333	.43018	30
Item25	3.0333	.88992	30

Item26	2.0000	.00000	30
Item27	2.4333	1.35655	30
Item28	4.0000	.00000	30
Item29	3.0333	.88992	30
Item30	3.0333	.88992	30

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
83.9000	108.921	10.43651	30

RELIABILITY

/VARIABLES=Item1 Item2 Item3 Item4 Item5 Item6 Item7 Item8 Item9 Item10 Item11 Item12 Item13

Item14 Item15 Item16 Item17 Item18 Item19 Item20 Item21 Item22 Item23 Item24 Item25

/SCALE('ALL VARIABLES') ALL

/MODEL=ALPHA

/STATISTICS=DESCRIPTIVE SCALE.

Reliability Test for Psychomotor Skill Performance

Scale: ALL VARIABLES

Case Processing Summary

		N	%
Cases	Valid	30	100.0
	Excluded	0	.0
	Total	30	100.0

Reliability Statistics

Cronbach's Alpha	N of Items
.828	25

Item Statistics

	Mean	Std. Deviation	N
Item1	2.9000	1.47040	30
Item2	3.1000	1.39827	30
Item3	2.8000	1.49482	30
Item4	2.8000	1.03057	30
Item5	4.0000	.00000	30
Item6	2.6000	1.22051	30
Item7	3.5667	.89763	30
Item8	4.0000	.00000	30
Item9	2.9667	1.27261	30
Item10	4.0000	.00000	30
Item11	3.4667	.93710	30
Item12	3.2667	1.14269	30
Item13	3.5000	1.04221	30
Item14	2.9667	1.32570	30
Item15	3.1667	1.05318	30
Item16	3.9000	.30513	30
Item17	3.1000	1.09387	30
Item18	4.0000	.00000	30

Item19	3.0333	1.15917	30
Item20	3.9000	.30513	30
Item21	3.2000	.92476	30
Item22	3.0000	1.28654	30
Item23	2.9333	1.04826	30
Item24	3.0333	.88992	30
Item25	2.8667	1.13664	30

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
82.0667	136.892	11.70008	25

Appendix K
Data Analysis for Covariance (ANCOVA)

ANCOVA POST BY GROUP SEX WITH PRE

/METHOD=SSTYPE(3)

/INTERCEPT=INCLUDE

/CRITERIA=ALPHA(.05)

/DESIGN=PRE GROUP SEX GROUP*SEX.

Analysis of covariance

Between-Subjects Factors

		Value Label	N
GROUP	1.00	EXPERIMENTAL 1 GROUP	42
	2.00	EXPERIMENTAL2 GROUP	38
SEX	1.00	MALE	50
	2.00	FEMALE	30

Dependent Variable: POST

GROUP	SEX	Mean	Std. Deviation	N
EXPERIMENTAL GROUP 1	MALE	78.5000	6.56308	28
	FEMALE	75.6429	8.02503	14
	Total	77.5476	7.11646	42
EXPERIMENTAL GROUP 2	MALE	75.9091	4.61786	22
	FEMALE	74.5625	6.19644	16
	Total	75.3421	5.30312	38
Total	MALE	77.3600	5.87891	50
	FEMALE	75.0667	7.00213	30
	Total	76.5000	6.37837	80

Tests of Between-Subjects Effects

Dependent Variable: POST

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4.72726	4	236.138	28.387	.000
Intercept	1736.664	1	1736.664	208.771	.000
PRE	11.476	1	11.476	1.380	.244
Method	472.099	1	472.099	56.753	.000
Error	640.524	77	8.318		
Total	18636.000	80			
Corrected Total	112.800	79			

```
ANCOVA PRE BY GROUP SEX WITH POST
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
   /CRITERIA=ALPHA(.05)
  /DESIGN=GROUP SEX GROUP*SEX.
```

Analysis of covariance

Between-Subjects Factors

		Value Label	N
GROUP	1.00	EXPERIMENTAL GROUP 1	42
	2.00	EXPERIMENTAL GROUP 2	38
SEX	1.00	MALE	50
	2.00	FEMALE	30

Dependent Variable: PRE

GROUP	SEX	Mean	Std. Deviation	N
EXPERIMENTAL GROUP1	MALE	26.8571	5.30349	28
	FEMALE	25.2857	4.46230	14
	Total	26.3333	5.03968	42
EXPERIMENTAL GROUP 2	MALE	28.5909	2.78874	22
	FEMALE	28.6875	2.79806	16
	Total	28.6316	2.75505	38
Total	MALE	27.6200	4.42576	50
	FEMALE	27.1000	3.99439	30
	Total	27.4250	4.25091	80

Tests of Between-Subjects Effects

Dependent Variable: PRE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	.358	2	.179	1.342	.265
Intercept	189.607	1	189.607	1.4213	.000
Pre-test	.226	1	.226	1.694	.195
Group	.156	1	.156	1.171	.281
Error	18.278	137	.133		
Total	1891.285	140			
Corrected Total	18.636	139			

IISEIMW

```
ANCOVA POST BY GROUP SEX WITH PRE
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
    /CRITERIA=ALPHA(.05)
  /DESIGN=PRE GROUP SEX GROUP*SEX.
```

Analysis of covariance

Between-Subjects Factors

		Value Label	N
GROUP	1.00	EXPERIMENTAL 1GROUP	42
	2.00	EXPERIMENTAL GROUP 2	38
SEX	1.00	MALE	50
	2.00	FEMALE	30

Dependent Variable: POST

GROUP	SEX	Mean	Std. Deviation	N
EXPERIMENTAL	MALE	3.3467	.89839	28

GROUP	FEMALE	3.3750	.98858	14
	Total	3.3562	.91737	42
CONTROL GROUP	MALE	3.8470	.91949	22
	FEMALE	3.1327	.60903	16
	Total	3.4899	.72086	38
Total	MALE	3.1268	.93267	50
	FEMALE	3.1841	.70459	30
	Total	3.1594	.80750	80

Tests of Between-Subjects Effects

Dependent Variable: POST

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	8.306	4	2.077	3.457	.011
Intercept	3.980	1	3.980	6.625	.011
PRE	4.488	1	4.488	7.471	.007
GROUP	1.031	1	1.031	1.716	.193
SEX	1.453	1	1.453	2.419	.123
GROUP * SEX	.482	1	.482	.303	.372
Error	66.680	77	.601		
Total	1232.884	80			
Corrected Total	74.986	79			

```
ANCOVA PRE BY GROUP SEX WITH POST
  /METHOD=SSTYPE(3)
  /INTERCEPT=INCLUDE
  /CRITERIA=ALPHA(.05)
  /DESIGN=POST GROUP SEX GROUP*SEX.
```

Analysis of covariance

Between-Subjects Factors

		Value Label	N
GROUP	1.00	EXPERIMENTAL GROUP1	42
	2.00	EXPERIMENTAL GROUP2	38
SEX	1.00	MALE	50
	2.00	FEMALE	30

Dependent Variable: PRE

GROUP	SEX	Mean	Std. Deviation	N
EXPERIMENTAL GROUP 1	MALE	1.9196	.28665	28
	FEMALE	1.8274	.24778	14
	Total	1.8889	.27480	42
EXPERIMENTAL GROUP 1	MALE	1.7727	.17048	22
	FEMALE	1.6468	.18824	16
	Total	1.6842	.19099	38
Total	MALE	1.8550	.25131	50
	FEMALE	1.6851	.21358	30
	Total	1.7583	.24461	80

Tests of Between-Subjects Effects

Dependent Variable: PRE

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1.790	4	.447	9.753	.000
Intercept	16.199	1	16.199	353.154	.000
POST	.343	1	.343	7.471	.007
GROUP	.424	1	.424	9.249	.003
SEX	.332	1	.332	7.249	.008
GROUP * SEX	.015	1	.015	.335	.564
Error	5.091	77	.046		
Total	365.522	80			
Corrected Total	6.881	79			

```
ANCOVA POST BY GROUP SEX WITH PRE
 /CONTRAST(GROUP)=Simple
 /CONTRAST(SEX)=Simple
 /METHOD=SSTYPE(3)
 /INTERCEPT=INCLUDE
 /CRITERIA=ALPHA(.05)
 /DESIGN=PRE GROUP SEX GROUP*SEX.
```

Analysis of covariance

Between-Subjects Factors

		Value Label	N
GROUP	1.00	EXPERIMENTAL GROUP1	42
	2.00	EXPERIMENTAL GROUP 2	38
SEX	1.00	MALE	50
	2.00	FEMALE	30

Dependent Variable: POST

GROUP	SEX	Mean	Std. Deviation	N

EXPERIMENTAL GROUP 1	MALE	78.5000	6.56308	28
	FEMALE	75.6429	8.02503	14
	Total	77.5476	7.11646	42
EXPERIMENTAL GROUP 2	MALE	75.9091	4.61786	22
	FEMALE	74.5625	6.19644	16
	Total	75.3421	5.30312	38
Total	MALE	77.3600	5.87891	50
	FEMALE	75.0667	7.00213	30
	Total	76.5000	6.37837	80

Test of Equality of Error Variances

Dependent Variable: POST

F	df1	df2	Sig.
2.107	3	76	.106

Tests of Between-Subjects Effects

Dependent Variable: POST

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	719.607	2	236.138	28.387	.000
Intercept	5842.688	1	17.688	208.771	.000
PRE	529.577	1	529.577	1.380	.244
GROUP	205.208	1	205.208	56.753	.000
SEX	49.089	1	49.089		
GROUP * SEX	.914	1	.914		
Error	2494.393	77	33.259		
Total	471394.000	80			
Corrected Total	3214.000	79			

1	Contrast Coefficients (L' Matrix)	Simple Contrast (reference category = 2) for GROUP
	Transformation Coefficients (M Matrix)	Identity Matrix
	Contrast Results (K Matrix)	Zero Matrix
2	Contrast Coefficients (L' Matrix)	Simple Contrast (reference category = 2) for SEX
	Transformation Coefficients (M Matrix)	Identity Matrix
	Contrast Results (K Matrix)	Zero Matrix

GROUP Simple Contrast			Dependent Variable POST
Level 1 vs. Level 2	Contrast Estimate		3.475
	Hypothesized Value		0
	Difference (Estimate - Hypothesized)		3.475
	Std. Error		1.399
	Sig.		.000
	95% Confidence Interval for Difference	Lower Bound	.688
		Upper Bound	6.262

Test Results

Dependent Variable: POST

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	472.099	1	472.099	56.753	.000
Error	640.524	77	8.318		

Contrast Results (K Matrix)

SEX Simple Contrast			Dependent Variable POST
Level 1 vs. Level 2	Contrast Estimate		1.631
	Hypothesized Value		0
	Difference (Estimate - Hypothesized)		1.631
	Std. Error		1.343
	Sig.		.228
	95% Confidence Interval for Difference	Lower Bound	-1.043
		Upper Bound	4.305

Test Results

Dependent Variable: POST

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	5.040	1	5.040	247.443	.000

Error	625.219	77	8.336		

1. GROUP

Estimates

Dependent Variable: POST

GROUP	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
EXPERIMENTAL GROUP	77.936	.968	76.007	79.865
EXPERIMENTAL GROUP	74.461	.967	72.534	76.387

Pairwise Comparisons

Dependent Variable: POST

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.		
EXPERIMENTAL GROUP 1		3.475	1.399	.000		
	EXPERIMENTAL GROUP 2	-3.475	1.399	.000		

Pairwise Comparisons

Dependent Variable: POST

(I) GROUP	(J) GROUP	95% Confidence Interval for Difference	
		Lower Bound	Upper Bound
EXPERIMENTAL GROUP 1		.688	6.262
	EXPERIMENTAL GROUP 2	-6.262	-.688

Dependent Variable: POST

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	472.099	1	272.099	56.753	.000
Error	640.524	77	8.318		

2. SEX

Estimates

Dependent Variable: POST

SEX	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
MALE	77.014	.823	75.374	78.653
FEMALE	75.383	1.058	73.276	77.489

Dependent Variable: POST

(I) SEX	(J) SEX	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
MALE	FEMALE	1.631	1.343	.228	-1.043	4.305
FEMALE	MALE	-1.631	1.343	.228	-4.305	1.043

Dependent Variable: POST

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	5.040	1	5.040	247.443	.000
Error	625.219	77	8.336		

3. GROUP * SEX

Dependent Variable: POST

GROUP	SEX	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
EXPERIMENTAL GROUP 1	MALE	78.863	1.094	76.684	81.041
	FEMALE	77.009	1.579	73.864	80.154
EXPERIMENTAL GROUP 2	MALE	75.165	1.244	72.687	77.642
	FEMALE	73.756	1.456	70.856	76.657

ANCOVA PRE BY GROUP SEX WITH POST

/CONTRAST(GROUP)=Simple
/CONTRAST(SEX)=Simple
/METHOD=SSTYPE(3)
/INTERCEPT=INCLUDE
/PLOT=PROFILE(GROUP*SEX)
/CRITERIA=ALPHA(.05)
/DESIGN=POST GROUP SEX GROUP*SEX.

Analysis of covariance

Between-Subjects Factors

		Value Label	N
GROUP	1.00	EXPERIMENTAL GROUP1	42
	2.00	EXPERIMENTAL GROUP2	38
SEX	1.00	MALE	50
	2.00	FEMALE	30

Dependent Variable: PRE

GROUP	SEX	Mean	Std. Deviation	N
EXPERIMENTAL GROUP 1	MALE	26.8571	5.30349	28
	FEMALE	25.2857	4.46230	14
	Total	26.3333	5.03968	42
EXPERIMENTAL GROUP 2	MALE	28.5909	2.78874	22
	FEMALE	28.6875	2.79806	16

	Total	28.6316	2.75505	38
Total	MALE	27.6200	4.42576	50
	FEMALE	27.1000	3.99439	30
	Total	27.4250	4.25091	80

Dependent Variable: PRE

F	df1	df2	Sig.
2.043	3	78	.115

Custom Hypothesis Tests Index

1	Contrast Coefficients (L' Matrix)	Simple Contrast (reference category = 2) for GROUP
	Transformation Coefficients (M Matrix)	Identity Matrix
	Contrast Results (K Matrix)	Zero Matrix
2	Contrast Coefficients (L' Matrix)	Simple Contrast (reference category = 2) for SEX
	Transformation Coefficients (M Matrix)	Identity Matrix
	Contrast Results (K Matrix)	Zero Matrix

ontrast Results (K Matrix)

GROUP Simple Contrast			Dependent Variable PRE
Level 1 vs. Level 2	Contrast Estimate		-3.071
	Hypothesized Value		0
	Difference (Estimate - Hypothesized)		-3.071
	Std. Error		.886
	Sig.		.001
	95% Confidence Interval for Difference	Lower Bound	-4.835
		Upper Bound	-1.307

Test Results

Dependent Variable: PRE

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	171.850	1	171.850	12.028	.001
Error	1071.545	77	14.287		

Contrast Results (K Matrix)

SEX Simple Contrast			Dependent Variable
			PRE
Level 1 vs. Level 2	Contrast Estimate		.161
	Hypothesized Value		0
	Difference (Estimate - Hypothesized)		.161
	Std. Error		.888
	Sig.		.857
	95% Confidence Interval for Difference	Lower Bound	-1.609
		Upper Bound	1.931

Test Results

Dependent Variable: PRE

Source	Sum of Squares	Df	Mean Square	F	Sig.
Contrast	.469	1	.469	.033	.857
Error	1071.545	77	14.287		

Estimated Marginal Means

1. GROUP

Estimates

Dependent Variable: PRE

GROUP	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
EXPERIMENTAL GROUP1	25.915	.620	24.680	27.150
EXPERIMENTAL GROUP 2	28.986	.627	27.737	30.235

Pairwise Comparisons

Dependent Variable: PRE

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.		
EXPERIMENTAL GROUP 1	GROUP	-3.071	.886	.001		
	EXPERIMENTAL GROUP 2	3.071	.886	.001		

Pairwise Comparisons

Dependent Variable: PRE

(I) GROUP	(J) GROUP	95% Confidence Interval for Difference	
		Lower Bound	Upper Bound
EXPERIMENTAL GROUP 1		-4.835	-1.307
	EXPERIMENTAL GROUP 2	1.307	4.835

Dependent Variable: PRE

	Sum of Squares	Df	Mean Square	F	Sig.

Contrast	171.850	1	171.850	12.028	.001
Error	1071.545	77	14.287		

2. SEX

Estimates

Dependent Variable: PRE

SEX	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
MALE	27.531	.541	26.454	28.608
FEMALE	27.370	.698	25.979	28.761

Dependent Variable: PRE

(I) SEX	(J) SEX	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
MALE	FEMALE	.161	.888	.857	-1.609	1.931
FEMALE	MALE	-.161	.888	.857	-1.931	1.609

Dependent Variable: PRE

	Sum of Squares	Df	Mean Square	F	Sig.
Contrast	.469	1	.469	.033	.857
Error	1071.545	77	14.287		

3. GROUP * SEX

Dependent Variable: PRE

GROUP	SEX	Mean	Std. Error	95% Confidence Interval

				Lower Bound	Upper Bound
EXPERIMENTAL GROUP1	MALE	26.309	.727	24.859	27.758
	FEMALE	25.521	1.012	23.505	27.537
EXPERIMENTAL GROUP2	MALE	28.753	.807	27.146	30.360
	FEMALE	29.219	.954	27.318	31.120

```
ANCOVA PRE BY GROUP SEX WITH POST
 /CONTRAST(GROUP)=Simple
 /CONTRAST(SEX)=Simple
 /METHOD=SSTYPE(3)
 /INTERCEPT=INCLUDE
  /CRITERIA=ALPHA(.05)
 /DESIGN=POST GROUP SEX GROUP*SEX.
```

Analysis of covariance

Between-Subjects Factors

		Value Label	N
GROUP	1.00	EXPERIMENTAL GROUP1	42
	2.00	EXPERIMENTAL GROUP2	38
SEX	1.00	MALE	50
	2.00	FEMALE	30

Dependent Variable: PRE

GROUP	SEX	Mean	Std. Deviation	N
EXPERIMENTAL GROUP 1	MALE	1.9360	.30629	28
	FEMALE	1.7946	.17021	14
	Total	1.8889	.27480	42

EXPERIMENTAL GROUP 2	MALE	1.7106	.19338	22
	FEMALE	1.6417	.18479	16
	Total	1.6816	.19042	38
Total	MALE	1.8368	.28371	50
	FEMALE	1.7131	.19151	30
	Total	1.7904	.25889	80

Test of Equality of Error Variances

Dependent Variable: PRE

F	df1	df2	Sig.
7.471	3	78	.000

1	Contrast Coefficients (L' Matrix)	Simple Contrast (reference category = 2) for GROUP
	Transformation Coefficients (M Matrix)	Identity Matrix
	Contrast Results (K Matrix)	Zero Matrix
2	Contrast Coefficients (L' Matrix)	Simple Contrast (reference category = 2) for SEX
	Transformation Coefficients (M Matrix)	Identity Matrix
	Contrast Results (K Matrix)	Zero Matrix

Contrast Results (K Matrix)

GROUP Simple Contrast			Dependent Variable: PRE
Level 1 vs. Level 2	Contrast Estimate		.232
	Hypothesized Value		0
	Difference (Estimate - Hypothesized)		.232
	Std. Error		.055
	Sig.		.000
	95% Confidence Interval for Difference	Lower Bound	.123
		Upper Bound	.342

Test Results

Dependent Variable: PRE

Source	Sum of Squares	df	Mean Square	F	Sig.
Contrast	.918	1	.918	17.954	.000
Error	3.837	77	.051		

Contrast Results (K Matrix)

SEX Simple Contrast		Dependent Variable: PRE
Level 1 vs. Level 2	Contrast Estimate	-.155
	Hypothesized Value	0
	Difference (Estimate - Hypothesized)	-.155

	Std. Error		.110
	Sig.		.163
	95% Confidence Interval for Difference	Lower Bound	-.374
		Upper Bound	.064

Test Results

Dependent Variable: PRE

Source	Sum of Squares	Df	Mean Square	F	Sig.
Contrast	.102	1	.102	1.985	.163
Error	3.837	77	.051		

Estimated Marginal Means

1. GROUP

Estimates

Dependent Variable: PRE

GROUP	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
EXPERIMENTAL GROUP1	1.924	.043	1.839	2.010
EXPERIMENTAL GROUP2	1.692	.038	1.617	1.767

Pairwise Comparisons

Dependent Variable: PRE

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.		
EXPERIMENTAL GROUP		.232	.055	.000		

	EXPERIMENTAL GROUP	-.232	.055	.000		

Pairwise Comparisons

Dependent Variable: PRE

(I) GROUP	(J) GROUP	95% Confidence Interval for Difference	
		Lower Bound	Upper Bound
EXPERIMENTAL GROUP1		.123	.342
	EXPERIMENTAL GROUP2	-.342	-.123

Dependent Variable: PRE

	Sum of Squares	Df	Mean Square	F	Sig.
Contrast	.918	1	.918	17.954	.000
Error	3.837	77	.051		

2. SEX

Estimates

Dependent Variable: PRE

SEX	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
MALE	1.731	.047	1.637	1.825
FEMALE	1.885	.075	1.737	2.034

Pairwise Comparisons

Dependent Variable: PRE

(I) SEX	(J) SEX	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
MALE	FEMALE	-.155	.110	.163	-.374	.064
FEMALE	MALE	.155	.110	.163	-.064	.374

Dependent Variable: PRE

	Sum of Squares	Df	Mean Square	F	Sig.
Contrast	.102	1	.102	1.985	.163
Error	3.837	77	.051		

. GROUP * SEX

Dependent Variable: PRE

GROUP	SEX	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
EXPERIMENTAL GROUP 1	MALE	1.807	.064	1.678	1.935
	FEMALE	2.042	.110	1.823	2.261
EXPERIMENTAL GROUP 2	MALE	1.654	.053	1.550	1.759
	FEMALE	1.729	.065	1.599	1.859

/CONTRAST(GROUP)=Simple

/CONTRAST(SEX)=Simple

/METHOD=SSTYPE(3)

/INTERCEPT=INCLUDE

/CRITERIA=ALPHA(.05)

/DESIGN=PRE GROUP SEX GROUP*SEX.

Analysis of covariance

Between-Subjects Factors

		Value Label	N
GROUP	1.00	EXPERIMENTAL GROUP 1	42
	2.00	EXPERIMENTAL GROUP 2	38
SEX	1.00	MALE	50
	2.00	FEMALE	30

Dependent Variable: POST

GROUP	SEX	Mean	Std. Deviation	N
EXPERIMENTAL GROUP1	MALE	3.9345	.09312	28
	FEMALE	2.1994	.68897	14
	Total	3.3562	.91737	42
EXPERIMENTAL GROUP2	MALE	3.5970	.23365	22
	FEMALE	2.9354	.14579	16
	Total	3.3184	.38623	38
Total	MALE	3.7860	.23838	50
	FEMALE	2.5919	.60271	30

	Total	3.3382	.71203	80

Test of Equality of Error Variances

Dependent Variable: POST

F	df1	df2	Sig.
11.112	3	78	.000

Tests of Between-Subjects Effects

Dependent Variable: POST

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	32.875	4	8.219	85.886	.000
Intercept	7.897	1	7.897	82.525	.000
PRE	.693	1	.693	7.244	.009
GROUP	1.223	1	1.223	12.784	.001
SEX	23.679	1	23.679	247.443	.000
GROUP * SEX	5.040	1	5.040	52.664	.000
Error	7.177	77	.096		
Total	931.554	80			
Corrected Total	40.052	79			

Custom Hypothesis Tests Index

1	Contrast Coefficients (L' Matrix)	Simple Contrast (reference category = 2) for GROUP

	Transformation Coefficients (M Matrix)	Identity Matrix
	Contrast Results (K Matrix)	Zero Matrix
2	Contrast Coefficients (L' Matrix)	Simple Contrast (reference category = 2) for SEX
	Transformation Coefficients (M Matrix)	Identity Matrix
	Contrast Results (K Matrix)	Zero Matrix

Contrast Results (K Matrix)

GROUP Simple Contrast			Dependent Variable
			POST
Level 1 vs. Level 2	Contrast Estimate		-.276
	Hypothesized Value		0
	Difference (Estimate - Hypothesized)		-.276
	Std. Error		.077
	Sig.		.001
	95% Confidence Interval for Difference	Lower Bound	-.430
		Upper Bound	-.122

Test Results

Dependent Variable: POST

Source	Sum of Squares	Df	Mean Square	F	Sig.
Contrast	1.223	1	1.223	12.784	.001
Error	7.177	77	.096		

Contrast Results (K Matrix)

SEX Simple Contrast			Dependent Variable: POST
Level 1 vs. Level 2	Contrast Estimate		1.156
	Hypothesized Value		0
	Difference (Estimate - Hypothesized)		1.156
	Std. Error		.073
	Sig.		.000
	95% Confidence Interval for Difference	Lower Bound	1.009
		Upper Bound	1.302

Test Results

Dependent Variable: POST

Source	Sum of Squares	Df	Mean Square	F	Sig.
Contrast	23.679	1	23.679	247.443	.000
Error	7.177	77	.096		

Estimated Marginal Means

1. GROUP

Estimates

Dependent Variable: POST

GROUP	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound

EXPERIMENTAL GROUP 1	3.037	.052	2.933	3.140
EXPERIMENTAL GROUP 2	3.313	.054	3.206	3.419

Pairwise Comparisons

Dependent Variable: POST

(I) GROUP	(J) GROUP	Mean Difference (I-J)	Std. Error	Sig.		
EXPERIMENTAL GROUP1		-.276	.077	.001		
	EXPERIMENTAL GROUP2	.276	.077	.001		

Pairwise Comparisons

Dependent Variable: POST

(I) GROUP	(J) GROUP	95% Confidence Interval for Difference	
		Lower Bound	Upper Bound
EXPERIMENTAL GROUP1		-.430	-.122
	EXPERIMENTAL GROUP2	.122	.430

Dependent Variable: POST

	Sum of Squares	Df	Mean Square	F	Sig.
Contrast	1.223	1	1.223	12.784	.001
Error	7.177	77	.096		

2. SEX

Estimates

Dependent Variable: POST

SEX	Mean	Std. Error	95% Confidence Interval

			Lower Bound	Upper Bound
MALE	3.752	.044	3.664	3.841
FEMALE	2.597	.058	2.482	2.712

Pairwise Comparisons

Dependent Variable: POST

(I) SEX	(J) SEX	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval for Difference	
					Lower Bound	Upper Bound
MALE	FEMALE	1.156	.073	.000	1.009	1.302
FEMALE	MALE	-1.156	.073	.000	-1.302	-1.009

Dependent Variable: POST

	Sum of Squares	Df	Mean Square	F	Sig.
Contrast	23.679	1	23.679	247.443	.000
Error	7.177	77	.096		

3. GROUP * SEX

Dependent Variable: POST

GROUP	SEX	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
EXPERIMENTAL GROUP 1	MALE	3.875	.062	3.751	4.000
	FEMALE	2.198	.083	2.033	2.362
EXPERIMENTAL GROUP 2	MALE	3.629	.067	3.496	3.763
	FEMALE	2.996	.081	2.835	3.156

Appendix L

Lesson Plan for Demonstration Teaching Method (Experimental Group 1)

Week 1: **Lesson One**

Subject: Electrical Installation and Maintenance work

Class: NTC II

Topic: Electrical Installation tools and wiring accessories

Unit: Domestic Installation

Duration: 90 minutes (Double Period)

Average Age 15-years

Objective: To educate and help students to acquire psychomotor skills in handling tools and installing wiring accessories.

Specific Objectives: By the end of the lesson the students should be able to;

i. Dismantle and install wiring accessories with installation tools.
ii. Use measuring instruments appropriately
iii. Use each installation tool and measuring instrument in installing wiring accessories on the wiring board.

Topic Content: Types of installation tools and uses. Types of measuring instrument and uses, wiring accessories and uses.

Task Required:

1. Ability to use installation tooıs
2. Ability to use measuring instrument
3. Ability to install wiring accessories using installation tools and measuring tools.

Instructional Techniques: observation, demonstration repetition,clarification and workshop practice

Content Development	Teacher's Activities	Learners Activities	Strategies Emphasized
Step 1	The teacher introduces the topic and	The students observed the	Set induction

Introduction	shows the students the different installation tools. Then listed some of the tools as; Hammer, wire strippers, bending springs linesman plier and phsase/megger tester	tools	
Step 2 uses of the installation tools	The teacher asks the students to place their tools on their wiring board and then oberve the teacher as she demonstrates with tools on the wiring board	The students observe the teacher use the installation. Noting the step by step move of the teacher	Demonstration, planned repetition Questioning
Step3 measuring instrument	The teacher mentions the measuring instrument as; measuring tape, engineer's rule and scriber. The students were given these instruments to demonstrate with.	Students observe the instruments	Use of example
Step 4 uses of measuring instrument	The teacher explains the uses of the measuring instrument then demonstrates with it for students to observe	The students observe then demonstrates with the measuring instrument as they also observe the teacher demonstrates with the instrument	Demonstration,planned repetition, questioning clarification
Step 5 wiring accessories	The teacher lists the wiring accessories as; joint boxes, switches, ceiling rose, socket outlet, plugs and lamp holders. The teacher distributes these accessories to students to observe.	The students observe the wiring accessories	Use of example planned repetition stimulus variation
Step 6 uses of wiring accessories	The teacher states the uses of wiring accessories then demonstrates with it for students to observe and follow the step by step mounting and dismantling of the accessories	The students observe the teacher and follow the step by step dismantling and mounting of the accessories on the wiring board. They also ask questions	Demonstration, planned repetition, clarification

.

Workshop Practice: Students continues to practice the mounting of wiring accessories.

Assignment: Using the wiring board mount the lamp holder, switch, socket, outlet and joint box.

Evaluation: The teacher will use the above assignment to evaluate the students' performance, scores the assignment to ascertain their psychomotor skill acquired in mounting of accessories and in the appropriate use of installation tools on the job.

Correction: the teacher gives general and particular corrections after students' assignment have been scored and returned to them. During this session the various mistakes corrected by the teacher should be noted by students. (See Appendix N on page 203-212 for diagrams of installation tools and accessories)

Week 2: **Lesson Two**

Subject: Electrical Installation and Maintenance Work

Class: NTC II

Topic: Cables for surface Installation (PVC/PVC Cables).

Unit: Demonstic Installation

Duration: 90 mins (Double Period)

Averageage: 15 years

Objective: To educate and help students to acquire psychomotor skills in cable clipping.

Specific Objectives: By the end of the lesson, the students should be able to;

i. Identify the various parts of the cable
ii. Fix clips on cables
iii. Perform surface installation involving cable bending skills.

Subject Content:

A. Cable parts
B. Cable clips
C. Clipping of PVC/PVC cables

Task Required:

A. Ability to clip cables
B. Ability to bend and
C. Ability to run cable

Instructional Materials: Wiring board, text book, 1.5mm^2 cables, clips of various sizes.

:

Content Development	Teacher's Activities	Learners Activities	Strategies Emphasized
Step 1 Introduction	The teacher introduces the topic and shows the students various sizes of cables for them to observe	The students observe the cables	Set induction
Step 2 different sizes of clips	Also the teacher distributes clips of different sizes to students to observe and get ready to demonstrate with	Students observe and askes questions	Use of example Stimulus variation
Step 3 uses of different cable and clip sizes	The teacher displays the $1.5mm^2$ and $2.5mm^2$ cables to students and explains the use of each to them.	Students observe and askes questions	Use of example Stimulus variation
Step 4 parts of cables	The teacher lists the parts of the cables as conductor, insulation, and sheath. Then using the linesman plier the teacher cuts the insulation for students to see the conductor. With the cable the teacher demonstrates to the students how to make connection to the wiring accessories and also clipping of cables	The students observe the teacher as she cuts insulation, clip cables and makes connections.	Demonstration, stimulus variation, planned repetition and questioning
Step5 Methods of bending cable	The teacher demonstrates to the students the different methods of bending cable without causing damage to the cable	The students observe the teacher as she demonstrates	Demonstration Planned repetition and questioning

Workshop practice: Students continue to practice surface installation using wiring board, PVC cable and clips and using appropriate installation tools for the job.

Assignment: Using the wiring board install a lamp holder and clip $1.5mm^2$ PVC cable acurrately.

Evaluation: The teacher uses the above assignment to evaluate students' performance, scores the assignment to ascertain the psychomotor skill acquired in surface wiring skills and in appropriate cable clipping.

Correction: The teacher gives corrections after students assignment have been scored and returned to them. In this section, the various mistakes are corrected by the teacher and the students take note of them.

Week 3: **Lesson Three**

Subject: Electrical Installation and Maintenance Work

Class: NTC II

Topic: Conductor Joints and Terminating Technique

Unit: Domestic Installation

Duration: 90 minutes (double period)

Age: 15 years

Objective: To educate and help students acquire psychomotor skills in soldering.

Specific objectives: By the end of the lesson the students should be able to:

- Use soldering iron to join two conductors
- Clamp conductor (with bolts and nuts of clamp)
- Terminate conductors

Subject Content:

- Soldering
- Clamping
- Terminating conductors

Task Required:

- Ability to solder
- Ability to clamp
- Ability to terminate conductor

Instructional materials: conductors, soldering iron, lead, wiring accessories.

Content Development	Teacher's Activities	Learners Activities	Strategies Emphasized
Step 1 introduction	The teacher introduces the topic and shows the students some samples of conductor joints and terminals for them to observe.	The students observe the material presented to them by the teacher.	Set induction
Step 2 Methods of conductor joining	The teacher explains the two methods of joining conductor as; a) the use of heat to fuse together the surface of the joint example soldering and welding. b) use of pressure and mechanical means to hold together example clamping,bolting and riveting	The students listen and jot down points	Use of examples stimulus variation
Step 3 Soldering	Lifting solering iron, the teacher explains the use of it to students. With the soldering iron heated and lead the teacher demonstrates how to solder conductor material.the teacher showed the students how to join and how to separate joints with the heated soldering iron	The students observe the teacher as she make the soldering on a material. The students also follow the step by step in making their own soldering. They also ask questions and answers given	Demonstration Questioning Planned repetition

		to them.	
Step 4 Clamping	Lifting the clamp for the students to see. The teacher explains to the students that clamp joint are easy to make as no particular preparation is required. The teacher demonstrates clamping by loosing the bolts and nuts of the clamp then inserting the stranded conductor to it and locked tight.	The students observe the teacher's demonstration; ask questions, they also start demonstration as they follow the step by step demonstration of the teacher.	Demonstration Planned repetition Use of example Stimulus variation
Step5 Screw terminals	The teacher demonstrates how to terminate a conductor in a screw terminal first the teacher removes the conductor insulation far enough to allow the conductor to enter the terminal the teacher uses the stranded conductor, twist them to form a solid mass.	The students observe the teacher as she demonstrates and ask questions and answers given to them	Demonstration questioning

Workshop Practice: the students begin to practice how to solder and terminate conductors using the soldering iron and lead together with 1.5mm^2 conductors.

Assignment: Using a solding iron join two conductors neatly.

Evaluate: The teacher uses the above assignment to evaluate the students' performance, scores the assignment to ascertain the psychomotor skill acquired in soldering and terminating techniques.

Correction: The teacher gives correction after assignment have been scored and returned to them. In this section the various mistakes are corrected by the teacher and the students take note of them.

Week 4: **Lesson Four**

Subject: Electrical installation and maintenance work

Class: NTC II

Topic: Wiring system

Unit : Domestic Installation

Duration: 90 mins (double period)

Averageage: 15 years

Objective: To educate and help students to acquire psychomotor skills in wiring systems.

Specific objectives: By the end of the lesson, the students should be able to:

1. Identify the methods and systems of wiring
2. Perform wiring connection using joint box method and loop-in system.
3. Pull/draws cables in a conduit.
4. Draw/interprete wiring diagrams of joint box wiring.

Subject Content

- Systems of wiring
- Conduit wiring

Task Requird:

- Ability to make joint box wiring connection.
- Ability to make loop-in system wiring connection.
- Ability to pull/draw cables in conduit.
- Ability to connect lighting point control by two different switches using joint box system
- Connect five lighting points with three separate switches, using joint box system.

Instructional Material: Wiring board, textbook, 1.5mm^2 PVC cables, bulb, (lamp), switches, lamp holder, joint boxes and plastic tube.

Content Development	Teacher's Activities	Learners Activities	Strategies Emphasized
Step 1 introduction	The teacher introduces the topic and shows the students samples of wiring system with the wiring diagram of each. The teacher explains to students that wiring system are network of wires connecting various accessories for the distribution of electrical energy from supply board to numerious electrical energy consuming devices such as lamp, fans domestic appliances.	The students observe the wiring board and wiring diagram given to them and listen to the teacher.	Set induction Use of example
Step 2 Methods of wiring	The teacher lists the two method of wiring as; a) joint box or Tee system of wiring b)loop in system of wiring. From the wiring diagram shown in appendix P Ppage 208. The teacher starts marking the proper positioning of switches and lamps for joint box wiring.	The students observe the teacher as she demonstrates the joint box wiring; ask questions and answers given to them.	Demonstration Planned repetition Questioning
Step 3	The teacher explains the loop-in system wiring to the students as the method that consists of taking two conductors twisted together into the terminals of a lightening point or switch, using one as the incoming and the other as the outgoing conductor to the next point. The teacher demonstrates to the students how to make loop-in system wiring. The teacher now establishes a distribution board (see the wiring diagram in appendix Q on page 209).	The students observe the teacher as she demonstrates loop in system of wiring, ask questions and answer given to them	Demonstration Planned repletion And Questioning
Step 4 Conduit wiring	The teacher lifts the plastic tube for students to observe. The teacher explains to the students that there are at least four internal wiring system employed in installation they are a. Wooding casing and capping wiring b. Cleat wiring c. Lead sheathed d. Conduit wiring. The teacher shows the students the charts of the different types of internal wiring. The teacher showing the students the plastic tube explains that the tube is use for conduit wiring the teacher explains conduit wiring as a type of wiring where insulated cables are drawn into metal or plastic tube. The teacher explains to the students that the plastic tube is used for domestic installation and steel conduit system is mostly used for industrial application in a loop-in system. The teacher demonstrates to the students how to pull/draw cables in PVC conduits. First: The teacher displays the wiring board and the tools used for the PVC conduit wiring.	The students also ask questions and answers given to them.	Demonstration planned repetition stimulus variation use of examples

	The tools include; Bending spring, Hacksaw, Draw –in- wire and the draw-in tape. The teacher explains the uses of the tools to the students. The teacher lifts the bending spring and explains that it is use for bending PVC conduit pipe that saw is used for cutting pipes, draw-in wire- It is used for pulling in the wires, and the Draw-in-tape: It is also used for pulling in wire. With the Hacksaw the teacher cuts the pipe to sizes Second: The teacher makes marks on the wiring board where the 3 lamps and switch are to be located. Thirdly: Mounting the switches and three lamps the teacher then clips the PVC conduits to make it firm on the wiring board. The teacher clips the PVC conduit in all the places the PVC cable will pass through before getting to energy consumer (lamp). Forth: The teacher connects the neutral to the neural terminal of the switch and the live to the live terminal of the switch from there, the cable is drawn inside the PVC conduit to the lamp, where the neutral is connected to neutral lamp terminal and live to the live lamp terminal, The teacher draws the PVC cable inside the conduit linking to lamp and the connection is made the same way in the lamp and the same process repeated in lamp. In this way, one switch is controlling the three lamps. The teacher repeats the process for the students to observe.		

Workshop Practice. The students continues to practice the conduit wiring using the wiring board, PVC pipe, PVC cable and conduits clips

Assignment: Using the wiring board install five lighting points cntrolled by three switches using joint box method such that SW1 control L1, L2 and L3, SW2 for L4, SW3 L5 respectively

Evaluation: The teacher will use the above assignment to evaluate students' performance, scores the assignment to ascertain their psychomotor skill acquired in joint box wiring.

Corrections: The teacher gives corrections after students assignment have been scored and returned to them. In this section the various mistakes are corrected by the teacher and the students take note of them.

Week 5: **Lesson Five**

Subject: Electrical Installation and maintenance work

Class: NTC II

Topic: Electrical Installation design diagrams

Unit: Domestic installation

Duration: 90 Minutes (Double Period)

Average: 15 years

Objective: To help students acquire psychomotor skill in drawing building plan and interpretation of plan.

Specific Objectives: By the end of the lesson the students should be able to:

i. Identify electrical symbols
ii. Design and interpret electrical installation plan
iii. Install accessories on plan

Topic Content:

Electrical symbols

Drawing plan and installing accessories

Interpretation of plan

Task Required:

1. Ability to identify electrical symbols
2. Ability to design and interpret electrical installation building plan

Instructional Material: Text book showing electrical design diagrams, drawing board, drawing sheet, scale, pencil, sharper, square, Set Square.

.Content Development	Teacher's Activities	Learners Activities	Strategies Emphasized
Step 1 Introduction	The teacher informs the students that design diagrams here refers to the building plans showing the locations of equipment, accessories, with their protective devices. In furtherance to the above explanation the teacher distributes the diagrams of electrical symbols for students to observe. The teacher explains how to identify it in a diagram. The teacher then explains the need to properly plan electrical installation work before execution. The planning of electrical installation work is made easy with the aid of a working diagram. The working diagram gives a clear picture of the type of installation to be used, the rating of distribution board, the quantity of accessories required, the rating of main switch and the cable sizes needed for a particular electrical installation. The teacher also made the students to understand that successfully performing electrical work requires the ability to read and interpret different types of drawing. In understanding circuit symbols, equipment rating is another basic building blocks needed to become an electrician, therefore the teacher informs the students that it is important to know how to properly take information from electrical drawing and apply it to the real world. The teacher then asks students to place their drawing sheets on their individual drawing boards with their set square ready for electrical symbol drawing. The teacher lists some wiring accessories on the chalkboard and starts drawing the electrical symbol of each. The students' start drawing what the teacher is drawing on their drawing sheets. The teacher moves round the class to ensure that students are drawing the symbols. After which the teacher will clean the chalkboard and lists some of the accessories and asks the students to draw the symbols. Like lighting point, fan, socket, deep freezer, switch, air conditioner and refrigerator see appendix R Page 210 for electrical symbol	The students listen to the teacher, observe what she is doing and starts their own demonstration	Set induction Use of examples and demonstration
Step 2 Drawing instruments	The teacher explains to the student the use of various drawing instrument example: metric scale rule, T-square, drawing board/tables, set-(30°, 60°, and 45°), adjustable set-square, pencil (grade 5B to 9H pencil), French curves and dividers. The teacher asks the workshop attendant to distribute the instruments to the students as they are already seated. Each	Students ask questions, get answers, looked at the various instrument. Listen attentively, observe the teacher as she demonstrates on her drawing table with different instruments and equipment. Students also	Demonstration Planned repetition Use of examples Questioning

	person occupying one drawing table ready to demonstrate. The teacher moves round to help the students place their drawing sheet properly on the drawing board. The teacher emphasizes the neatness of work, importance of careful handling of instrument, maintenance, and storing of drawing instruments and equipment after use. Also the teacher explains the basic principles of design. The teacher further states that the modern residential building has the following parts: Living room, dining room, bedroom, kitchen, garage, bath/toilet, laundering and store. The teacher explains that in designing, there must be functional relationship and the teacher introduces design of residential, public, storage; assemble building as types of design. Draws examples of each type of designs.	sketch in their drawing sheets the different types of design	
Step3 Designing of plan	The teacher explains that students should first attempt to sketch the plan with freehand, before using metric scale to draw the plan, in preparing the free hand sketch, the students should uses drawing sheet and with the aids of pencil, set-square or rule, sketch the floor plan with accurate dimensions. The student should indicate the parts of the plan as earlier explained. The teacher demonstrates the freehand sketch of a two bedroom see appendix X page 227. After the free hand sketch of the 2 bedroom bungalow the teacher starts using the electrical symbols which the students are already familiar with.	Students observe the teacher as she sketches the plan and places the electrical symbol in the appropriate locations in the building plan; students also observe as the accurate dimensions of apartments.	Demonstration planned repetition
Step4 using metric in drawing plan	The teacher introduces metric scale rule in the 1:100mm, 1:25mm, 1:150mm, 1:50mm, 1:200mm. The teacher goes from one student to the other to illustrate the use of these metric scale rule graduations. The teacher demonstrates how to hold the scale rule to pick out the required dimensions. The teacher also demonstrates this on the chalk board by sketching the metric scale rule and indicates how to picture the dimension based on the scale graduations. The teacher uses a room of 3.6mmx3.6mm to illustrate how to interpret scale rule. The teacher also explains to the students of the appropriate locations of socket, switches, and lighting points in a building plan.	Students ask questions, answer given to them, observe the teacher's demonstration. Students interpret the dimension from the scale rule.	Demonstration Planned repetition questioning
Step 5 interpretation of diagram	The teacher explains to students that the diagram is simple representation of circuits, in which only the essential components are	Students observe the teacher; ask questions and answer the question given	Demonstration Planned Repetition

	taken into consideration. For example, the physical location of the equipment and the path of cables are not indicated. The teacher then ask the students to sketch a kitchen and place the electrical symbols of equipment found in the kitchen like the water heater, electric cooker, dish-washer, washing machine, socket, outlets, lighting points. The teacher sketches a kitchen plan then install the equipment and accessories.	to them then starts sketching the kitchen plan	Questioning

Workshop practice: each students starts drawing the plan and making installation of electrical symbol in the plan.

Assignment: Draw the electrical installation plan for two bedroom flat with the following apartments.

1. Two bedroom
2. One sitting room
3. Kitchen
4. Toilet and bathroom

Evaluation: The teacher will use the above assignment to evaluate the students performance, scores the assignment to ascertain their psychomotor skill acquired in placing the electrical symbol in their proper locations in the plan.

Correction: The teacher gives general and particular corrections after students' assignment have been scored and returned to them. During this session the various mistakes corrected by the teacher should be noted by students.

Appendix M

Accessories and Installation Tools

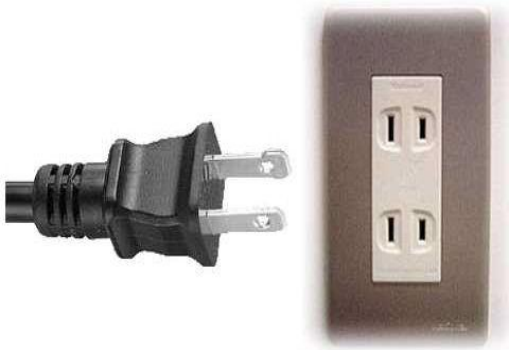
Angle and Batten Lampholder

Angle and Batten Lampholder

Plug

Ceiling Rose

Switches



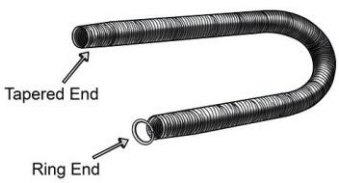
Plug

Spirit Level

Scriber

Saw

Calipers



Bending Springs

Linesman Plier

Wire Strippers

Side Cutter Diagonal Plier

Hammer

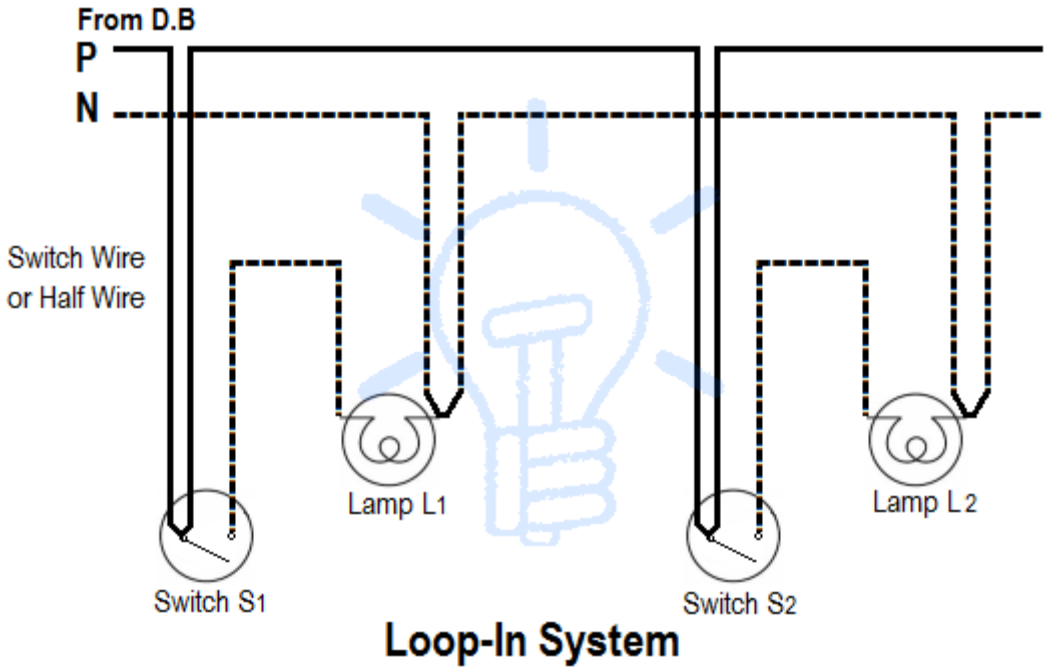
Phase Tester

Voltmeter

Megger Tester

Appendix N

Loop-in System



Appendix O

The Lighting Points, Each With One-Way Control, Wired Rubber Or Plastic Sheathed Cable Using A Joint Box.

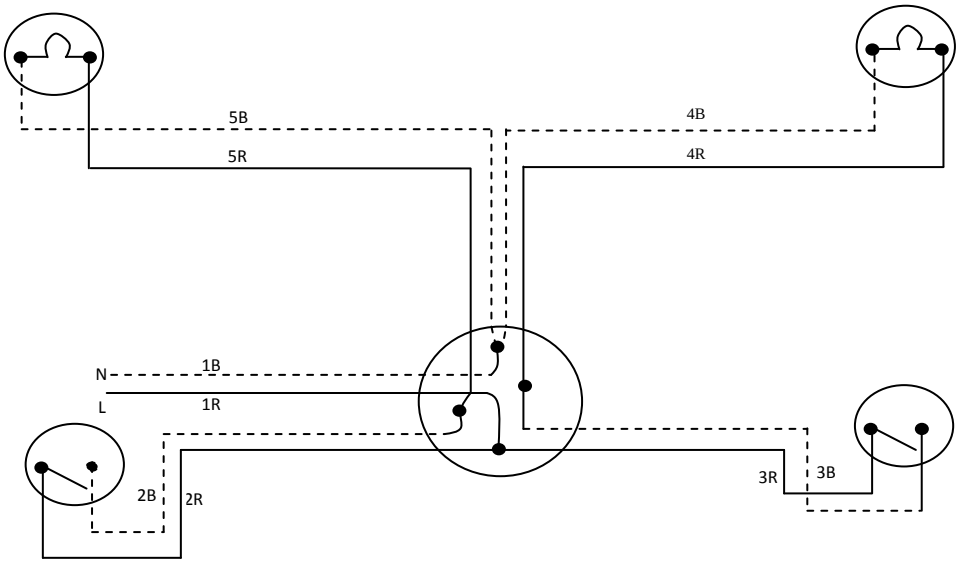


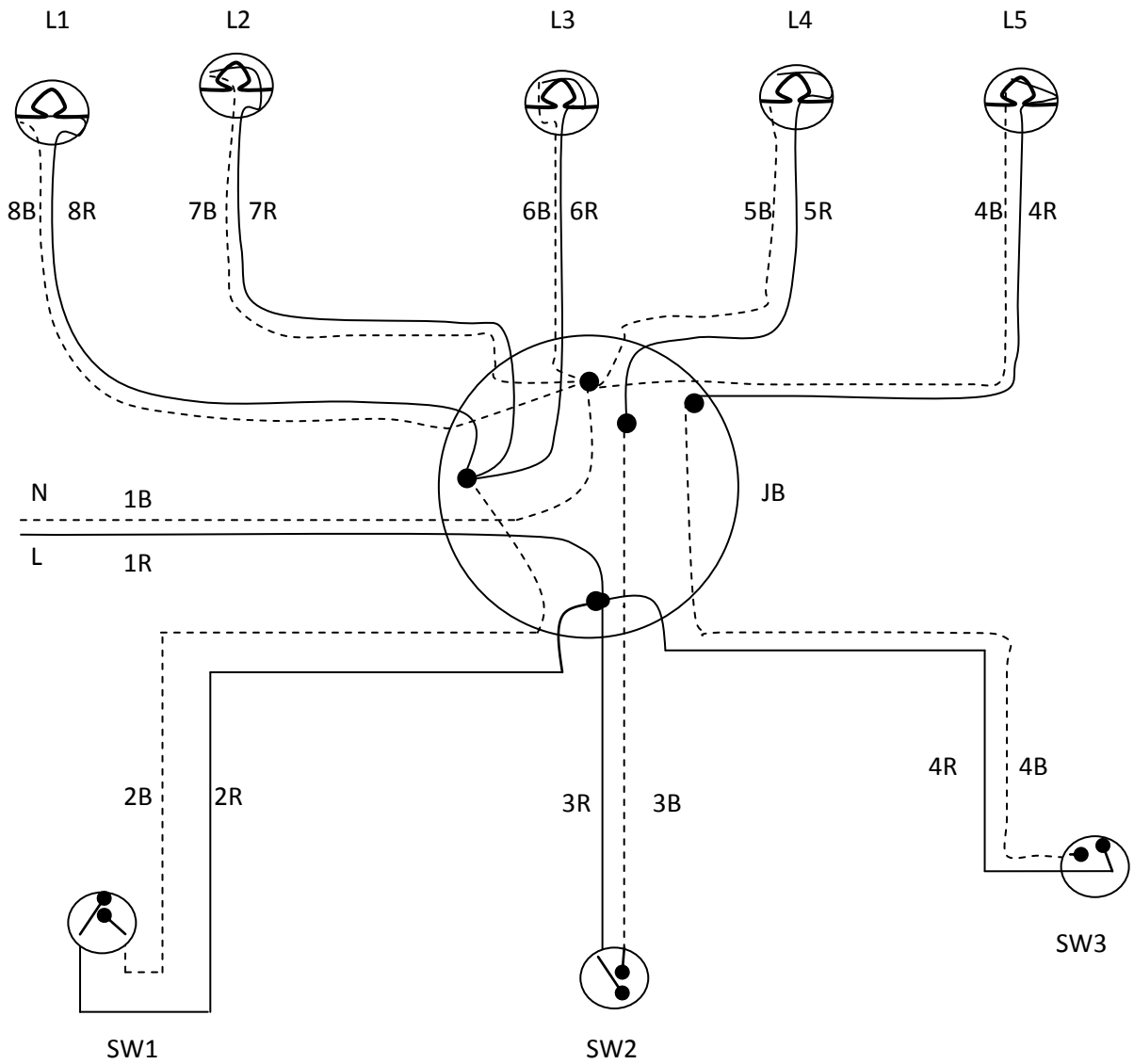
Fig. 2.3: Two lighting points controlled by two seperate switches

Guide

1R	Line
1B	Neutral
2R, 3R	Switch Feed
2B, 5R	Switch Wire
3B, 4R	Switch Wire
4B, 5B	Lamp Feed

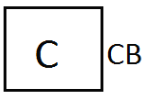
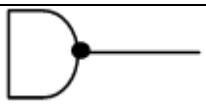
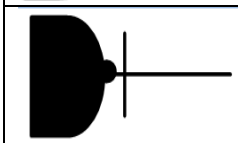
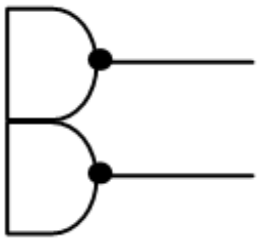
Appendix P

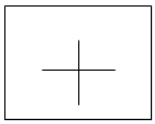
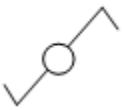
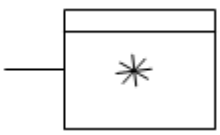
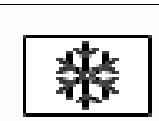
Five Lighting Points Controlled By Three Separate Switches Such That SW_1 Controls Lamps L_1L_2 AndL_3; SW_2 Controls L_4 And SW3 Controls L_5 As Shown Below.

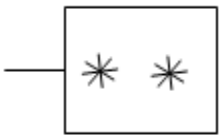
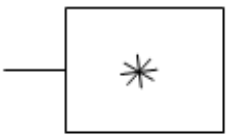
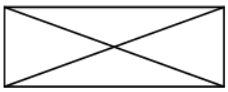


Appendix Q

Electrical Symbol

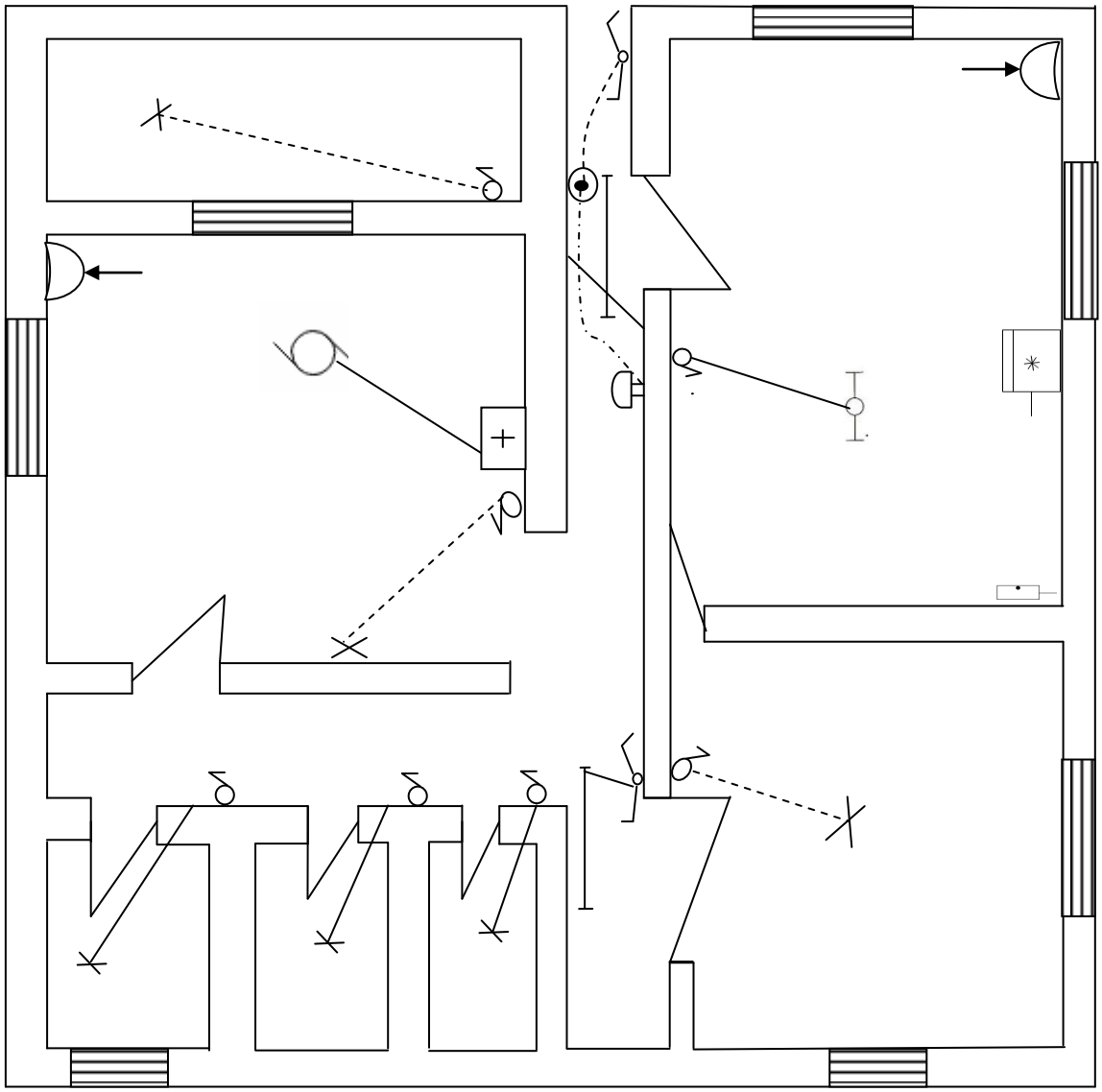
Symbols	Descriptions
	**2 x 240w Fluorescent Fitting**
	**1x 40w Popular pack fluorescent fitting**
	**1 x 60w scrw neck fitting**
	**1 x 100w bulk head fitting**
	**1 x 100w ceiling mounted fitting**
	**Ceiling fan with regulator**
	**Ceiling fan regulator bank**
	**13A socket outlet**
	**15A Socket outlet**
	**13A Twin socket outlet**
	**20A Socket outlet for Air conditioner**

Symbols	Descriptions
	Two Gang One Way Switch
	Fan Regulator
	Switch
	Ceiling Fan
	Ceiling Fan
	Two way Switch
	Luminous Push Button
	One Gang One Way Switch
	Ceiling light
	Wall Light
	Wall light
	Out Door Light
	Refrigerator
	Electric Water Heater
	Electric Heater
	Air Conditioner
	Air Conditioner
	Lamp Holder

	Call Bell
	Bell Push
	Deep Freezer
	Refrigerator
	Distribution Board
	Main Distribution Board

Appendix R

Two Bedrorom Bungalow Installation Plan



Appendix S

Lesson Plan for Project Teaching Method (Experimental Group 2)

Week 1: **Lesson One**

Subject: Electrical installation and maintenance work

Class: NTC II

Topic: Electrical Installation tools and using accessories

Unit: Domestic Installation

Time: 90 mins (Double period)

Average Age: 15years

Objectives: To help students acquire psychomotor skills in electrical installation through project/assignment

Specific Objectives: By the end of the lesson the students should be able to:

i. Dismantle and couple wiring accessories with installation tools
ii. Use measuring instrument appropriately
iii. Use each of the installation tools and measuring instrument in installing wiring accessories

Content Topic: types of installation tools and uses, types of measuring tools and uses, wiring accessories and uses

Task Required:

1. Ability to use installation tools

2. Ability to use measuring instrument

3. Ability to install wiring accessories using installation tools and measuring tools.

Instructional Materials: Charts, real objects (tools and wiring accessories).

Instrutional Techniques: Set induction, questioning, planned repetition, project, clarification

Entry Behaviour: Students are familiar with tools used in the workshop. To determine their entry behaviour the teacher asks the following question

--mention different types of tools in the workshop?

--What are they used for?

Content Development	Teacher's Activities	Learners Activities	Strategies Emphasized
Step 1 introduction	From the answers the teacher introduces the topic to students. Installation tools will be displayed for students to observe. The teacher asks students to state the uses of the tools displayed	The students listen and answers the teachers' question	Set induction use of examples
Step 2 Measuring instruments	Measuring instruments will be dsplayed by the teacher for students to observe and students will be required to state the uses of the measuring instruments	The students will supply answers to the questions	Use of examples questioning
Step 3 Wirng accessories	Wiring accessories will be displayed for students to observe. The students will be required to use the installation tools to dismantle the wiring accessories.	Students observe, ask questions and listen to answers given to them by the teacher.	Useof examples Questioning

Assignment: Using the wiring board install the lamp holder, switch, socket outlet, and joint box.

Workshop practice; Each student will use their wiring board to install the wiring accessories and the teacher moves round to supervise

Evaluation: the teacher will use the above assignment to evaluate the students' performance, scores the assignment to ascertain their psychomotor skill acquired in installing accessories and appropriate use of tools on the job

Corrections: the teacher gives general corrections after their project have be scored and returned to them. During this session the various mistakes corrected by the teacher should be noted by students.

Week 2: **Lesson Two**

Subject: Electrical Installation and Maintenance Work

Class: NTCII

Topic: Cables for surface Installation (PVC/PVC Cables)

Unit : Domestic Installation

Time: 90mins (Double Period)

Average Age: 15 Years

Objectives: To help students acquire psychomotor skills in cable clipping

Specific Objectives: By the end of the lesson the students should be able to:

i. Identify the various parts of cable

ii. Fix clips on cables

iii. Perform surface installation including cable bending skills

Topic Content: Cable parts, Cable clips, Clipping of PVC/PVC Cable

Task Required:

1. Ability to clip cables

2. Ability to bend and

3. Ability to run cable

Instructional Material: surface wiring charts, cables, clips, installation tools.

Instructional Techniques: Set induction, questioning, planned repetition, project, clarification and variety and variation

Entry Behaviour: The students are familiar with cables and accessories to determine their entry behaviour the followings were ask by the teacher

- Mention the accessories used in domestic installation

Content Development	Teacher's Activities	Learners Activities	Strategies Emphasized
Step1 introduction	From the answers the teacher introduces the topic to students. The teacher displays cables of various sizes for students to observe the teacher asks the students to identify the various sizes of cables	The students listen to what the teacher is saying and also carry out the instruction given to them	Set induction use of examples
Step 2 uses of clips	The teacher displays the clips for students to observe in their individual seats. The teacher asks the students to state the uses of clips in wiring.	Students supples answers to the question asked by the teacher	Stimulus variation Use of example questioning
Step3 Cable clipping	Distributing all the materials needed for cable clipping to students in their individual seats. The teacher asks the students to start cable clipping with their wiring boards	students observe, ask questions and listens to answers questions given to them by the teacher	

Assignment: Using the wiring board install a lamp holder and clip 1.5mm^2 PVC cable accurately.

Work practice: Each student with the wiring board, PVC cable and clips using the appropriate installation tools start constructing the project given to them by the teacher. The teacher moves round to supervise.

Evaluation: the teacher uses the above assignment to evaluate the students' performance. Scores the assignment to ascertain their psychomotor skill acquired in surface wiring, cable clipping and cable bending.

Correction: The teacher gives correction after students project have been scored and retured to them. In this section, the various mistakes are corrected by the teacher and students took note of them.

Week 3: **Lesson Three**

Subject: Electrical Installation and Maintenance Work

Class: NTC II

Topic: Conductor Joints and Termination Technique

Unit: Domestic Installation

Time: 90mins (Double Period)

Average Age: 15years

Objectives: To help students acquire psychomotor skills in soldering

Specific Objectives: By the end of the lesson the students should be able to;

1. Use soldering iron to join two conductors
2. Clamp conductor (with bolts and nuts of clamp)
3. Terminate conductors

Subject content: Soldering, Clamping, Terminating conductors

Task Required:

-Ability to solder

- Ability to clamp

- Ability to terminate conductor

Instructional Material: Real object of soldering bit/iron, lead, clamp and wiring accessories

Entry Behaviour: The students are familiar with cables and cable clipping to determine the students entry behaviour this question was asked by the teacher

-mention the parts of cable.

Content Development	Teacher's Activities	Learners Activities	Strategies Emphasized
Step 1 introduction	The teacher introduces the topic to students. The teacher displays the materials for the project and asks the students to observe. The teacher asks the students to state the uses of the materials displayed.	the students observe what was displayed and answers the question asked by the teacher	Set induction use of examples
Step 2 Joints	The teacher asks the students to identify the bolt and nut. The teacher also asks the students to insert the stranded conductor to the bolt and nut then lock tight	The students answers the teachers question then carrys out the assignment given to them.	Stimulus variation Use of example Questioning
Step 3 Soldering	The teacher asks the students to use the soldering iron given to each of them to solder material	the students observe the materials for the project; ask questions and answers given to them by the teacher	Stimulus variation Demonstration Use of example

Workshop practice: Each student begins to solder and terminate conductors using soldering iron and lead together with 1.5mm^2 conductors. The teacher moves round to supervise.

Assignment: using soldering iron join two conductors neatly

Evaluation: the teacher uses the above assignment to evaluate the students performance, scores the assignment to ascertain their psychomotor skill acquired in soldering and terminating techniques.

Correction: the teacher gives correction after assignment have been scored and returned to them. In this session the various mistakes are corrected by the teacher and the students take note of them.

Week 4: **Lesson Four**

Subject: Electrical Installation and Maintenance Work

Class: NTC II

Topic: Wiring System

Unit: Domestic Installation

Time: 90mins (Double Period)

Average Age: 15years

Objective: To help students to acquire psychomotor skill in wiring system

Specific Objectives: By the end of the lesson the students should be able to;

1. Identify the methods and system of wiring
2. Perform wiring connection using joint box method and loop-in system
3. Pull/draws cables in a conduit
4. Draw and interprete wiring diagrams

Subject Content: system of wiring, conduit wiring

Task Required:

- Ability to make joint box connection
- Ability to make loop-in system wiring connection
- Ability to pull/draw cables in conduit
- Ability to connect two lighting points control by two separate switches using joint box system
- Connect five lighting points with three separate switches using joint box method

Instructional Material: Text book, charts displaying diagrams of different wiring system and its wiring diagram. Real object of cables of various sizes, wiring accessories and conduit pipes.

Entry Behaviour: The students are a familiar with surface wiring and conductor joints to determine their entry behaviour the teacher ask the following question

- what is soldering

- mention two reasons for soldering

	Teacher's Activities	Learners Activities	Strategies Emphasized
Step 1 introduction	From the answers the teacher introduces the topic, displays wiring boards showing different systems of wiring. The teacher asks the students to identify the wiring systems.	The students answers the teacher's question	Set induction Use of examples
Step 2 Typesof wiring system	the teacher asks each student to dismantle the already existing wiring system on the wiring boards	The students starts practicing	Demonstration Use of examples Stimulus variation
Step 3 joint box wiring system	The teacher asks each student to using wiring accessories, cables and installation tools to install two lighting point control by two different switches using joint box system wiring.	The students starts practicing	Demondtration Stimulus variation

Workshop practice: each students start construction of the project and the teacher moves round to supervise

Assignment: Using wiring board produce five lighting points controlled by three switches using joint box such that sw1 controls L1,L2, and L3 and SW2 L4, SW3 L5 respectively.

Evaluation: the teacher will use the above assignment to evaluate students' performance, scores the assignment to ascertain their psychomotor skill acquired in joint box surface wiring.

Correction: the teacher give corrections after students' assignment have been scored and returned to them. In this session the various mistakes are corrected by the teacher and students take note of them.

Week 5: Lesson 5

Subject: Electrical installation

Class: NTC II

Topic: Electrical design diagrams

Unit: Domestic installation

Time: 90mins (double period)

Average Age: 15 years

Objective: To help students to acquire psychomotor skill in design and interpretation of working drawings

Specific objectives: By the end of the lesson the students should be able to:

i. Identify electrical symbol
ii. Design and interpret electrical installation building plan
iii. Install accessories on building plan

Topic content: electrical symbol, drawing plan and installing accessories, drawing and interpretation of single line diagram

Task Required:

- Ability to identify electrical symbol
- Ability to design and interpret electrical installation building plan

Instructional materials: Text books showing electrical symbols, design diagrams, drawing board, drawing sheets, scale, pencil, sharper, T-square, set square.

Entry behaviour: Students are familiar with wiring system and wiring accessories to determine their entry behaviour the teacher ask this question.

- Mention five wiring accessories.

Content Development	Teacher's Activities	Learners Activities	Strategies Emphasized
Step 1	The teacher distributes different building plan together with installation plan to each student to observe. The teacher asks the students to identify the electrical sysmbol in the plan	The students listens and observe what has been displayed	Set induction Use of examples
Step 2 interpretation of diagram	the teacher distributes diagram to each student and asks them to interpret	The students interprets the diagrams	Use of examples Questioning

Step3 Drawing of building plan	the teacher distributes all the materials needed for drawing and asks students to use accurate measurement to draw two bedroom flat and install the wiring accessories in their proper positions.	students observe all the drawings, ask questions and answers given to them	Demonstration Stimulus variation Planned repetition

Workshop practice: Each student using accurate measurement starts drawing the plan and making installation with electrical symbols. The teacher moves round to supervise.

Assignment: Draw electrical installation plan of a two bedroom flat with the following apartments i) two bedroom ii) sitting room iii) kitchen iv) toilet and bathroom.

Evaluation: The teacher will use the above assignment to ascertain students' performance in psychomotor skill acquired in installation of accessories and equipment.

Correction: The teacher gives general and particular correction after the assignment/project have been score and returned. During this session the various mistakes corrected by the teacher and noted by the students.

Appendix U

Appendix U

ANAMBRA STATE GOVERNMENT
POST PRIMARY SCHOOLS SERVICE COMMISSION
GOVERNMENT TECHNICAL COLLEGE (G.T.C) UMUNZE

Our Ref:.....
Your Ref:.....

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Date: 8/7/2019

Obi, Catherine Conducted an experimental study in my school in collaboration with some teachers.

Thanks

Yours faithfully,

GOVT. TECHNICAL COLLEGE UMUNZE ANAMBRA STATE
PRINCIPAL
DATE 8/7/19

Okonkwo, G.N

Appendix V
TABLE OF SPECIFICATION

S/N	TOPICS	Perception	Set	Guided response	Basic Proficience mechanism	Complex Overt response expert	Adaptation	Ori Ginat natio n	
1	Electrical installation tools and accessories	3	1	-	-	-	-	1	5
2	Cables and surface installation of PVC/PVC cables	1	-	-	-	-	-	-	1
3	Conductor joints and termination technique	-	-	-	2	-	-	-	2
4	Wiring system	5	1	3	1	-	-	-	10
5	Electrical installation design	1	1		3	-	-	2	7
	Total	10	3	3	6	-	-	3	25