EFFECTS OF EXPLORATION AND COACHING INSTRUCTIONAL STRATEGIES ON ELECTRICAL INSTALLATION AND MAINTENANCE WORK STUDENTS' LEARNING OUTCOME IN TECHNICAL COLLEGES IN BAUCHISTATE

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MARCH, 2023

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A THESIS SUBMITTED TO THE POSTGRADUATE SCHOOL FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA, NIGERIAIN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTERS DEGREE IN INDUSTRIAL AND TECHNOLOGY EDUCATION (ELECTRICAL/ELECTRONICS)

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ABSTRACT

The study investigated the Effects of Exploration and Coaching instructional strategies on learning outcomes of Electrical Installation and Maintenance Work Students in Technical Colleges in Bauchi State. Four research questions and four null hypotheses guided the study.Relevant literature was reviewed in line with the objectives of the study. The study adopted a quasi-experimental research design of pretest, posttestnon-equivalent control design. The population of the study comprised 263 National Technical College Year Two (NTC II) students offering Electrical Installation and Maintenance Workin eight Technical Colleges in Bauchi State for the 2020/2021 session.Purposive and simple random sampling techniques were used to sample four technical colleges having male and female students with a sample of 134 students and a simple random sampling was used to assign the fourTechnical Colleges into experimental groups I and II for the study. The instrument used for data collection was the Electrical Installation and Maintenance Work Achievement Test (EIMWAT) and Electrical Installation and Maintenance Work Interest Inventory (EIMWII). EIMWAT and EIMWII were validated by three (3) research experts. To ascertain the internal consistencies of the instruments, Kuder Richardson 21 (KR 21) was used forEIMWAT and a coefficient of 0.76 was obtained,on the other hand, the Cronbach Alpha reliability technique was used forthe EIMWII instrument and a coefficient of 0.78 was obtained. The data for research questions were analyzed using meanwhile the hypotheses were tested using Analysis of Covariance (ANCOVA) at $p < 0.05$ level of significance. The findings of the study revealed that exploration and coachinginstructional strategies significantly increased academic achievement and interest of learning of the students but the group taught with coaching instructional strategy had the highest mean achievements score (15.3 > 15.2) and the highest mean interest score (22.1 > 20.2) than group taught with exploration instructional strategy. The result of the hypotheses tested at 0.05 level of significance,with a p-value of 0.518 on electrical installation and maintenance work achievement mean score showed that there was no significant difference in the achievement mean score, but with a p-value of 0.003 on electrical installation and maintenance work interest mean score shows that there was a significant mean difference in the interest of learning as regards the instructional strategies. Also, the gender of the students significantly influences their achievement and interest but male students had high achievement and interest mean scores than female students. There is no significant interaction effect of the treatment given to the students and their gender concerning achievement and interest in electrical installation and maintenance work. Based on the findings, of the study, therefore, it is recommended among others that more attention should be given to the inclusion of modern instructional strategies such as exploration and coachingfor teaching Electrical Installation and Maintenance Work and other Technical and Vocational Trades in Technical Colleges in Nigeria.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background to the Study

Electrical Installation and Maintenance Work (EIMW) is a trade-in Technical College that provides learners with the knowledge and practical skills required to become effective and efficient technicians in the field. Such persons are needed for employment in organizations like electricity distribution companies and manufacturing industries. According to National Board for Technical Education (NBTE, 2013) Electrical Installation and Maintenance Work comprises; Domestic and industrial installation, Cable jointing and battery charging, and Winding of electrical machines. According to Ezenwafor*et al* (2020) graduates of EIMW are expected to develop psychomotor skills in installing, operating, maintaining, and repairing electrically energized systems such as residential, commercial, and industrial buildings as well as equipment. According to NBTE (2013), Electrical Installation and Maintenance Work aim to give training and impart the necessary skills leading to the production of craftsmen, technicians, and other skilled personnel who will be enterprising and self-reliant in electrical installation and maintenance work.

For the aim of EIMW to be realized, Teachers of EIMW, apart from being versed in the subject matter, need to be skilled in the selection of appropriate instructional strategies, as well as effectively put them to use in the classroom. Federal Republic of Nigeria (FRN, 2014) in National Policy on Education recommended that the quality of instruction at all levels of education shall be oriented towards the acquisition of functional skills and competencies necessary for self-reliance. The policy implies that EIMW educators must be in constant search of instructional strategies that could improve students' achievement, motivate learners to participate actively in the learning process, and adapt more perfectly

to peculiar classroom situations towards improving the acquisition of productive skills, academic achievement, and interest thereby, meeting the societal and industrial needs.Some of the strategies adopted by the teachers in technical college are lectures and demonstrations.

The lecture instructional strategies are commonly used by technical teachers including EIMW teachers, probably because they are not aware or familiar with modern instructional strategies such as exploration and coaching instructional strategies. There are some merits of the lecture are demonstration instructional strategies. According to Mundi (2006) thelecture and demonstrationinstructional strategiesare especially useful where the apparatus is expensive, the experiment involves some danger, and the apparatus is sensitive to break. The author added that these instructional strategies are economical, promotes useful discussion and it could be effective in handling large class sizes. Despite these merits of the lecture and demonstrationinstructional strategies, it may not be effective because of its several disadvantages. Asogwa (2018) posited that the lecture and demonstrationinstructional strategies encourage laziness, rote memorization and could eventually kill students' interest and attitude towards the subject.

The use of the lecture and demonstrationinstructional strategies for EIMW might not be very effective due to the non-active participation of students in the instructional-learning process. According to Eze*etal* (2016) student-centeredinstructional strategiescould improve students' academic performance in different subjects better than teacher-centeredinstructional strategies. The authors stressed further that student-centered instructional strategiesare characterized by the active involvement of students in the teaching-learning process. Some of the examples of student-centered instructional strategies include problem-based, guided discovery, modeling, scaffolding, coaching and exploration.

Exploration instructional strategy involves guiding students to a mode of problem-solving, on their own. It is a strategy put in place to help and encourage the students to form hypotheses, test them, and find new ideas and viewpoints. According to Oyarole (2019) exploration is an approach whereby students learned to use their knowledge to build on skills and concepts for themselves. The strategy is similar to that of problem-solving, except that in exploration students move in a less restrictive and more natural environment with much less teacher direction. Maigida (2013) attributes that in exploration**,** learners try out different hypotheses, methods, and strategies by exploring their project and work environment. Through exploration, they can learn how to set achievable goals, form and test hypotheses, and make independent discoveries like other instructional strategies such as coaching.

Coaching instructional strategy involves guiding and helping students to improve their academic achievement. In coaching, strategy teachers offer specific guidance to the students while working on exercises so that the correct approach is applied to the solution of the problems, to correct performance deviations as soon as possible. Coaching is a developmental behavior subsumed within the context of mentoring (Miller, 2018). The teacher creates an exercise session; these sessions are individualized for each student while the teacher posts a series of exercises to enhance student academic achievement.

Student academic achievement is quantified by a measure of the student's academic standing to those of other students of his/her age. Academic achievement denotes the knowledge attained in the school subject which is usually designed by test scores (Yeung, 2015). Academic achievement refers to a person's strong performance in a given academic arena. A student who earns good grades in exams has achieved in the academic field. Academic achievement may be seen as excellence in all academic disciplines, in class as well as co-curricular activities (Lopez, 2015).Educators, trainers, and researchers have

long been interested in exploring variables to contribute effectively in improving students' low academic achievements in Technical Colleges.

Achievements of students in Technical Colleges in Nigeria are low, the attestation to this low achievement by stakeholders in the education sector includes school administrators, parents, and relevant National Examination Bodies like National Business and Technical Examination Board (NABTEB). NABTEB makes this a worrisome, embarrassing, and problematic plague as shown in Appendix A, page 84. Low academic achievement is eating deep into our educational system and is derailing the realization of the set educational aims, goals, and objectives of Technical Collegesthat include Electrical Installation and Maintenance Work students'achievementin Nigeria.

Low academicachievement of EIMW Students in Technical Collegescan be attributed to many factors among which are the instructional strategies. Studiesby (Nwoke&Akukwe 2015, and Oviawe*et al.*, 2017) have shown that the fall in the standard of achievement is incontrovertibly attributed to the instructional strategies adopted by teachers in schools. Bwini (2014) stated that many products of technical colleges are unemployed, due to a lack of appropriate technical skills. Genungwee (2018) maintained that appropriate instructional strategies should be employed in teaching Technical subjects to achieve the National goals as elucidated in the National Policy on Education. Effective instructional strategies create greater EIMW students' academic achievement and interest.

Interest as a psychological construct plays a major role in various life activities including academics. The decision to engage or not to engage in an activity, desire to persist, or even to re-engage after disengagement, and the degree of effort and time put into activity are mainly dictated by the level of interest in the individual. Kpolovie*et al*(2019) defined interest as a psychological state of having an affective reaction to and focusing attention

on particular content and or the relatively enduring predisposition to engage repeatedly in particular classes of objects, events, or ideas. According to Adeyemi and Adeyemi (2014) interest has to do with a learner's predisposition to react positively in certain ways towards certain aspects of the environment and is usually developed to and remains allied to more basic motives.

According to Adeyemi and Adeyemi (2014) noted that when students lose interest in their studies, the failure rate will be higher. Adding that students may engage in any unlawful activities like cultism, robbery, prostitution, and tyranny among other vices. Awodun*et al*(2016) interest is a feeling of curiosity or concern about something that makes attention turn towards it. They further stated that, lack of interest in Technical Colleges has been unabated over the years and is a re-occurring decimal every year. Hence teachers in technical colleges are expected to select appropriate instructional strategies that can enhance academic achievement and interest of male and female students.

Gender is regarded as a sense of being male or female. Tatum *et al.,* (2018) indicated that in classes where males outnumber females, the female student's willingness to participate decreased and was related to the number of male students in the classroom. Richman (2014) states that gender alone has no effect on academic achievement but could act in conjunction with other variables to affect learning outcomes. According to Olagbaju (2017) the two sexes (male and female) have differences in their strengths and weaknesses.

1.2 Statement of the Research Problem

Electrical Installation and Maintenance Workis aimed at equipping students with the knowledge and practical skills required to become effective and efficient craftsmen in the fieldafter graduation.According to Ezenwafor*et al* (2020) Electrical Installation and

Maintenance Workgraduates are expected to develop psychomotor skills in installing, operating, maintaining, and repairing electrically energized systems such as residential, commercial, and industrial buildings as well as equipment. Ezenwafor*et al*further state that, such persons are needed for employment in organizations like electricity distribution companies and manufacturing industries.According to NBTE (2013)Electrical Installation and Maintenance Work is aimed to given training and impart the necessary skills leading to the production of craftsmen, technicians, and other skilled personnel who will be enterprising and self-reliant.

Unfortunately, the low academic achievements of EIMW students in Technical Colleges send a negative signal in achieving the aim of the trade especially in the North Eastern States that include Bauchi State see appendix A.The recorded persistence of low academic achievement holds negative consequences that manifest the inability of EIMW graduates to be gainfully employed or to beself-reliant economically.Most of the graduates either take up jobs that are not related to their fields of study or roam the streets in search of white-collar jobs (Folu, 2018).

The academic achievements of EIMW students in Bauchi State revealed that, only 28.5% of EIMW students who sat for the NABTEB examination in the year 2016 passed with credit, 38.3% in 2017, 15.8% in 2018, and 22.6% in 2019 respectively as shown in Appendix A page 84. The recorded low academic achievement of EIMW students became an issue of great concern to stakeholders in the education sector including school administrators and parents. Nwoke and Akukwe (2015) confirmed that the low academic achievement of students in EIMW is attributed to many factors among which are the instructional strategies adopted by teachers in Technical Colleges. Hence, the problem of this study was to determine the effects of exploration and coaching instructional strategies on EIMW students' achievement andinterest in Technical colleges.

1.3 Aim and Objectives of the Study

The study determined the effects of exploration and coaching instructional strategies on EIMW students' learning outcomes in Technical Colleges in Bauchi state. The specific objectives of the study determined the:

1. Effect of exploration and coaching instructional strategies on students' achievement in EIMW in Technical Colleges in Bauchi State.
2. Effect of exploration and coaching instructional strategies on students' interest in EIMW in Technical Colleges in Bauchi State.
3. Effect of gender on achievement of EIMW students' taught with exploration and coaching instructional strategies in Technical Colleges in Bauchi State.
4. Effect of gender on the interest of EIMW students' taught with exploration and coaching instructional strategies in Technical Colleges in Bauchi State.

1.4Significance of the Study

The findings of the study will be of immense significance to the following group of stakeholders in education: EIMW students, teachers, curriculum planners, society, administrators,National Business and Technical Examination Board (NABTEB) and researchers.

The finding of this study will be of benefit to the students who have been skeptical about studying EIMW since the study will provide pedagogical information that may improve their learning in EIMW. If the use of exploration and coaching instructional strategies are found to be effective, students will gain adequate knowledge in the course of training.

The research findings will as well increase the achievement and interest of male and female students in EIMW. It will help students to increase their knowledge and understanding of the EIMW thereby improving their achievement and interest

academically. The results of the study will help them to be imaginative, encourage positive thinking and reasoning, and active participation in the classroom. It will improve the academic achievement of students and this will, in turn, lead to more male and female students offering EIMW, thereby creating an opportunity for students to acquire the necessary basic skills needed for further studies in the field of electrical electronics technology. It is expected that the findings will create awareness and stimulate male and female students' interest during lessons. It will help students become reflective, self-confident, self-mediating, and social. Students will gain confidence to embark on more complex challenges in Electrical Installation and Maintenance Works.

Through workshops and seminars, thefinding of this study will sensitize the Electrical Installation and Maintenance Work Teachers on the benefit of the use of exploration and coaching instructional strategies in teaching since it has a greater effect on the academic achievement and interest of the students. The research findings will as well form another dimension of innovations in teaching and learning Electrical Installation and Maintenance Works. It will provide an alternative teaching approach in teaching Electrical Installation and Maintenance Works, for easier understanding and effective application by students. It can also encourage more male and female participation in EIMW, by teaching EIMW students using Exploration and coaching strategies.

Thefinding of this study through publication will provide the curriculum planners with the information which could lead to the recommendation of Exploration and coaching strategies not only in EIMW but also in other Technical trades at various levels of Education. It will help to introduce innovations that will provide a greater variety of ways and activities that will address the diverse learning preferences of students.

Society will benefit from the findings of this study, when the students become gainfully engaged in productive activities after school and also become employers of labour, with achievement and interest the rate of dropout will reduce in Technical Colleges. Parents will also benefit from the findings of the study when there is a better achievement of their ward and children that will bring joy and satisfaction, for their education and good certification as an assurance of a better future.

The Education Ministry would also find this study useful. The findings of the study can be utilized by the Education Ministry for organizing conferences, seminars, and workshops to sensitize and re-train teachers on the use of the most effective instruction to improve their teaching. Also the findings of the effect of Exploration and coaching instructional strategies on achievement and interest on EIMW students in Technical College will be of benefit to national examination bodies such as NABTEB. When there is a better academic achievement of students in national technical examination certificate.

Lastly, the findings on the effect of Exploration and coaching instructional strategies on achievement and interest on EIMW students in Technical College will be of immense benefit to prospective researchers who may wish to conduct a study in other areas related to Educational programmes achievement and interest. Such prospective researchers will particularly benefit from the findings on the literature review when the findings of the study are published.

1.5 Scope of the Study

The study was delimited to, exploration and coaching instructional strategies. The study coveredNTC II EIMW Trade content as it is in NBTE curriculum, such as; Electrical working drawing of a factory, Conduit wiring for industrial installation, Installation of Mineral Insulated Copper Cable (MICC), the importance of earth continuity, Safety

measures as provided by the statutory regulation when carrying industrial installation and installation of MICC cable, Ducts, and Trunkingsystems and the advantages and disadvantages of ducts and trunking system.

1.6 Research Questions

The following research questions guided the study.

1. What is the effect of exploration and coaching instructional strategies on students' achievement in EIMW in Technical Colleges in Bauchi State?
2. What is the effect of exploration and coaching instructional strategies on students' interest in EIMW in Technical Colleges in Bauchi State?
3. What is the effect of gender on the achievement of EIMW students' taught with exploration and coaching instructional strategies in Technical College Bauchi State?
4. What is the effect of gender on the interest of EIMW students' taught with exploration and coaching instructional strategies in Technical Colleges in Bauchi State?

1.7 Research Hypotheses

The following hypotheses were tested at a 0.05 level of significance.

Ho_1: There is no significant difference betweenthe mean achievement scores of students taught EIMW with exploration instructional strategy and those taught using coaching instructional strategy in Technical Colleges in Bauchi State.

Ho_2: There is no significant difference between the mean interest scores of students taught EIMW with exploration instructional strategy and those taught with coaching instructional strategy in Technical Colleges in Bauchi State.

Ho_3:There is no significant difference betweenthe mean achievement scores of male and female students of EIMW taught with exploration instructional strategy and those

taught using coaching instructional strategies in Technical Colleges in Bauchi State.

Ho_4: There is no significant difference betweenthe mean interest scores of male and female students in EIMW when taught using exploration and coaching instructional strategies in Technical Colleges in Bauchi State.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1.0 Theoretical Framework

2.1.1 Jerome Brunner's Cognitive Theory

Bruner (1960) is best known mainly for his contribution to education. He is an educational learning theorist, who conducts considerable contributions and enlightenment in the construction of educational theories that gives far-reaching influence on researchers concerning human thinking, learning, motivation, stages of cognitive development and knowledge structure, and modern curriculum and teaching.

Bruner's Stages of Cognitive Development

Influenced by Piaget's theory of cognitive development, Bruner as well conducted several experiments in terms of children's intellectual development. The contributions of Bruner's theory of cognitive development lie in helping people understand how children learn and are assisted to learn and he believed that mental information could be carried out by expressing completed tasks or things to do through the language, selections and alternatives could be generated right away. Therefore, he took a further step to focus on the fields of perception, reasoning, thinking, cognitive characteristics, education, motor skills in infanthood and childhood. In the light of the cognitive development of children, Bruner (1960), proposed "three modes of representation", three processes of three types of step-by-step thinking mode, representing three stages and learning methods of the cognitive development respectively:

1. **Enactive Representation Stage:** The most common cognitive approach for children from ages 1 to 2 is that they learn and understand about the world around them through movements and actions. In terms of the surrounding objects, children whether touch them with their hand's orbit or lick them with their mouths. They

tend to form associations with objects in the surrounding environment through actions like grabbing, pushing, taking, lifting and walking, and acquire knowledge through explorative activities comprised of senses and motors, in his world, there were no specific differences between internal and external objects, hence he adopted an intuitive view and stored it first, and then make it into a movement skill later. Enactive representation is the basis of acquiring knowledge; although it first appears in early childhood, can be extended to life-long.

2. **Iconic Representation Stage:** For children at ages 2 to 6, learn through visual perceptions and can substitute explanations with pictures or imaginations of objects that appeared in front of their eyes, that is, children can express objects or things through iconic images instead of senses and controls of movements. Knowledge acquirement goes from the concrete to the abstract in the image representation.
3. **Symbolic Representation Stage:** For children above 6 years old, in this stage children comprehend the world around themselves through language skills, works, and abstract symbols, can perform reasoning, and express using words, languages, or linguistic symbols as well interact with the environment.

Bruner (1960) believed that these three stages coexisted in parallel patterns and contained uniqueness; the relationship among them is complementary rather than replacing. As enter into the “iconic stage” from the “enactive stage”, cognitive functions of movement representation still exist, and in the “symbolic stage”, cognitive methods of various movements and images are included as well. In Bruner’s view, the cognitive development of humans has been proceeding by following these three stages. Each of us continues to use these three modes of representation from time to time. In other words, there are at least three varied ways to express our learning and thinking, and if teachers could design

the teaching curriculum by this approach, the purposes of promoting students' wisdom or cognitive growth could then be achieved.

The Relation betweenBruner's Theory of Cognition and Curriculum Organization

Bruner believed that education and cognitive development skills are closely related to each other; at the same time, he emphasized that functions of curriculum structure could reach peak only through education and teaching. Therefore, he emphasized that education was the key to helping an individual to develop his/her mental skills; to bring out the efficiency of education, curriculum arrangement should be thought highly of.

Brunner emphasized that the content of the curriculum requires theories of cognitive development, the structure of materials, and teaching methods. He thought that teachers must understand the cognitive structure of children, the design of curriculum should meet the cognitive method and correspond to cognitive approach, making students take the initiatives to discover the structural context, and designing new curriculum should be a benefit to the cognitive approaches that children could find them easier to study, making students take initiatives to discover the content included in the textbook, and further to promote the individual's cognitive development as teaching methods should be applied to stages of cognitive development to increase the effectiveness of learning.

Bruner believed that by passing out and instructing knowledge cannot be regarded as complete education, we should let children explore, reason and think, solve problems, discover facts or principles, enjoy the happiness derived from learning results on their own to further cultivate the curiosity, encourage the creativity, and explore the unknown world in the future, as well as cultivate innovative and responsible modern people. Such an approach allows for students to construct meaning using their prior knowledge on a subject, and new knowledge gained during the learning process (Riordan et al., 2019).

Bruner (1966) emphasized that the important tasks for teachers are to teach children how to think and discover principles from activities of acquiring knowledge, and then integrate and summarize them and form them into their own experiences of knowledge. He proposed the "discovery learning theory", as the teacher instructed students to learn, the purpose was not to have them learn knowledge and facts of all sorts, but have them discover whether meaning-related structure exists among teaching materials and objects, and as children were familiar of the structure due to it comprised of generality and categorization, the larger effect of learning transferring could thus be generated, which could help children face other similar situations.

Bruner believed that an effective teaching environment should be available during teaching to stimulate students' curiosity and maintain their interests as well as to guide students to explore in the right directions. In Bruner's book "Toward a theory of instruction", which was published in 1966, he mentioned four principles that needed attention when came to curriculum design (Bruner, 1966).

1. **Best Experience goes with Intrinsic Motivation:** Teachers should firstly understand the best experience of students' learning while presenting discovery teaching, the best experience refers to the purpose of orientation or problem-solving in terms of students' learning needs; learning requires motivation, students must grow affections to learn to be willing to learn, thus effectiveness could be derived; therefore, during teaching activities, must provide room for students to choose freely, and individual differences must be taken into consideration because the difficulty of materials varies.
2. **Curriculum Structure goes with Cognitive Structure:** Regardless of the size of curriculum structure, the key lies in whether there is a good association between structures, and such association can comply with cognitive representations such as

movements, icons, and symbols to stimulate students' discovery to combine with images and information of the real world. As long as the curriculum structures match up with the learning psychology of children, good effects can be achieved always.

3. **Curriculum Translation goes with the Sequence of Presentation:** Curriculum translation means transforming the curriculum into movements, images, and symbols that students can percept, and the sequence of presentation refers to orders of time, logic, and objects. First, to transform the curriculum into the basic knowledge this is acceptable for students, and then layer by layer gets into newer and deeper knowledge day after day. The sequence refers to two meanings: one is "preparation", at the beginning of the teaching, students' motivation and interests must be taken into accounts, once their motivation is stirred, their interests will remain, and once there is preparation, learning can be easy. Another meaning is "the use of curriculum teaching", Bruner's claim regarding such point was "spindle curriculum", on one hand, it matches up the sequence of cognitive development of children, from the concrete to the abstract, from the simple to complex, from the movement to symbol; on the other hand, it matches up the characteristics of curriculum, the design of discovery teaching process is similar to the concept of spindle curriculum, that is, the context goes from the simple to difficult, the wide to the narrow, and keeps rising like a spindle. So, it not only matches up children's age abilities but helps the new experience connect with the old one, thus learning efficiency increases.
4. **Learning Strategy goes with Enhanced Constraints:** Strategies regarding how to increase learning efficiency should be pointed out concretely, Bruner thought to reduce the "external reward" because students were restricted within certain

enhanced parts and would influence the satisfaction derived from the “inner reward.”

Bruner (1960) also emphasized that children took the initiative to learn due to the curiosity or the satisfaction of fulfilling the curiosity. To believe in adopting an inspirational approach during teaching, the role of a teacher during teaching should be a guider that helped students discover the principles by themselves and gain self-satisfaction through perception and understanding, this way, learning activities would certainly be enhanced.

According to the above-mentioned theoretical research conducted by Bruner, every subject contains basic principles, concepts, and structures, as long as the teacher can present the structure of the curriculum, he/she then can help students understand the principle of such subject and percept the new structure to achieve the purpose of learning to transfer. Brunner (1960) advocated for the use of discovery learning in schools. According to him, the student is not to be presented with the subject matter in its final form but that the learner should be allowed to organize it himself to be able to discover relationships that exist among items of information.

In the teaching of electrical installation and maintenance works, students are not to be presented with the subject matter in its final form but the students should be allowed to organize it themselves to be able to discover relationships that exist among items of information. When students are allowed to pursue concepts on their own, they would gain a better understanding. It is therefore very necessary that the EIMW classrooms should be organized so that students can learn through their active involvement while the teacher guides the students into discovery. Here, students should be confronted with a problematic situation and should be allowed to find a solution.

2.1.2 Vygotsky's Theory

Vygotsky's 1987 sociocultural theory of human learning describes learning as a social process and the origination of human intelligence in society or culture. The major theme of Vygotsky's theoretical framework is that social interaction plays a fundamental role in the development of cognition. Vygotsky believed everything is learned on two levels. First, through interaction with others, and then integrated into the individual's mental structure. Every function in the child's cultural development appears twice: first, on the social level, and later, on the individual level; first, between people (inter psychological) and then inside the child (intra psychological). This applies equally to voluntary attention, logical memory, and the formation of concepts. All the higher functions originate as actual relationships between individuals. Vygotsky's theory focused more upon the processes through which children develop rather than the characteristics that children of a particular age are likely to demonstrate. Proponents applaud the strategies for the fact that they enable diverse learning styles and at the same time, encourage the active involvement of all students while facilitating individual improvement of weaknesses (Starkey, 2019).

The relationship of Vygotsky's theory to the present study;Incompleteness has sometimes been noticed in the instructional strategies used for imparting knowledge to students of Electrical Installation and Maintenance Work. This is as a result of the students lacking in practical skills required of modern Electrical Installation and Maintenance Work. This learning gap will hopefully be remedied if the appropriate teaching strategy is adopted for teaching Electrical Installation and Maintenance Work. Thus a critical look at the guiding principles of learning theory reveals the relationship of the theory to the present study, in that learning theory advocate that optimum learning occurs when students are allowed to learn together (collaborative learning). It also advocates physical activities as opposed to teaching abstract concepts. It also supports creativity. Hence, the use of appropriate

teaching strategies to teach Electrical Installation and Maintenance Work will hopefully and positively affect the psychomotor achievement of students in Technical Colleges, to fill the learning gaps identified.

2.2 Conceptual Framework

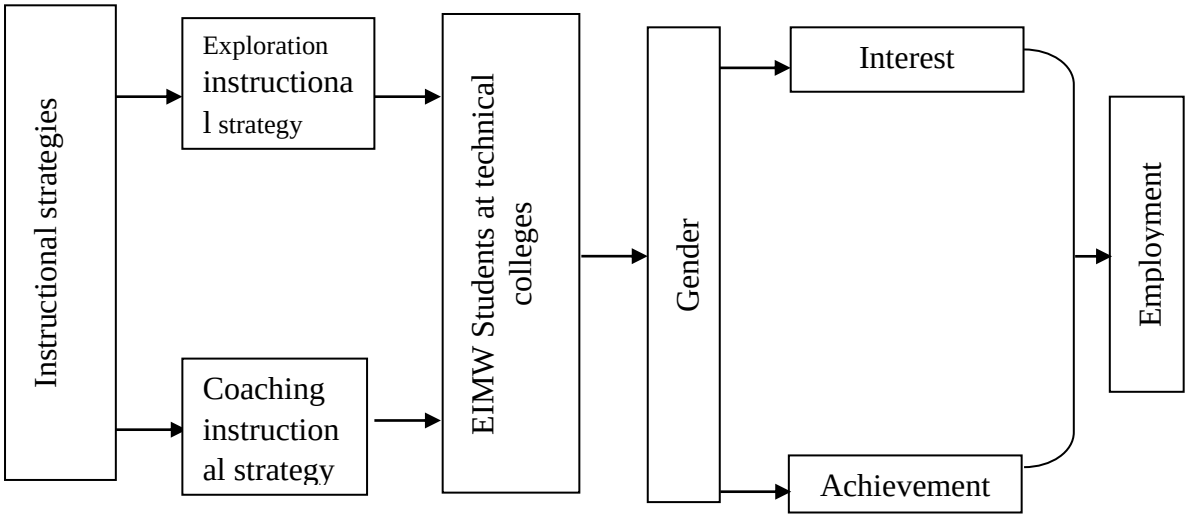


Figure 2.1: Schematic diagram of conceptual frameworks. Source (researcher)

2.2.1 Electrical Installation and Maintenance Work in Technical Colleges

The scope of electrical installation and maintenance work includes domestic installation, industrial installation, cable jointing, battery charging, and winding of electrical machines. According to NBTE (2013) the aim and objective of Electrical Installation and Maintenance Work are to give training and impart the necessary skills leading to the production of craftsmen, technicians, and other skilled personnel who will be enterprising and self-reliant. Electrical Installation and Maintenance Work is a broad field of study designed to train students to meet up with the day–to–day needs of individuals in the winding of electrical machines, cable jointing, battery charging, domestic and industrial installation in an ever-changing society (Ogbu, 2016).

Ohanu*et al.* (2020) stated that Electrical Installation and Maintenance Work is an area of specialization in Technical Colleges in Nigeria, designed to impart knowledge and practical skills in areas such as house wiring (conduit and surface), coil winding and re-

winding, electrical gadgets repairs, installation and maintenance of electrical machines, battery charging, installation and maintenance of electric motors.

Electrical Installation and Maintenance Work also equips an individual with functional and saleable skills, knowledge, and attitude or value that would enable them to operate in rendering service in an electrical-related institution or work. Ogwo and Nnachi (2016) noted that the objectives of Electrical Installation and Maintenance Work-trade are to give training and impact needed skills to technical college students in that area to enable them to secure employment in a recognized organization, create a job or become self-reliant economically.

2.2.2 Instructional Strategies Used in Technical Colleges

Strategies are typically described as mental procedures that facilitate the acquisition of knowledge and skill, or the re-organization of one's knowledge base. Formal teaching and learning take place in academic environments continuously. Above all, various levels of teaching and learning which include both formal and informal learning require specific skills, techniques, or methods to adequately pass on the necessary information to the learner (Samuel, 2018). Teaching and learning environments no doubt must complement each other for effective learning to take place. Samuel also added that the goals, aims, and objectives of teaching are for the learner to learn and the evidence that learning has been achieved is the permanent change produced in the learner.

Wandberg and Rohwer (2017) define teaching strategies "to refer to the structure, system, methods, techniques, procedures, and process that a teacher uses during instruction. These are strategies the teacher employs to assist students learning". In addition, teaching strategies are the strategies that teachers can use alone or with others. Some researchers divided teaching strategies into traditional and Non-traditional strategies (Nabors *et al*,

2018). Whereas others said that teaching strategies should take into consideration the four language domains which are: reading, writing, listening, and speaking. (Wandberg&Rohwer, 2017).

Teaching strategies can be divided into two types: Traditional and Non- traditional strategies. Lecturing is considered a traditional strategy because the teachers talk most of the time, while the students only listen. This means that students are passive learners (Cashin, 2010). While Non- traditional strategies refer to active learning strategies in which students are active in the learning process and are engaged to learn. Nabors *et al* (2018) stated that active learning is not just a transmission of information, but focuses on developing learners' skills and increasing students' attention in the classroom. The techniques that teachers use, promote creative thinking, students' involvement, and develop problem-solving skills.

Hamiloðlu and Temiz (2017) teaching strategies are very important, they check students' understanding, allow the students to say their opinion. Eison (2016) stated that some of the teachers don't like to use teaching strategies in the classroom because they need time and they cannot cover the content also teachers need to work more and be more prepared to use these strategies in the classroom. In addition, it is difficult to use teaching strategies in large classes and students fear dealing with strategies so teachers prefer lecturing. However, Eison (2016) proposed solutions to overcome these problems and to help teachers to use them like using short activities to save time, and discussion to decrease the risk of not covering the material. Also, students do all the work in the classroom so this will help the teacher and decrease their energy in the classroom.

Mocinic (2010) conducted a study entitled **"**Active Teaching Strategies in Higher Education". He stated that education has been changed and teaching should be changed as

well. In Technical Colleges, teaching strategies are aimed at developing in the learner the ability to acquire the knowledge and skills useful for work. These instructional strategies can vary in department and times, depending on the level of students and the materials available for instruction.

2.2.3 Exploration Instructional Strategy

Exploration is an approach whereby students learned to use their knowledge to build on skills and concepts for themselves. Exploration refers to trying out new approaches to the resolution of the problems, with the intent of developing independent thought (Kuo*et al.*,2018). Maigida (2013) states that in exploration**,** learners try out different hypotheses, methods, and strategies by exploring their projects and work environment. Through exploration, they can learn how to set achievable goals, form and test hypotheses, and make independent discoveries. Here, the teacher's role is to encourage students to be independent learners; identify personal interests; and pursue personal goals. Forcing students to engage in exploration teaches them how to frame interesting questions and to identify difficult problems on their own, it is also a good way to obtain fresh unique responses and ideas from the students.

Maigida further explained that giving students an interesting assignment with only generally formulated goals give students the latitude to explore and thus extend their understanding of a subject. Exploration can also help students gain confidence in their ability to learn on their own thereby extending their understanding of the subject.

The strategy allows the students to discover their capabilities while working on their own, consequently enhancing the creativity within the movements. The method is designed to have everyone experience instant success, thus providing the students with increased confidence in their ability to move. The major drawback is the inappropriateness of the

method if a particular movement outcome is desired. A well-conducted exploration strategy serves the following functions in the teaching and learning of Electrical Installation and Maintenance Works Students are made to gain knowledge on their own through active participation thus leading to mental development.

Exploration enhances students' ability to appraise problematic situations constructively and objectively, it encourages analytical thought and promotes intuitive development in students and it promotes students' level of intellectual productivity that leads to higher academic achievement and retention of the things they discovered. Sweeting (2017) asserts that exploring attitude formation provides valuable knowledge about the factors that contribute to the development of both positive and negative attitudes in learners of Mathematics.

Exploration is the most student-centered style on the continuum (Nichols, 2004). This style can be very beneficial when introducing concepts, ideas, and new equipment. It is also a good way to obtain fresh unique responses and ideas from the students. Because this style provides the students with a great amount of freedom to work at their own pace and do what they want it is important to understand that the teacher does not simply set up the equipment and let the students play totally on their own. The teacher does have some say in what the students do. The style allows the students to discover their capabilities while working on their own, consequently enhancing the creativity within the movements. The method is designed to have everyone experience instant success, thus providing the students with increased confidence in their ability to move. A well-conducted exploration strategy serves the following functions in the teaching and learning of Electrical Installation and Maintenance Work. The student is made to gain knowledge on their own through active participation thus leading to mental development. Mundi(2006) stated the importance of exploration as:

i. It is integrative as it has practical and theoretical value.

ii. Students autonomously find out information for themselves thus making it a student-center.

iii. Retention appears to be markedly increased among student

iv. It promotes problem-solving skills which are useful in curriculum revitalization by foundry and forging technology experts

v. It makes learning dynamic as the student can discover things the curriculum does not address.

vi. It enhances students' ability to appraise problematic situations constructively and objectively.

vii. It encourages analytical thought and promotes intuitive development in students.

viii. It promotes students' level of intellectual productivity that leads to higher academic achievement and retention of the things they discovered on their own.

2.2.4 Coaching Instructional Strategy

Coaching instructional strategy the instructor creates an exercise session using the asynchronous forum. These sessions are individualized for each student. The instructor posts a series of exercises focused on iteration statements. Coaching is often described as a developmental behaviour subsumed within the context of mentoring (Miller, 2018). According to Killion*et al* (2012) the impact of coaching may be enhanced by increasing the number of times teachers have with a student. Piper and Zuilkowski (2015) justified coaching as a means for changes in student outcomes.

Locating specific information about coaching programmes confirmed through research to be effective at improving teachers' instructional delivery, their overall job satisfaction including their social-emotional health, and the bottom-line measure of student growth has

been somewhat limited due to coaching being a relatively new education initiative. In the words of Aguilar (2018) coaches provide a supportive environment for teachers when they provide confirmation, offer encouragement help the client [teacher] maintain focus and motivation notice and experience their moments of success, and encourage risk-taking to promote further learning. It's not just about making another person feel good but also about helping the client see all the micro-movements toward meeting the goals. Looking at six models of literacy coaching, Vogt and Rogalla (2011) described coaching as potential support for improving classroom practice. They explored various ways in which different groups looked at the roles and responsibilities of literacy coaches they discovered six basic models in which most could be grouped: Informal Coaching, Mixed Model Coaching, Formal Literacy Coaching, Peer Coaching and Mentoring, Cognitive Coaching, and Clinical Supervision. Following are brief descriptions of each model according to the authors;

Informal Coaching: Emphasizes coaching outside the classroom. The goal is to improve student achievement by helping teachers realize their self-identified goals. The teacher creates a positive one-to-one relationship with the student and assists in setting and following through on the students' personal goals through listening, consultation and conversation.

Mixed Model Coaching: Has elements of both informal and formal coaching. While this model is rooted in supporting students primarily outside the classroom, the teacher may spend limited time in the classroom at the students' request. In this case, the coach's task is to observe in the classroom for a limited time, then guide reflection with the focus on meeting the teacher's personal goal.

Formal Literacy Coaching: Vogt and Rogalla (2011) describedformal literacy coachingas focused on supporting teacher goals through conferring, planning, and analyzing outside the classroom, but also includes more time spent in the classroom where the coach is involved in model teaching or co-teaching classroom strategies and providing support for differentiation. The coach in this model also provides professional development workshops combined with sustained in-classroom support.

Peer Coaching and Mentoring: This usually refers to the partnering of beginning teachers with experienced, nurturing teachers with strong communication and teaching skills. The coach/mentor in this model assists the teacher in negotiating her way through the multiple responsibilities in the school as well as conferring on lesson planning and problem-solving. This model may include model teaching by the coach or co-teaching with the coach as well as observation of lessons and focused feedback.

Cognitive Coaching: Is more structured than most models and is built around a three-part process: a planning conference (clarification of goals and objectives, teaching strategies, and determining the data the coach is to gather), observation (teacher as researcher and coach as data collector as determined in planning conference), and a reflective post-conference (reflect on the success of the implementation of the plan). One of the major goals of cognitive coaching is for the coach to question the teacher in such a way as to promote and stimulate the teacher's thinking.

Clinical Supervision: Is administrative, with the "coach" being in a supervisory role with responsibilities to evaluate lessons and provide feedback on teaching performance. Typically, this would include a cyclical process of a pre-conference with the teacher, observation in the classroom, analyzing and interpreting the observation, concluding with a post-conference with the teacher.

As we consider the various coaching models identified by Vogt and Rogalla (2011) we look further at the role and responsibilities of the instructional coach. According to Knight (2012) evidence is emerging that coaching can improve classroom teaching and learning, but he stated that, only if the following conditions are met:

- **Sufficient time;** Instructional Coaches spend most of their time working directly with teachers on instruction; supervisors ensure that coaches are not assigned tasks such as substitute teaching or ordering supplies.
- **Research-based practices**; Coaches are highly trained in proven classroom management, content knowledge, instruction, and formative assessments and they are skilled at communicating and demonstrating works in classrooms or workshops.
- **Professional development**; Coaches receive ongoing training and development about their coaching functions and in instructional theory and practice.
- **Trust**; Coaches build trusting partnerships with teachers before offering them suggestions for change in instructional practice.
- **Collaboration**; Coaches work closely with principals to improve teaching and learning.
- **Selection**; Coaches are excellent and respected teachers who teach model lessons. They are flexible in daily duties and are friendly and likable.
- **Evaluation**; Coaches help in assessments for their job evaluations; coaches never evaluate teachers on their job performance.
- **Schoolleadership**; Coaches are a significant strategy in a comprehensive plan and commitment to raising student academic achievement.

Knight's list of conditions demonstrates the importance of establishing an intentional approach to planning and implementing coaching as a form of instructional for

development. This is one of the ways of trying to bring learning closer to the students and eventually learning may be successful.Teemant *et al* (2018) carried out a study on the development and validation of a measure of critical stance for instructional coaching. The authors found out that the use of a coaching strategy is an effective development strategy. This behaviour would attract the students to the activity and as well arouse their interest.

2.2.5 Application of Exploration and Coaching in Learning EIMW

Exploration is aimed at externalizing thinking processes that are usually internal, not explicitly explained in EIMW students. Once this thinking is made visible, it can be more easily reproduced and the thinking process itself is learned. Exploration refers to trying out new approaches to the resolution of the problems, with the intent of developing independent thought (Kuo*et al,* 2018).

Coaching refers to a student working on problems while the expert offers guidance in applying the correct approach to the solution, in coaching the instructor offers specific guidance to the student while working on exercises so that the correct approach is applied to the solution of the problems, to correct performance deviations as soon as possible.

Exploration and coaching the EIMW teacher support students' effort at doing the task. Students are encouraged to continue their work independently. Teachers may be able to reap equal satisfaction from reinvigorating their teaching practices, hence, high academic achievement (Lorna, 2013). Harley (2019) state that the optimal method of teaching is the method that closely matches students' learning styles. A key aspect of the Exploration and coaching learning environment is the expert's evaluation of when the EIMW student is ready to be ushered into understanding a new step.

2.2.6 Achievement in Electrical Installation and Maintenance Works

Academic achievement is the extent of accomplishment or failure of a goal in particular content that the student has earlier been exposed to. Academic achievements are a measure of a learner's level of knowledge, skills, or performance (Ogbuanya & Onatunde, 2015). In the context of this study, the achievement is the successful accomplishment of goals and how students can demonstrate their intellectual abilities in Electrical Installation and Maintenance Work concepts through testing over some time.

The quality of students' performance, therefore, remains a top priority for educators. The knowledge, skills, and attitudes learned by students are often measured in oral and written achievements (Otunga*et al*, 2018). Achievement is meant for making a difference locally, regionally, nationally, and globally. Educators, trainers, and researchers have long been interested in exploring variables contributing effectively to the quality of performance of learners. Research indicates that student academic achievement correlates with teacher motivation (Hayden, 2017). Teachers with a high level of motivation can plan, implement and pursue their educational duties more consistently which brings out higher academic achievement as an expected outcome. Watitwa (2010) on the other hand established that there is a statistically significant relationship between students' motivation and achievement in Biology practical work. Students who were motivated were more likely to achieve higher scores in Biology practical work.

Achievement can be regarded as a course or subject grade, an average for a group of courses/subjects in a programme of study (In this case EIMW is being referred to). There are two dimensions to academic achievement a good academic achievement that leads to success and poor academic achievement that fails. Exploration and coaching instructional strategies could enhance academic achievement and interest.

2.2.7 Interest in Electrical Installation and Maintenance Work

The decision to engage or not to engage in an activity, desire to persist, or even to re-engage after disengagement, and the degree of effort and time put into activity are mainly dictated by the level of interest in the individual. Hence, Kpolovie*et al* (2019) defined interest as a psychological state of having an affective reaction to and focus attention for particular content and or the relatively enduring predisposition to engage repeatedly in particular classes of objects, events, or ideas. According to Adeyemi and Adeyemi (2014), interest has to do with a learner's predisposition to react positively in certain ways towards certain aspects of the environment and is usually developed about and remains allied to more basic motives. Interest is the motive that acts as an influence in producing activities and attitudes that are pleasing to learning.

Lack of interest in a subject discourages students from staying in class and working hard to achieve a good grade and prevents them from being enthusiastic and taking the class seriously. Adeyemi and Adeyemi noted that when students lose interest in their studies, the failure rate will be higher. Adding an anti-social dimension to it, they wrote that students may engage in very many unlawful activities like cultism, robbery, prostitution, and tyranny among other vices. Teachers are therefore enjoined to apply the suggested instructional strategies to achieve the goal of generating interest in learners. Goulart and Bedi (2017) working on the impact of interest on educational success in Portugal, noted that after controlling for time-invariant unobservable traits for the simultaneous determination of interest and achievement, there is little support for the idea that prior interest in school has a bearing on future educational achievement. Previous studies have reported that students' academic achievement and interest could be improved if proper learning style dimensions could be taken into consideration when developing any learning or instructional process (Graf*et al.,* 2010).

According to Gokalp (2018) a country never stops to explore and develop its methods of learning to respond to the demands particular of its environment. It is pertinent that the relationship between achievement and interest of EIMW students with different learning strategies be examined. Learning strategy technical college has been cited as effective means of helping teachers to recognize the incredibly diverse needs EIMW students bring into the classroom, as well as helping the learners discover how they learn EIMW concepts best for optimum academic achievement. Through developing a variety of teaching strategies to benefit all learners, the students learn how to learn and consequently achieve better academic results as well as develop a positive attitude and interest. There is a great need for students to be motivated to develop a positive attitude which is crucial to achievement in any subject most importantly EIMW.

2.2.8 Influence of Gender on Achievement

Gender according to Myers (2018) refers to the characteristics, whether biological or social; influenced by which people define male and female. The term gender in this study simply refers to male and female. Available works of literature sometimes are conflicting, while some advocate male superiority, others take the opposite view. For example, Umunadi (2009) in a study found that males performed better than their female counterparts in Radio, Television, and Electronic Work. The study conducted by Oviawe (2010) revealed that gender had no significant effect on students' performance in Building Technology. Richman (2014)studied revealed that gender alone does not affect academic achievement but could act in conjunction with other variables to affect learning outcomes while the study conducted by AbubakarandBada (2019) revealed that the gap that once existed between genders is fast closing. Owosho (2018) revealedthat there is a gender difference in science, mathematics, and technology, while men are more interested in science and technology than women.

The differences in the attitude of students to cooperative learning strategies and technical education about gender should be expected. Onwuameze (2018) attributes that despite significant progress in the expansion of education in most developing nations, females still lag in enrolment and achievement at all levels of schooling. At the lowest level of basic schooling (primary), participation rates are high for both males and females and appear to have the promising gender-leveling prospect, but the situation reverses remarkably at later transitions i.e the technical college and tertiary levels of education where the discrimination and segregation against the girl child education are obvious and the handwriting is well written on the wall (Stromquist, 2018). Thus the form of male and female achievement in EIMW will be critical to EIMW teachers particularly in classroom instruction.Oluyemo *et al* (2020) carried out a study on gender differences in mathematics interest and achievement in junior secondary school students, Niger state, Nigeria. The study revealed that male students excel in mathematics more than their female counterparts. Also, Ngugi and Muthima (2017) studied gender participation in technical training institutions in Kenya and found that female participation and interest in technical and vocational training was relatively low compared to high participation and interest of male counterparts in vocational and technical education and training. Igweh (2017) investigated the combined effect of computer tutorials and drill on senior secondary school students' achievement, interest, and retention in basic electronics in Lagos State. In the study, the author found out that there was no significant difference between the mean scores of boys and girls taught basic electronics with computers and drills in the test for retention of learning.

2.3 Related Empirical Studies

Ozden and Gultekin (2008) investigated the effects of cognitive apprenticeship techniques learning on achievement and Retention of knowledge in a science course. The

experimental study was designed as a pre-test and post-test control group at KutahyaAbdurrdman post-primary school, Turkey. The study was carried out on two intact classes selected randomly. One of the classes was defined as the experimental group and the other as the control group. Both classes were tested before and after the experiment.

The study hypothesized among others that, using the principles of cognitive apprenticeship learning approach will perform significantly better than the control group using traditional instruction on the achievement test designed for a science course and, using the principles of cognitive apprenticeship approach will perform significantly better than the control group using traditional instruction on retention test designed for a science course. The study lasted three months for a total of 18 class hours. During the research process, the experimental group was administered a cognitive apprenticeship teaching approach, while the control group was administered a traditional teaching approach.

Analysis of post-test on achievement and retention level tests revealed a significant difference between the groups favouring cognitive apprenticeship techniques. The findings of the study revealed that using the principles of cognitive apprenticeship learning approach students perform significantly better than the control group using traditional instruction on the achievement test designed for a science course, the study is related to the present study in research design but varies in area of the study and location of the study hence this is the gap present study seek to be fill.

Oyenuga (2010) determined the effect of models on interest and academic achievement of auto mechanics students in technical colleges in Lagos State. Six research questions and six hypotheses were formulated to guide the study. The research design that was adopted was the quasi-experimental design. The type of quasi-experimental design used is the non-

equivalent control group which involves two groups. The purposive sampling technique was used to select four out of the five technical colleges used for the study. A simple random sampling technique was adopted to select the technical colleges that were in the experimental and the control group respectively. The year one intact class was used for the research exercise. The sample consisted of 153 years one auto-mechanic student in the technical colleges. Regular auto-mechanic teachers were trained and used for the study.

The instruments used for data collection in this study were: Auto-Mechanics Achievement Test (AMAT) and Auto-Mechanics Interest Inventory (AMII). The AMAT and AMII were developed by the researcher and validated by experts in the Department of Vocational Teacher Education, University of Nigeria, Nsukka. The reliability coefficient of AMAT was found to be 0.61 and that of AMII was 0.81. Mean and standard deviation was used to answer the research questions while the analysis of covariance (ANCOVA) was used for testing the hypotheses at a level of significance of 0.05.

The findings of the study were as follows:

1. Using a model has a significant effect on the academic achievement and interest of the students in auto-mechanic work.
2. Gender does not affect the academic achievement of students in auto-mechanic work.
3. Gender was a factor in the interest of students in auto-mechanic work. (4) Ability level does not affect the academic achievement and interest of the students in auto-mechanic work.

Based on the findings of this research, it was recommended among others that the use of the model is paramount in Nigeria technical colleges; government should make available various models of a vehicle system for effective teaching and learning in the classroom.

The use of the model for teaching various concepts in-vehicle systems should be incorporated into the technical college and another vocational education curriculum. The study is related to the present study in research design but varies in instructional strategy, subject, and geographical area of the study these are the gap the study seeks to fill in the study.

Ogundola *etal* (2010) carried out studied on the effect of the constructivism instructional approach on teaching practical skills to mechanical-related trade students in Western Nigeria Technical Colleges. Elements of constructivism assessed include concept mapping, cooperative work skills, and cognitive apprenticeship. Pretest, posttest experimental design with a non-equivalent control group was adopted for the study. A total of one hundred and six randomly selected year two students in mechanical-related trades were drawn from four technical colleges spread across the southwestern Nigeria States. Forty-six of these numbers were placed in the experimental group while sixty were placed in the control group. The research instruments developed, validated, and used for data collection were the constructivism lesson plan, conventional lesson plan, and the general metalwork achievement test (GMWAT). The GMWAT which was a 30 item objective question with four options was administered to all the groups before the commencement of teaching (pretest). This was later administered as a posttest on the students after the experiment.

Three research questions were raised while two hypotheses tested at 0.05 level of significance were used for the study. Frequency counts, mean and standard deviation were employed to answer the research questions while t-test and analysis of covariance (ANCOVA) were used to test the hypotheses. Preliminary results of findings showed a significant difference between the students taught with the constructivism teaching approach and those in the control group. A significant difference does not exist between

male and female students exposed to the constructivism approach. Recommendations and suggestions for further studies were advanced.

This study is related to the present study in that it is aimed at facilitating effective teaching and learning. It also examined the influence of constructivism on students' achievement in mechanical. However, this present study intends to examine the influence of exploration and coaching on Electrical Installation and Maintenance Work student's learning outcome in Technical Colleges in Bauchi State, Nigeria hence one of the gaps it wants to fill.

Oviawe (2010) in a study to determine the effects of peer tutoring, reciprocal peer tutoring, and conventional teaching method on students' performance in Building Technology. The population of the study consisted of all the 232 ND II students in the four Polytechnics offering Building Technology in Edo, Delta, and Ondo States of Nigeria. The study sample was made up of 192 ND II Building Technology students. The purposive random sampling technique was used in selecting three out of the four Polytechnics offering Building Technology in the three States. In each of the Polytechnics, the ND II Building Technology intact classes were randomly assigned to peer tutoring, reciprocal peer tutoring, and conventional teaching method treatments, respectively.
The quasi-experimental research design which utilized a non-randomized pre-test, post-test, experimental-control group design was employed. Four null hypotheses were tested at 0.05 level of significance. The instruments used for data collection - the Building Technology Achievement Test (BTAT) and the Workplace Skill Rating Scale (WRRS) were used for both pre-test and post-test. The data collected were analyzed using Mean, t-test, ANOVA, and ANCOVA statistics. The findings revealed that: there was a significant difference between the post-test Mean score of the control group taught with conventional teaching method and that of the experimental groups taught with peer tutoring and reciprocal peer tutoring, in favour of reciprocal peer tutoring; there was a significant

difference in Building Technology students' acquisition of workplace skills as a result of different teaching methods used in teaching students among others.

This study is related to the present study in the research design adopted but different strategies were used. The study under review investigates the effects of peer tutoring, reciprocal peer tutoring while this study is investigating the effects of exploration and coaching strategies on students' learning outcomes. Both studies tried to make teaching and learning easier, but the area of the studies differ in subject and geographical location, if the present study is completed its adaptation may ease the erroneous threat posed to students' in studying Electrical Installation and Maintenance Work in Technical Colleges by the use of teaching instructional strategies.

Nonye and Nwosu (2011) in a study carried out to investigate the effects of instructional scaffolding on the achievement of male and female students in financial accounting in Abakaliki Urban of Ebonyi State, Nigeria. A pretest, posttest, control group, the non-randomized quasi-experimental design was used in this study. The population of the study comprised all SS II students in all the secondary schools in Abakaliki Urban offering financial accounting. Four secondary schools were selected out of the fourteen secondary schools in Abakaliki offering financial accounting. Two schools were assigned to the treatment group while the other two were assigned to the control group. A total of one hundred and sixty-three (163) students offering financial accounting were used for the study.

Two instructional packages were developed, one for the treatment group and the other was subjected to the conventional method of teaching financial accounting. The financial accounting achievement test was used for data collection. The data were analyzed using mean and standard deviation while the analysis of covariance was used to test the

hypothesis. Summary of result revealed that instructional scaffolding method was superior to the conventional method in improving the achievement of male and female students in financial accounting. The test of interaction showed that gender had no significant interaction with the teaching approach on students' mean achievement. It was concluded that instructional scaffolding is a good teaching method for teaching financial accounting and the researcher recommended that financial accounting lessons should be scaffolded irrespective of the gender of the students.

The study under review and this study both adopted cognitive apprenticeship components as teaching strategies to enhance academic achievement and retention among students, it is also related tothe method of research design used, the tool used in analyzing the data. However, there are differences in the population used and the geographical area of the study. This study focus on the effects of exploration and coaching strategies on students' achievement and interest in Electrical Installation and Maintenance Work in Technical Colleges in Bauchi State, Nigeria. While the study under review focuses on the effects of Instructional Scaffolding on the Achievement of Male and Female Students in Financial Accounting in Secondary Schools in Abakaliki Urban of Ebonyi State, Nigeria

Idris (2018) researched the effect of the cognitive apprenticeship instructional method on the achievement of auto-mechanic students in Rivers State, Nigeria. The purpose of this study was to identify the effect of the cognitive apprenticeship instructional method on the performance of auto-mechanic students in technical colleges. Five research questions and 5 hypotheses guided the study. A quasi-experimental pre-test design with an experimental and non-equivalent control group was adopted. The population of the study comprised all the 212 second-year auto-mechanic students of the four technical colleges in Rivers State, no sampling was carried out as the entire population of the students was used. Three instruments were used for data collection. These were cognitive apprenticeship

instructional lesson plans, which served as the treatment, traditional lesson plans, and an auto-mechanic achievement test. Mean and standard deviation was used to analyses the data while analysis of covariance (ANCOVA) was used to test the hypothesis at 0.05 level of significance. The study found among others that the students taught with cognitive apprenticeship instructional method tended to have higher mean post-test scores in the auto-mechanic achievement test than those taught with the conventional lecture method. Based on this, it was recommended that auto-mechanic teachers should always adopt cognitive apprenticeship instructional components, namely: modelling, scaffolding, coaching, articulation, and exploration. This will enable them to cater to the diverse learning styles of the students.

Omoiya (2018) titled investigated the comparative effect of three teaching techniques (modeling, coaching, and scaffolding) on students' achievement, interest, and retention in Radio and Television in Technical Colleges in Kogi state. Six research questions were posed, while nine hypotheses were formulated and tested at a $p > 0.05$ level of significance. The study was conducted using a quasi-experimental research design. The population for the study comprised all 212 second-year students offering Radio and Television trade in the six Technical Colleges in Kogi State. Two sets of instruments were used for data collection. These include Radio and Television Achievement test (RTVAT) and Radio and Television Interest Inventory (RTVII) was utilized to gather research information.

The data collected were analyzed using meanwhile the hypotheses were tested using Analysis of Covariance (ANCOVA) at $p < 0.05$ level of significance. The findings of the study showed that all the three teaching techniques (modeling, coaching, and scaffolding) significantly increased academic achievement; interest, and retention of learning of the students but the group taught with coaching technique had the highest performance

followed by the students taught with scaffolding and modeling techniques respectively. The result of the hypotheses tested showed that there was a significantly different ($p > 0.05$) in the mean achievement, interest, and retention learning as regards the three teaching techniques. Also, the gender of the students significantly ($p > 0.05$) influence their achievement and interest but did not significantly influence their retention of learning. There is no significant ($p > 0.05$) interaction effect of the treatment given to the students and their gender concerning achievement, interest, and retention in the Radio and Television trade.

Based on the findings, the study, therefore, recommended among other things that more attention should be given to the adoption of modern and interactive teaching techniques such as coaching and scaffolding techniques in teaching vocational subjects and trade such as radio and television in Nigerian schools and colleges. The study under review and this study both adopted cognitive apprenticeship components as teaching strategies to enhance academic achievement among students, it is also related to the method of research design used, the tool used in analyzing the data. However, there are differences in the population used and the area where the research was carried out. The study also tested the interaction effect of the treatment given to the students and their gender concerning achievement, interest, and retention in the Radio and Television trade which is one of the major differences.

This study focuses on the effects of exploration and coaching strategies on students' learning outcomes in Electrical Installation and Maintenance Work in Technical Colleges in Bauchi State, Nigeria. While the study under review focuses on the comparative effect of three teaching techniques (modeling, coaching, and scaffolding) on students' achievement, interest, and retention in Radio and Television in Technical Colleges in Kogi state.

Atsumbe*et al* (2018) determined the effect of scaffolding and collaborative instructional approaches on students' achievement in Basic Electronics. A quasi-experimental research design was adopted for the study. The performance of 105 Senior Secondary two (SS 2) students in Basic Electronics was obtained after being taught with scaffolding and collaborative instructional approaches using the Basic Electronics Cognitive Achievement Test (BECAT). Data collected were analyzed using mean and ANCOVA. Results revealed that a collaborative instructional approach is more effective in improving student achievement in Basic Electronics than a scaffolding instructional approach. Also, gender had no significant influence on students' achievement in Basic Electronics when taught using scaffolding and collaborative instructional approaches. It was concluded that the collaborative instructional approach is a viable teaching method for improving students' achievement in Basic Electronics.

It was recommended that teachers adopt the collaborative instructional approach for teaching Basic Electronics. The study is related to the present study in design adopted for the study but varies in instructional strategies, subject area of the study, and area for the study these are the gap to be filled by the study.

Ogbuanya and Akinduro (2017) investigated the effects of floating facilitator and peer tutor instructional approaches on students' psychomotor achievement in electrical installation and maintenance in technical colleges in Ondo State, Nigeria. The design used was quasi-experimental. The purposive sampling technique was used to select 171 students from four technical colleges. Two technical colleges each were randomly selected to peer tutor as group A and the other two colleges to the floating facilitator as group B.

The instrument used for data collection was the Electrical installation and maintenance Psychomotor Test (EPT). Treatment group A used the peer tutor approach while treatment

group B used the floating facilitator approach. The treatment lasted for six weeks for the groups concurrently each topic covering two weeks. The data obtained were analyzed descriptively and inferentially. The mean and standard deviation were used to answer the research questions while all the null hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA) statistics and partial eta square for the effect size. The results obtained showed that the peer tutor approach had a significant effect on students' psychomotor achievement compared to the floating facilitator approach.

There was a significant influence of gender on the psychomotor achievement of male and female students also; there was a significant influence in the ability level of students in their psychomotor achievement, from the post hoc test, the significance lies between the average and low ability level. These findings imply among others that given a conducive learning environment provided through the use of the peer tutor approach, the psychomotor achievement of students will be greatly improved.

Based on the findings of this study, some recommendations and suggestions for further research were made. The study among others showed that students in EIMW taught with peer tutor approach had a higher mean gain in achievement test than those taught with floating facilitator approach. The study is related to the present study in the subject area and design adopted for the study but varies in instructional strategy and location for the study; it becomes pertinent to determine if exploration and coaching instructional strategies would provide similar mean gain in students' achievement and interest in EIMW.

Halliru and Muhyideen (2018) investigated the Effect of Multi-Media Instructional Strategy on Academic Performance of Students in Radio, Television and Electronic Work Trade in Technical Colleges of Kano State. A quasi-experimental design was adopted. A

sample size of 40 Technical College (NTC III) students participated in the study. A purposeful sampling technique was used to select two intact classes from two colleges. A validated 40 – item instrument from NABTEB standardized test was used to collect data on the students' performance in the following topics; Radio Communication, Satellite Transmission / Reception, and Television. To avoid bias, the researchers prepared lesson plans that were used for the teaching of the two groups. The teachers from the two technical colleges were trained on how to use the lesson plans and multi-media instructional strategy, to control variability in the instructional procedure in the study. Four research questions and one hypothesis were raised. The data were analyzed using SPSS, mean and standard deviation were used to answer the research questions while t-test was used to test the null hypothesis.

Multi-Media instructional strategy improved the mean performance of the students in Radio, Television, and Electronic Work Trade, as seen in the post-test mean performance of 46.75 as compared with pre-test mean performance of 25.75 respectively, for the experimental group. There is a significant mean difference in the post-test academic performance of students taught Radio Communication, Satellite Transmission / Reception, and Television using Multi-Media instructional strategy.

Among the recommendations made was: Stakeholders in education should make available and encourage the use of multimedia instruction in technical colleges of Kano State by providing multimedia instructional tools. This study is related to the present study in terms of the design adopted and the methods of data analysis employed for answering research questions and testing null hypotheses formulated but varies in instructional strategy, subject of the study, and geographical area of the study these are the gaps to be filled by the study.

Titus and Sunday (2018) determined the effects of the problem-based teaching method (PBTM) on students' academic performance in electrical installation and maintenance works (EIMW) in Government Science and Technical Colleges (GSTC) in Edo State. Three research questions guided the study and three null hypotheses were formulated and tested at 0.05 level of significance. The quasi-experimental research design of non-randomized control groups was the method used to carry out the study. The population of the study was 180 NTC II electrical installations and maintenance works students. A sample of 86 was purposively selected and studied. The instrument for data collection was Electrical Installation and Maintenance Works Achievement Test (EIMWAT). The instrument was validated by three experts with a reliability coefficient of 0.81. Mean ($\bar{x}$) was used to answer the research questions while Analysis of Covariance (ANCOVA) was used to test the null hypotheses.

Findings revealed that students taught electrical installation and maintenance works with problem-based teaching methods performed better with higher post-test mean scores than those taught using the lecture-demonstration teaching method. Also, findings indicated that problem-based teaching methods improved the academic performance of high and low-achieving students in EIMW. However, findings also revealed that the effect of using the problem-based teaching method on the academic performance of male and female students in EIMW does not significantly different from the effect of using the lecture-demonstration teaching method.

Consequently, it was recommended among others that electrical installation and maintenance work teachers should use PBTM in teaching electrical installation and maintenance works to enhance students' academic performance and mastery in the subject. The study is related tothe present study in the subject area, the design adopted for

the study, and the method of data analysis but varies in the population of the study, instructional strategy, and area of the study will moderately fill in the gap.

Fisayo and Omolola (2018) examined the adoption of the jigsaw and individual personalization instructional strategies for improving the interest of senior secondary school students in mathematics. The moderating effects of students' gender and socio-economic status were also examined. The study adopted the pre-test-post-test, control group, quasi-experimental design with a 3x3x2 factorial matrix. Two hundred and fifty senior secondary two students from six public schools purposively selected from three local educational districts in Lagos-Nigeria participated in the study. Three research questions were answered and two null hypotheses were tested at 0.05 significant level. Four instruments were developed, validated, and used for data collection. Data were analyzed using percentages, Bar-charts and Analysis of Covariance (ANCOVA).

The findings showed that there were significant main effect of treatment, gender and Socio-economic-status (SES) on students' interest in Mathematics $F(2, 231) = 27.88$; $p<0.05$; $F(1, 231) = 10.64$; $p<0.05$; $F(2, 231) = 5.19$; $p<0.05$ respectively. Students exposed to Jigsaw Strategy had the highest post interest score; male students were above their female counterparts in all groups, while those of high SES had the highest post interest score. It further revealed that the 3-way interactions showed no significant interaction effects of treatment, gender, and SES on students' interest in Mathematics $F(4, 231) = 1.27$; $p>0.05$.

It was recommended that Mathematics teachers should be trained to use both Jigsaw and conventional approaches in the classroom since they were more effective in arousing and increasing students' interest in Mathematics than the individual personalization instructional strategy. This study is related to the present study in design adopted for the

study and the methods of data analysis employed for answering research questions and testing null hypotheses formulated. The study differs in the geographical area of the study and instructional strategies these are in the study.

Jolly (2019) investigated the effect of modeling and coaching instructional strategies on Academic achievement and interest of General Metalwork students in Kaduna state, Relevant literature was reviewed in line with the objectives of the study. The study adopted a quasi-experimental research design of pretest, posttest, and non-equivalent control design. The population of the study comprises 171 Technical College year II students offering General metalwork in two technical colleges in Kaduna state for the 2018/2019 session, the total population was used for the study, Hence, no sampling was made. The instrument used for data collection was General Metalwork Achievement Test (GMAT) and General Metalwork Interest Inventory (GMWII). The GMWAT was validated by a test developer in National Business and Technical Examination Board with the addition of three validates, that validated the (GMWAT) and (GMWII). A trial testing of the two sets of instruments was carried out on 30 randomly selected Technical College year II students of Government Technical Minna, Niger state. To ascertain the internal consistencies of the instruments, Kuder Richardson 21 (KR 21) was used to obtain the coefficient of reliability as 0.71. On the other hand, the Cronbach Alpha reliability technique was used for obtaining the internal consistency of the General Metalwork Interest Inventory (GMWII) instrument and a coefficient of 0.94 was obtained. The data for research questions were analyzed using meanwhile the hypotheses were tested using Analysis of Covariance (ANCOVA) at $p < .05$ level of significance.

The findings of the study revealed that all the instructional strategies modeling and coaching significantly increased academic achievement; interest and retention of learning of the students but the group that was taught with modeling instructional strategy had the

highest achievements. The result of the hypotheses tested showed that there was significantly different (p >.05) in the mean achievement, interest, and retention of learning as regards the instructional strategies. Also, the gender of the students significantly (p >.05) influences their achievement and interest. There is no significant (p>.05) interaction effect of the treatment given to the students and their gender concerning achievement and interest in General Metalwork.

Based on the findings, the study, therefore, recommended among other things that more attention should be given to the inclusion of modern instructional strategies such as modeling and coaching in technical colleges in teaching Technical and vocational trade subjects such as General Metalwork. The study is related to the present study in the research design adopted for the study but the studies vary in the subject area and geographical location of the study. These are the gab the present study sought to fill in the study.

Ogumah et *al* (2019) investigated the effect of the guided inquiry teaching method on students' academic performance in Electrical Installation and Maintenance Work in Technical Colleges in Gombe State. Two research questions and two null hypotheses guided the study. The hypotheses were tested at 0.05 level of significance. A quasi-experimental design was adopted for the study. The samples for the study were 118 NTC2 students made up of 95 males and 23 females. The purposive sampling technique was used to select two schools from Gombe and YamaltuDeba Educational zones. The instruments used for data collection were 50 objective questions. Pearson correlation coefficient formula was used to establish the reliability of the instrument which yielded a 0.81 correlation coefficient. The research questions were answered using mean scores whereas the hypotheses were tested using ANCOVA. The result showed that guided inquiry significantly impacted the academic performance of the students. It also showed

that the effect of guided inquiry on academic performance was not significant about gender.

Based on the findings of the study, it was recommended among others that guided inquiry teaching method should be adopted in technical colleges, secondary schools, and Vocational schools for instruction in EIMW to improve the academic performance of the students. This study is related to the present study in the design adopted subject area of the study, and the methods of data analysis employed for answering research questions and testing null hypotheses formulated. The study varies in population and location of the study these are the gap the study will moderately fill in the study.

2.4 Summary of Literature Reviewed

The literature reviewed was carried out under, theoretical framework, conceptual framework, and related empirical studies. The theories see learning as a matter of establishing or changing an association between the learner's responses and the stimuli that are impeded on him. Theories found to be relevant to this study are Jerome Brunner's Cognitive Theory and Vygotsky'ssociocultural theory its major trust is that social interaction plays a fundamental role in the development of cognition.

Advancement in Technology developments has created changes in all aspects of society. Therefore educational systems around the world are under increasing pressure to use modern teaching strategies to teach students the knowledge and skills they need to function effectively in the world of work. Teaching strategies provide powerful tools to support the shift to student-centered learning and are capable of creating a more interactive and engaging learning environment that stimulates learners and improve achievement and interest in learning. Hence, it is a generally held position that students'achievement in learning will improve when they are given modern-based teaching

strategies that allow for interactive access. Is view of that the present study investigated the effects of exploration and coaching instructional strategies on Electrical Installation and Maintenance Work Students' learning outcomes in Technical Colleges. In addition, exploration and coaching instructional strategies showed positive results in other subjects like General MetalWork and Basic Electronics among others.

CHAPTER THREE

3.0 RESEARCH METHODOLOGY

3.1 Design of the Study

This study adopted the quasi-experimental research design. Specifically, the pre-test post-test non-equivalent control group experimental design was used. The design wasadopted for the study because it is not possible for the researcher to randomly sample the subjects and assign them to groups without disrupting the academic programme of the schools involved in the studyhence the design permits the use of intact classes. The experimental procedures of exploration and coaching started with pre-test observation which was common to both experimental groups, then treatments using the two instructional strategies each in the experimental group then posttest observation which is common to both experimental groups.

The design is symbolically represented as follows:

E_1: O_1 X_1 O_2

E_2: O_1 X_2 O_2

Where

E_1: represents experimental treatment group one exploration strategy

E_2: represents experimental treatment group two coaching strategy

O_1: Represents pre-test observation for the two groups

O_2: Represents post-test observation for the two groups

X_1: Represents experimental treatment for group one (Exploration).

X_2: Represents experimental treatment for group two (Coaching).

3.2 Area of the Study

The study was carried out in Technical Colleges in Bauchi State. Bauchi State is located in the North-East geopolitical zone of Nigeria. Bauchi state has a landmass area of 49,259

square kilometers and falls within the Latitude $9^0.30^{'}$ to $12^0.3^{'}$north of the equator and Longitude $8^0.50^{'}$ to 11^0 East of Greenwich. It is also bounded by Kano and Jigawa States to the North, Yobe and Gombe State to the East, Kaduna State to the West, and Plateau and the Taraba States to the South. Bauchi State was chosen for the study due to the low academic achievement of Electrical Installation and Maintenance Work Students recorded in the NABTEB examination for the period of four years from 2016 to 2019 as shown in (Appendix A page 84).

3.3 Population for the Study

The population for the study comprised ofall 263 National Technical Certificate Two (NTC II) students offering EIMW in eight Technical Colleges. The data wereobtained from students' register books from each Technical College for the 2020/2021 academic session. The NTC II was chosen because they have studied EIMW in their first year and had an understanding of the various contents and functions of Electrical Installation and Maintenance Work. The population of the study is shown in table 3.1.

Table 3.1:Population for the Study

S/N	Colleges	Male	Female	Total
1	Government Technical College Gumau	34	7	41
2	Government Technical College Gamawa	52	0	52
3	Government Day Technical College Kafin/ Madaki	22	0	22
4	Government Day Technical College Gar	14	2	16
5	Government Day Technical College Azare	34	0	34
6	Government Day Technical College Bauchi	37	8	45
7	Government Day Technical College Jama'are	21	0	21
8	Government Day Technical College Tafawa-Balewa	27	5	32
	TOTAL	**241**	**22**	**263**

Source; NTC II EIMW School Register 2020/2021

3.4Sample and Sampling Techniques

The sample for the study comprised 134 NTC II EIMW students from four Technical Colleges as shown in table 3.2.

Table 3.2:Sample for the study

S/N	Colleges	Male	Female	Total
1	Government Technical College Gumau	34	7	41
2	Government Day technical College Gar	14	2	16
3	Government Day Technical College Bauchi	37	8	45
4	Government Day Technical College Tafawa-Balewa	27	5	32
	TOTAL	**112**	**22**	**134**

Purposive and simple random sampling techniques were used in the study. The four Technical Colleges were sampled from the list of eight Technical Colleges using the purposively sampling technique. The purposively sampling technique was used because the four Technical Colleges are the only mixed (male and female) Technical Colleges that are required in achieving the objectives of the study associated with gender. Nevertheless, a simple random sampling technique was used to assign the four technical colleges; Government Technical College Gumau, Government Day Technical College TafawaBalewa,Government Day Technical College Gar, and Government Day Technical College Bauchi to experimental groups one and two. The EIMW students in Technical Colleges assigned to group one were taught using exploration instructional strategy while EIMW students in Technical Colleges assigned to the experimental group two were taught using coaching instructional strategy.

3.5Instrument for Data Collection

The instruments for data collection are Electrical Installation and Maintenance Work Achievement Test (EIMWAT) as shown in (Appendix C page 86) and Electrical Installation and Maintenance Work Interest Inventory (EIMWMII) as shown in appendix G page 119. The EIMWAT questions covered NTC II, EIMW content that includes;

Electrical working drawing of a factory, Conduit wiring for industrial installation, Installation of MICC cable, Safety measures as provided by the statutory regulation when carrying industrial installation and installation of MICC cable, Ducts, and trunking systems, as shown in the table of a specification for electrical installation and maintenance work achievement test, appendix K page (126). The EIMWII items are based on a five-point Likert scale worded as follows Strongly Agree (SA) 5 points, Agree (A) 4 points, Undecided (D) 3 points, Disagreed (D) 2 points, Strongly Disagreed (SD) 1 point (appendix G, page 119).

3.6 Validation of the Instrument

The Electrical Installation and Maintenance Work Achievement Test, Electrical Installation and Maintenance Work Interest Inventory, and two sets of lessons plan were validated by twoexpert in the Department of Industrial and Technology Education, Federal University of Technology Minna Niger State and one expert in the Department of Psychometrics, National Examination Council Minna, Niger State.As shown in AppendixJ(page 125).

3.7 Reliability of the Instrument

A trial testing of the instruments was carried out to determine the internal consistency of the Electrical Installation and Maintenance Work Achievement Test and Electrical Installation and Maintenance Work Interest Inventory, using 20 (15 male students and 5 female students) randomly selected NTC II students of Government Science and Technical College (GSTC) Amada, Gombe state. The choice of GSTC Amada for the trial testing is because it is not part of the study area, but uses the same entry qualification and the same NBTE curriculum. Gombe state is close to the study area and believes to have similar characteristics. To ascertain the internal consistencies of the instruments,Kuder Richardson 21 (K-R21) was used for EIMWAT. The EIMWAT is a multiple-choice item

in which the items were dichotomously scored. Kuder Richardson 21 (K-R21) was usedand a coefficient of 0.76 was obtained as shown in appendix L (page, 127) and on the other hand, the Cronbach Alpha reliability technique was used for obtaining the internal consistency of the EIMWII a coefficient of 0.78 was obtained as shown in appendix M (page 128).

3.8 Experimental Procedures

Students in the treatment groups were not informed that they will be involved in the research process. The experimental groups were taught using exploration and coaching instructional strategies lesson plans. The study was conducted during the normal lesson periods of the schools using intact classes. The timetable of the participating schools was followed strictly. This is to avoid subjects becoming suspicious of the exercise. The regular EIMW teachers teach their classes using the timetable of their various schools.

On the first day of the exercise, a pre-test was administered to the groups (exploration and coaching) by the regular EIMW teachers in the participating schools. The exercise provides baseline data on students' Achievement and interest before the treatment. After the pre-test, intensive teaching/training was given to the entire group by the EIMW teachers in their respective schools.

Teaching for the experimental groups is designed to provide a broad-based contextual understanding within which meaningful exploration and coaching instructional strategies learning could occur. The experimental groups' strategies were designed specifically to employ the exploration and coaching learning elements. Each learning activity was deliberately sequenced through the strategies.

The treatments for this research last for six (6) weeks, while each lesson lasts for 90 minutes. At the end of the treatment, a post-test was administered to both groups using the EIMW teachers and their assistants.

3.9 Control of Extraneous Variables

The researcher controlled the following variables. Experimental Bias; to avoid experimental bias, the regular class Teachers in the participating Technical Colleges were used to teachtheir students. Hence, the researcher was not directly involved in the administration of the research instruments to avoid experimental bias.

3.10 Hawthorne Effect

Hawthorne effect is a situation where the performance of the research subject is affected because the students are conscious that they are involved in an experiment. To reduce this problem, the researcher used the normal classroom Teachers in both experimental groups. The students werenot informed that they are involved in the research process. The students were taught by their respective teachers using the same lesson content with different teaching strategies for experimental group one and experimental group two.

3.11 Development of the Lesson Plans

To ensure uniformity in standard and to control invalidity that may occur as a result of teachers' variability in the development of the instrument for the conduct of the study, the researcher personally prepared the teaching lesson plan for exploration and coaching instructional strategies in the following topics; Electrical working drawing of a factory, Conduit wiring for industrial installation, Installation of M.I.C.C cable, Safety measures, Ducts,and trunking system and Types, advantages and disadvantages of duct and trunkingsystem. as shown in appendix E, (page 95) and coaching instructional strategy lesson plans as shown in appendix F, (page. 106).

3.12 Training of Electrical Installation and Maintenance Work Teachers

Three days of training were organized for participating EIMW teachers at two contacts for each group. Teachers were given training and detailed explanations on the use of EIMWAT, EIMWII, lesson plans, and other research expectations and procedures. The presentation procedure for the experimental group was done in line with the framework of exploration and coaching instructional strategies. The researchers demonstrate the lessons and request the participating teachers to ask questions for clarifications where necessary. The exercise was repeated where necessary until all participating EIMW teachers showed capability in handling the EIMWAT, EIMWII instruments, and lesson plans strategies. At the end of the training exercise, a pre-test was given to students in the participating schools through their teachers, before the treatments commence. A training guideline was prepared by the researcher that explained the concepts in the lesson plans and other experimental details as shown in Appendix H,(page 122).

3.13 Administration of the Research Instrument

The researcher with the aid of four research assistants subjected the groups to a pre-testing exercise with EIMWAT. Hence, the groups were subjected to the treatment after which post-test EIMWII were administered by their respective teachers in each technical college. The students were asked to check, to indicate the degree to which they agreed or disagreed with the statements in the EIMWII. The respective teachers in each technical college scored their students in EIMWAT using the scoring guides developed by the researcher. The result was compared to see if there is any significant difference in the achievement and interest of the groups.

3.14 Method of Data Analysis

The scores obtained from the pre-test and post-test were compared in terms of mean and mean gain scoresto answer research questions 1-4.The mean and mean gain of each group was computed to determine the effects of exploration and coaching instructional strategies on students' achievementand interest in Electrical Installation and Maintenance Work. While Analysis of Covariance (ANCOVA) on the Statistical Package of Social Science was used to test the null hypotheses stated at 0.05 level of significance.The decision rule was that when the p-value is less than or equal to 0.05 level of significance the null hypothesis wasrejected and concluded that, there was a significant difference between the variable compared, in the order hand when the p-value is greater than 0.05 level of significance, the null hypothesis wasaccepted and concluded that there was no significant difference between the variables compared.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Research Question One

What is the effect of Exploration and Coaching instructional strategies on students' achievement in Electrical Installation and Maintenance Work in Technical Colleges in Bauchi State?

The data providing an answer to research question one is shown in table 4.1.

Table 4.1: Mean of Pre-test and Post-test Cognitive Achievement Scores of Students taught Electrical Installation and Maintenance Work using Exploration and Coaching Strategies.

Groups	N	Pre-test Mean	Post-test Mean	Mean Gain
Experimental Group I (Exploration strategy)	73	34.9	50.1	15.2
Experimental group II (Coaching strategy)	61	37.6	52.9	15.3

Table 4.1 shows that the experimental group I taught with exploration strategy had a pre-test mean cognitive achievement score of 34.9 and a post-test score of 50.1. The mean gain between the pre-test and post-test of the experimental group I was 15.2. The experimental group II taught with coaching strategy had a pre-test mean cognitive achievement score of 37.6and a post-test score of 52.9. The mean gain between the pre-test and post-test of the experimental group II was 15.3. The experimental group II performed slightly higher than experimental group I.

This indicated that students taught Electrical Installation and Maintenance Work using coaching instructional strategy had higher mean cognitive achievement score than students taught using exploration instructional strategy.

4.2 Research Question Two

What is the effect of exploration and coaching instructional strategies on students' interest in Electrical Installation and Maintenance Work in Technical Colleges in Bauchi State? The data providing an answer to research question two is shown in table 4.2.

Table 4.2: Mean of Pretest and Posttest Interest Inventory Scores of Students' taught Electrical Installation and Maintenance Work using Exploration and Coaching Instructional Strategies.

Groups	N	Pre-test Mean	Post-test Mean	Mean Gain
Experimental Group I (Exploration strategy)	73	33.4	53.4	20.0
Experimental group II (Coaching strategy)	61	33.1	55.2	22.1

Table 4.2 shows that the experimental group I taught with exploration strategy had a pre-test mean interest inventory score of 33.4and a post-test score of 53.4. The mean gain between the pre-test and post-test of the experimental group I was 20.0. The experimental group II taught with coaching had a pre-test mean interest inventory score of 33.1and a post-test score of 55.2. The mean gain between the pre-test and post-test of the experimental group II was 22.1. Experimental group II had a higher mean gain than experimental group I. This indicated that students taught Electrical Installation and Maintenance Work using coaching strategy had a higher mean interest score than students taught using exploration strategy.

4.3 Research Question Three

What is the effect of Gender on the Achievement of Electrical Installation and Maintenance Work students' taught with Exploration and Coaching Instructional Strategies in Technical Colleges in Bauchi State?

The data providing an answer to research question three is shown in table 4.3.

Table 4.3: Mean of Pretest and Posttest Cognitive Achievement Scores of male and female students' taught Electrical Installation and Maintenance Work using Exploration and coaching instructional strategies.

Instructional Strategy	Gender	N	Pre-test Mean	Post-test Mean	Mean Gain
Exporation	Male	61	35.83	50.18	14.35
	Female	12	37.67	49.83	12.16
Coaching	Male	51	38.39	53.52	15.13
	Female	10	34.00	48.90	14.90

Table 4.3 showsthe gender achievement score of students when taught Electrical Installation and Maintenance Workusing the exploration and coaching instructional strategies. Data on exploration instructional strategy had male'spre-test achievement mean score of 35.83and post-test mean achievement score of50.18 witha mean gain of 14.35, while femalespre-test mean achievement score of 37.67 and post-test mean achievement score of 49.83 with a mean gain of 12.16. Data on coaching instructional strategy had male achievement pre-test score mean of 38.39 and post-test mean achievement score of53.52 with achievement mean gain of 15.13, femalespre-test achievement mean score of 34.00 and post-test achievement mean score of 48.90 with achievement mean gain of 14.90. The results revealed that both exploration and coaching instructional strategies significantly increased academic achievement of both genders inElectrical Installation and Maintenance Work, but males performed slightly better than the females in the Electrical Installation and Maintenance Workachievement test when taught with exploration and coaching instruction strategies.

4.4 Research Question Four

What is the effect of gender on the interest of Electrical Installation and Maintenance Work students' taught with Exploration and Coaching Instructional Strategies in Technical Colleges in Bauchi State?

The data providing an answer to research question four is shown in table 4.4.

Table 4.4: Mean of Pretest and Posttest Interest Inventory Scores of male and female students' taught Electrical Installation and Maintenance Work using Exploration and Coaching instructional strategies.

Instructional Strategy	Gender	N	Pre-test Mean	Post-test Mean	Mean Gain
Exploration	Male	61	33.52	53.45	19.93
	Female	12	35.50	53.25	17.75
Coaching	Male	51	33.25	55.31	22.06
	Female	10	34.12	54.60	20.48

Table 4.4 shows the effect of gender on the interest score of students taught electrical installation and maintenance workusing exploration and coaching instructional strategies. The data shows that males taughtElectrical Installation and Maintenance Workwith exploration instructional strategy hadthe pre-test interest mean score of 33.52 andpost-test interest mean score of 53.45 with interest mean gain of 19.93 while females taught with exploration instructional strategy hada pre-test interest mean score of 35.50 andpost-test interest mean score of 53.25, with interest mean gain score of 17.75. The males taught Electrical Installation and Maintenance Workwith coaching instructional strategy had pre-test interest mean score of 33.25 and post-test interest mean score of55.31, with an interest mean gain of 22.06. While females taught with coaching instructional strategy hada pre-test interest score of 34.12 and post-test mean interest score of 54.60 with an interest mean gain of 20.48. From these results, both exploration and coaching instructional strategies increased theinterest of both gender in electrical installation and maintenance work while males had relatively higher interest than thefemales when taught Electrical Installation and Maintenance Work using exploration and coaching strategies.

4.5HypothesisOne

HO_1: There is no significant difference between the mean achievement scores of students taught Electrical Installation and Maintenance Work using Exploration instructional strategy and those taught using Coaching Instructional Strategy in Technical Colleges in Bauchi State.

The data used in the testing level of significance of hypothesis one is shown in table 4.5.

Table 4.5: Analysis of Covariance (ANCOVA) of students' Achievement in Electrical Installation and Maintenance Work taught using exploration instructional strategy and those taught with coaching instructional strategy.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	822.973[a]	3	274.324	21.287	.000
Intercept	4440.072	1	4440.072	344.548	.000
Pre-Test	560.167	1	560.167	43.469	.000
GROUP	106.882	2	53.441	4.147	.518
Error	1675.266	130	12.887		
Total	356562.000	134			
Corrected Total	2498.239	133			

***Significant at Sig of F<.05**

Table 4.5 shows the value for testing the significant difference between the cognitive achievement scores of students taught Electrical Installation and Maintenance Work using exploration and coaching strategies. The F-calculated value of 4.147 was obtained with an associated exact probability value of 0.518. Since the associated probability of 0.518 was greater than 0.05 set as a level of significance, the null hypothesis stated that there is no significant difference between the cognitive achievement scores of students taught electrical installation and maintenance work using exploration and coaching instructional strategies is accepted. Hence, there is no significant difference between the cognitive achievement scores of students taught Electrical Installation and Maintenance Work using exploration and coaching instructional strategies**.**

4.6 Hypothesis Two

HO_2: There is no significant difference between the mean interest scores of students taught Electrical Installation and Maintenance Work using Exploration Instructional Strategy and those taught with Coaching Instructional Strategy in Technical Colleges in Bauchi State.

The data used in the testing level of significance of hypothesis two is shown in table 4.6.

Table4.6: Analysis of Covariance (ANCOVA) of students' Interest Inventory in Electrical Installation and Maintenance Work taught using exploration instructional strategy and those taught with coaching instructional strategy.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1415.657[a]	2	707.828	50.656	.000
Intercept	4385.822	1	4385.822	313.873	.000
Pre-Test	1306.407	1	1306.407	93.494	.000
GROUP	130.113	1	130.113	9.312	.003
Error	1830.493	131	13.973		
Total	397020.000	134			
Corrected Total	3246.149	133			

***Significant at Sig of F<.05**

Table 6 shows the interest mean scores of students taught Electrical Installation and Maintenance Work using exploration and coachinginstructional strategies, an F-calculated value of 9.312 was obtained with an associated exact p-value of .003. Since the associated p-value (.003) is less than 0.05 set as the level of significance for testing the hypothesis, this means that the null hypothesis which stated thatthere is no significant difference between the mean interest scores of students taught Electrical Installation and Maintenance Work using Exploration and Coaching Instructional Strategies was rejected. The inference drawn is that there was a significant difference between the mean interest scores of students taught Electrical Installation and Maintenance Work using exploration instructional strategy and those taught using coaching instructional strategy.

4.7 Hypothesis Three

HO_3:There is no significant difference in the mean achievement scores of male and female students' in Electrical Installation and Maintenance Work when taught using Exploration and coaching instructional Strategies in Technical Colleges in Bauchi State.

The data used in the testing level of significance of hypothesis three is shown in table 4.7.

Table 4.7: Analysis of Covariance (ANCOVA) of male and female students' Achievement scores in Electrical Installation and Maintenance Work taught using exploration and coaching instructional strategies.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	716.369[a]	2	358.184	26.333	.000
Intercept	4195.857	1	4195.857	308.472	.000
PRTA	653.998	1	653.998	48.081	.000
GENDER	.278	1	.278	.020	.887
Error	1781.870	131	13.602		
Total	356562.000	134			
Corrected Total	2498.239	133			

***Significant at Sig of F<.05**

Table 4.7 shows the effect of male and female on students' cognitive achievement scores in Electrical Installation and Maintenance Work taught using exploration and coaching instructional strategies, an F-ratio of 0.020 was obtained with an associated exact probability value of 0.887. Since the associated probability value 0.887 is greater than 0.05 set as the level of significance for testing the hypothesis, this means that the null hypothesis which stated that there is no significant difference in the mean achievement scores of male and female students' in Electrical Installation and Maintenance Work when taught using Exploration and Coaching Instructional Strategies is accepted. Hence there is no significant difference in the mean achievement score of male and female students'achievement in Electrical Installation and Maintenance Work. The inference drawn is that there was no significant difference between the effect of gender (male and female) on students' achievement in electrical installation and maintenance work taught using exploration and coaching instructional strategies. This result showed that exploration and coaching instructional strategies resulted in the improvement of male and female students' achievement in Electrical Installation and Maintenance Work.

4.8 Hypothesis Four

HO_4: There is no significant difference in the mean interest scores of male and female students' in Electrical Installation and Maintenance Work when taught using Exploration and Coaching Instructional Strategies in Technical Colleges in Bauchi State.

The data used in the testing level of significance of hypothesis four is shown in table 4.8.

Table 4.8: Analysis of Covariance (ANCOVA) of male and female students' Interest Inventory scores in Electrical Installation and Maintenance Work taught using exploration and coaching instructional strategies.

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1285.571[a]	2	642.785	42.949	.000
Intercept	4381.172	1	4381.172	292.737	.000
Pre-Test	1279.464	1	1279.464	85.490	.000
GENDER	.027	1	.027	.002	.966
Error	1960.579	131	14.966		
Total	397020.000	134			
Corrected Total	3246.149	133			

***Significant at Sig of F<.05**

Table 4.8 shows the effect of male and female on students' interest in Electrical Installation and Maintenance Work taught using exploration and coaching instructional strategies, an F-ratio of 0.02 was obtained with an associated exact probability value of 0.966. Since the associated probability value 0.966 is greater than 0.05 set as the level of significance for testing the hypothesis, this means that the null hypothesis which stated that there is no significant difference in the mean interest scores of male and female students' in Electrical Installation and Maintenance Work when taught using Exploration and Coaching Instructional Strategies is accepted. An inference drawn is that there was no significant difference between the effect of gender (male and female) on students' interest in Electrical installation and maintenance work taught using exploration and coaching instructional strategies. This result showed that exploration and coaching instructional

strategies resulted in the improvement of students' interest in Electrical Installation and Maintenance Work.

4.9Findings of the Study

Based on the data collected and analyzed, the following findings emerged from the study:

1. Exploration and coaching instructional strategies were effective in improving students' academic achievement in Electrical Installation and Maintenance Work but the coaching strategy was more effective than the exploration strategy.
2. Exploration and coaching instructional strategies were effective in improving students' interest in studying Electrical Installation and Maintenance Work but coaching instructional `strategy was more effective than exploration instructional strategy.
3. The academic achievement score of male students is slightly higher than, that of female students when taughtElectrical Installation and Maintenance Workusing exploration and coaching instructional strategies.
4. There was an effect of gender on students' interest inElectrical Installation and Maintenance Workwhen taught usingexploration and coaching instructional strategies in favour of male students.
5. There was no significant difference in the academic achievement of students taught Electrical Installation and Maintenance Workwith exploration instructional strategy and those taught with coaching instructional strategy.
6. There was a significant difference in the interest mean score of students taughtElectrical Installation and Maintenance Workusing explorationinstructional strategy and those taught using coaching instructional strategy.

7. There was no significant effect of gender on students' achievement inElectrical Installation and Maintenance Workwhen taught using exploration and coaching instructional strategies.
8. There was no significant effect of gender on students' interest scores inElectrical Installation and Maintenance Workwhen taught using exploration and coaching instructional strategies. Both strategies improved students' (males and females) interest inElectrical Installation and Maintenance Work.

4.10 Discussion of Findings

The findings of this study as regards research question one showed that the two instructional strategies (exploration and coaching) significantly increased the academic achievement of the students but the students taught with coaching strategy had the highest performance in the achievement test. The significant effect of the instructional strategy on electrical installation and maintenance work achievement test showed that the F-calculated (F-cal) value of 4.147 is significant at 0.518 which is more than 0.05 level of significance. It shows that there was no significant difference in the score of students taught electrical installation and maintenance work with exploration and coaching instructional strategies.

The findings of the study agreed with the findings of Teemant *et al* (2018) who carried out a study on the development and validation of a measure of critical stance for instructional coaching. Where the authors found out that the use of a coaching strategy is an effective development strategy in the teaching and learning process. The findings of this study also agreed with the findings of Vogt and Rogalla (2011) who noted that coaching instructional strategy has potential support for improving classroom practice. Similarly, finding conform with the words of Aguilar (2018), who noted that coaching provides a supportive environment for teachers when they provide confirmation, offer encouragement, and help the students maintain focus, interest, and motivation notices and experience by

their moments of success, and encourage risk-taking to promote further learning. Piper and Zuilkowski (2015) justified coaching as a means for changes in student outcomes by theorizing that high-quality teacher professional development leads to changes in pedagogy which result in improvements in students outcomes.

The finding as well conforms to Sweeting (2017) who states that exploration instructional strategy provides valuable knowledge that contributes to the development of positive attitudes in learners. Inthe explorationstrategy, students actively exchange and negotiate ideas within their groups, and this increases the students' interest in learning. Importantly, by engaging in discussion and taking responsibility for their learning, students are encouraged to become critical thinkers. By working in small groups, students tend to learn more of what is being taught and retain the information longer, and also appear more satisfied with their classes.Similarly, Idris (2018) researched the effect of cognitive apprenticeship instructional strategy on the achievement of auto-mechanic students and discovered that cognitive apprenticeship instructional strategies such as exploration and others are viable in teaching technical courses.

The finding on the significant effect of the instructional strategy on electrical installation and maintenance work achievement test showed that there was no significant difference in the score of students taught electrical installation and maintenance work with exploration and coaching instructional strategies. Thisconforms to the study of Jolly (2019) who investigated the effect of modeling and coaching instructional strategies on Academic achievement and interest of General Metalwork students in Kaduna state. The author revealed among others that, there is no significant effect on Modelling and Coaching instructional strategies on students' academic achievement scores in General Metalwork. Similarly,Halliru and Muhyideen (2018) investigated the Effect of Multi-Media Instructional Strategy on Academic Performance of Students in Radio, Television and

Electronic Work Trade in Technical Colleges of Kano State. The finding revealed that there is a significant mean difference in the academic performance of students taught Radio Communication, Satellite Transmission / Reception, and Television using Multi-Media instructional strategy.

The findings of this study in respect to research question two showed that exploration and coaching instructional strategies significantly increased interest of the students in studying electrical installation and maintenance work but the students taught with coaching strategy had the highest interest score. This finding implied that the two teaching strategies are effective in boosting students' interest in studying electrical installation and maintenance work while coaching strategy is more effective than exploration strategy. The significant effect of the instructional strategy on electrical installation and maintenance work interest inventory score showed that the F-calculated (F-cal) value of 9.312 is significant at .002 which is less than 0.05 level of significance to show that there was a significant difference in the interest scores of students taught electrical installation and maintenance work with exploration and coaching instructional strategies.

This conforms to the study of Omoiya (2018) who investigated the comparative effect of three teaching techniques (modeling, coaching, and scaffolding) on students' achievement, interest, and retention in Radio and Television in Technical Colleges in Kogi state. Based on the findings of the study, therefore, recommended among other things that more attention should be given to the adoption of modern and interactive teaching techniques such as coaching and scaffolding techniques in teaching vocational subjects and trade such as radio and television in Nigerian schools and colleges this increases the students' interest in learning. Therefore, the difference observed between the two groups is a result of the coaching strategy being more effective in improving students' interest in electrical installation and maintenance work than the exploration strategy. This implies that when

academic achievement is high, there will be a corresponding increase in interest of the student in those areas of study. Samuel (2018) asserted that various levels of teaching and learning which include both formal and informal learning require specific skills, techniques, or methods to adequately pass on the necessary information to the learner. Teaching and learning environments no doubt must complement each other for effective learning to take place. Samuel also added that the goals, aims, and objectives of teaching are for the learner to learn and the evidence that learning has been achieved is the permanent change produced in the learner. According to the author, it is reasonable to infer that coaching and exploration practices contributed to higher achievement and interest in electrical installation and maintenance work.

The findings of this study are also in agreement with the findings of Goulart and Bedi (2017) that investigated the impact of interest on educational success in Portugal, the authors noted that after controlling for time-invariant unobservable traits for the simultaneous determination of interest and achievement, there is support for the idea that prior interest in school has a bearing on future educational achievement. Similarly, the findings conform to Kuo *et al (2018*) who attribute that, Exploration enhances students' ability to appraise problematic situations constructively and objectively, it encourages analytical thought and promotes intuitive development in students and it promotes students' level of intellectual productivity that leads to higher academic achievement and interest of the things they discovered.

The finding of the study shows that there is a significant difference in the interest mean scores of students taught electrical installation and maintenance work with exploration and coaching instructional strategies. This also conforms to the study of Omoiya (2018) who investigated the comparative effect of three teaching techniques (modeling, coaching, and scaffolding) on students' achievement, interest, and retention in Radio and Television in

Technical Colleges in Kogi state, and revealed thatthere is a significant difference in the interest of students taught radio and television with modelling, coaching and scaffolding teaching techniques. He further stressed that teachers should endeavour to adopt instructional strategies that are capable of stimulating students' interest in Technical Colleges.

The findings of this study on research question three showed that the two teaching strategies significantly improved academic achievement of both genders while males performed slightly better than the females in the electrical installation and maintenance work achievement test. The significant effect of the instructional strategy on male and female electrical installation and maintenance work students achievement test showed that the F-calculated (F-cal) value of .020 is significant at .887 which is more than 0.05 level of significance to show that there was no significant difference in the achievement scores of male and female students taught electrical installation and maintenance work using exploration and coaching instructional strategies. The findings of this study tend to conform to that of Umunadi (2009), who studied a relational study on students' academic achievement of television technology in technical colleges in the Delta state of Nigeria, the study found that males performed better than their female counterparts in Radio, Television, and Electronic Work. Similarly, Onwuameze (2018) attributes that despite significant progress in the expansion of education in most developing nations, females still lag in enrolment and achievement at all levels of schooling. In addition, the findings of this study tend to agree with that of Jolly (2019) who conducted a study on the effects of modeling and coaching instructional strategies on academic achievement and interest of metal-work students in Kaduna state, He reported, that male students had slightly higher mean scores than females, which was not considered significant.

The finding also revealed that there was no significant difference in the academic achievement scores of male and female students taught electrical installation and maintenance work using exploration and coaching instructional strategies. This conforms with, Igweh (2017) who investigated the combined effect of computer tutorials and drill on senior secondary school students' achievement, interest, and retention in basic electronics in Lagos State. In the study, the author found out that there was no significant difference between the mean scores of boys and girls taught basic electronics with computers and drills in the test for retention of learning.Atsumbe *et al*(2018) determined the effect of scaffolding and collaborative instructional approaches on students' achievement in Basic Electronics. The authors found out that gender had no significant influence on students' achievement in Basic Electronics when taught using scaffolding and collaborative instructional approaches.The findings disagreed with, Omoiya (2018) who investigated the comparative effect of three teaching techniques (modeling, coaching, and scaffolding) on students' achievement, interest, and retention in Radio and Television in Technical Colleges in Kogi state, the finding of the study revealed thatthere is a significant difference in the scores of boys and girls in the radio andtelevision achievement test.

The findings of this study on research question four showed that the two instructional strategies significantly increased the interest of both gender while the male had a higher interest in electrical installation and maintenance work than the female. The significant effect of the instructional strategy on electrical installation and maintenance work interest inventory score showed that the F-calculated (F-cal) value of .003 is significant at .966 which is more than 0.05 level of significance to show that there was no significant difference in the interest scores of male and female students taught electrical installation and maintenance work with exploration and coaching instructional strategies. Hence, the

finding of this study agreed with the findings of Oyenuga (2010), Owosho (2018) showed that there is a gender difference in science, mathematics, and technology, while men are more interested in science and technology than women. Similarly, the findings of this study on gender and interest in vocational education agreed with the result of Oluyemo*et al* (2020) carried out a study on gender differences in mathematics interest and achievement in junior secondary school students, Niger state, Nigeria. The study revealed that male students excel in mathematics more than their female counterparts. Also, Ngugi and Muthima (2017) studied gender participation in technical training institutions in Kenya and found that female participation and interest in Technical and Vocational Training was relatively low compared to the high participation and interest of male counterparts in Vocational and Technical Education and Training.

The finding also showed that there is no significant difference in the interest scores of male and female students taught electrical installation and maintenance work with exploration and coaching instructional strategies. The finding conform to Jolly (2019) who investigated the effect of modeling and coaching instructional strategies on academic achievement and interest of metal-work students in Kaduna state. The author revealed thatthere is no significant difference in the interest of male and female taught General Metalwork test with Modeling and coaching instructional strategies. Similarly, the finding conforms to Omoiya (2018) who determined the comparative effect of three teaching techniques (modeling, coaching, and scaffolding) on students' achievement, interest, and retention in Radio and Television in Technical Colleges in Kogi state, the study revealed that there is no significant difference in the interest of boys and girls in studying radio and television trade-in Technical Colleges.

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The most appropriate instructional strategy in knowledge delivery leads to skill development and advancement that will enhance students' achievements and arouse students' interest in the subject matter. Interest is a paramount factor in high academic achievements in Technical Colleges. This study established the Effect of exploration andcoaching instructional strategies on Achievements and Interest inElectrical Installation and Maintenance WorkinTechnical Colleges inBauchi State, Nigeria.

The study revealed that exploration and coaching instructional strategies were effective in improving Electrical Installation and Maintenance Work students' academic achievement in technical colleges, butcoaching instructional strategy has more effects in increasing students' academic achievements in Electrical Installation and Maintenance Workthan exploration instructional strategy. Alsoexploration and coaching instructional strategies were effective in improving students' interest in Electrical Installation and Maintenance Work, however coaching instructional strategy had a higher interest mean score than exploration instructional strategy.

Exploration and coaching instructional strategies were effective on gender disparity on the achievements and interest of students in Electrical Installation and Maintenance Workin favour of male to female in exploration and coaching instructional strategies. The results revealed that coaching instructional strategy is an effective strategy for knowledge delivery in Electrical Installation and Maintenance Work in Technical Colleges.

5.2 Recommendations s

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

1. Electrical installation and maintenance work teachers should adopt the use of coaching instructional strategy in teaching electrical installation and maintenance work in technical colleges.
2. Government and stakeholders in education should improve on the provision of facilities and equipment necessary for teaching electrical installation and maintenance work with exploration and coaching strategies.
3. Enlightenment should be organized by Ministries of Education and state Science and Technical Schools Boards to educate and improve teachers' capabilities on the use of coaching instructional strategy to enhance students' achievement and interest in electrical installation and maintenance work.
4. More encouragement should be provided to the female students to improve their performance, interest, and enrolment in skills-related courses such as Electrical Installation and Maintenance Work, through using effective instructional strategies such as exploration and coaching.
5. Workshops, seminars, and conferences should be organized by Ministries ofEducation/Science and Technical Schools Boards to enlighten Electrical Installation and Maintenance Work Teachers onhow to improve their knowledge and skills on the use of cognitive apprenticeshipinstructional strategies (Exploration and Coaching).

5.3 Contribution to Knowledge

The study has empirically established the effects of exploration and coaching instructional strategies on electrical installation and maintenance work students' achievement and interest in technical colleges in Bauchi State, Nigeria. Hence the study filled the gap by

providing empirical evidence on the effectiveness of both exploration and coachinginstructional strategies which proved that, coaching instructional strategywas an effective instructional strategy that improves students' achievement and interest in electrical installation and maintenance work in technical colleges and is capable of creating a viable and interactive learning environment that support students' active involvement in the teaching and learning process.

5.4 Suggestions for Further Study

From the findings of the study, the following are suggested for further research:

1. Effects of exploration and coaching strategies on student's achievement and retention in basic electricity in technical colleges in North-East of Nigeria.
2. Effects of exploration and coaching strategies on students' achievement, interest, and motivation in air condition and refrigeration in technical colleges in Bauchi state.
3. Effects of scaffolding and modeling strategies onelectrical installation and maintenance work students' learning outcomes in Bauchi state Technical colleges.

REFERENCES

Abubakar, R.B., &Bada, I.A. (2019). Age and gender as determinants of academic achievement in collegemathematics. *Asian Journal of Natural & Applied Sciences, 1*(20), 121–127.

Adeyemi, A.M., &Adeyemi, S.B. (2014). Personal factors as predictors of students' academic achievement in colleges of education in South-Western Nigeria. *Educational Research and Reviews* 9(4), 97-107.

Aguilar, E. (2018). The art of coaching. San Francisco, CA: Jossey-Bass.

Asogwa, E.E. (2018). "Transforming Nigeria undergraduate through information competency, information impact", *Journal of Information and Knowledge Management,* 2 (3), 60 - 72.

Atsumbe, B. N, Owodunni, A.S., Raymond, E., &Uduafemhe, M.E. (2018).Effect of scaffolding and collaborative instructional approaches on students' achievement in Basic Electronics.*EURASIA Journal of Mathematics, Science and Technology Education*3(6), 275-286.

Awodun, A.O., Adekunle, R.F., & Femi – Adeoye, K.O. (2016). Students attitude and interest as correlates of students' academic performance in biology in senior secondary school. *International Journal of Innovation Education and Research, 4(3), 200 – 216.*

Brunner, J.S. (1960). Toward a theory of instruction. Cambridge: Harvard University Press.

Brunner, J.S. (1966). The process of Education. New York: Vintage Books.

Bwini, C. (2014). Industrializing the Nigerian Society through creative skills Acquisition in inVocational and Technical Education programme. Paper Presented at a workshop for vocational and Technical Teachers, organized by NDE.

Cashin, W. (2010). Effectivelecturing. Theidea center Manhattan, Kansas press.

Eison, J. (2016). Using active learning instructional strategies to create excitement and enhancelearnisng.Retrievedfromhttps://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.456.7986&rep1&type=pdf

Ezanwafor, J.I., Obi.C.O.C., &Okoye, K.R.E.(2020).Relative effectiveness of demonstration and project-Based teaching methods in developing students' psychomotor skills and interest in electrical Installation and Maintenance Work. *International Journal of Science and Technology*9(1), 131-137.

Eze, T.I., Ezenwafor, J.I. and Obidile, I.J. (2016). Effects of problem-based teaching method on students' academic performance and retention in financial accounting in technical colleges in Anambra State", *Scholars Journal of Arts, Humanities and Social Sciences* 4(6), 634-639.

Federal Republic of Nigeria (FRN)(2014). National Policy on Education (6th edition), Lagos: NERDC Press.

Fisayo, A.,&Omolola, A.L. (2018). Adopting Jigsaw instructional strategy for improving students' interest in Mathematics.*International Journal of Education, Learning and Development*, 6(3) 53-67.

Folu, E. I. (2018). Technical and vocational education andtraining (TVET) in Ghana: Challenges and the way out.*Technology Education Journal*, 9(2), 3–14.

Genungwee, O.C. (2018). Improving Technology Education through Effective Teaching in technical Colleges. *Ghana Journal of Research Education*, 4 (2), 564 – 576.

Gokalp, M. (2018).The effect of students' learning styles on their academic success.*Creative Educational Journal, 4(10), 627-632.*

Goulart, P., &Bedi, A .S. (2017).The Impact of interest in school on Educational success in Portugal. IZA Discussion 5462 January 2011.

Graf, S., Liu, T.C &Kinshuk, S. (2010). Analysis of learner navigational behavior and their learning styles in an online course. *Journal of Computer Assisted Learning, 26(2), 116-131*.

Halliru, S.&Muhyideen. M. (2018).Effect of multi-media instructional strategies on academicperformance of students in radio and television electronics work trade in technicalcolleges in Kano State.*British Journal of Education*, 6(9) 1-24.

Harley, S. (2019). Dunn's learning style theory. Retrieved 15 Sept. 2020 from http://www.prezi.com/.../rita-dunns-learning.

Hamiloğlu, K. and Temiz, G. (2017). The Impact of Teacher Questions on Student Learning in EFL. *Journal of Educational and Instructional Studies in the World*, 2(2), 7442-7453.

Hayden, S. (2017). Teacher Motivation and Student Achievement in Middle School Students. Unpublished *doctoral dissertation*, Walden University.

Idris A.M. (2018). Effect of Cognitive Apprenticeship Instructional Method on Auto-Mechanics Students Research Paper 89AU J.T. 16 (2), 89-98.

Igweh, A. U. (2017). The combined effect of computer tutorial and drill on senior condary school students' achievement, interest, and retention in basic electronics in Lagos. Unpublished Ph.D Thesis, Department of Vocational Teacher Education. University of Nigeria, Nsukka.

Jolly, C.N. (2019). Effect of modeling and coaching instructional strategies on academic achievement and interest of General metalwork students in Kaduna State Nigeria. Unpublished MastersThesis Department of Industrial and Technology Education,Federal University of TechnologyMinnaNiger State.

Killion, J., Harrison, C., Bryan, C., & Clifton, H. (2012). Coaching matters. Oxford, OH:Learning Forward.

Knight, D.S. (2012). Assessing the cost of instructional coaching. *Journal of Education Finance, 38*(1), 52-80.

Kpolovie, J. P., Andy, I. J., & Tracy. O. (2019). Academic Achievement Prediction: Role of Interest in Learning and Attitude towards *School. International Journal of Humanities Social Sciences and Education* 1(11), 73-100.

Kuo, F., Hwang, G., Chen, S., & Chen, S. (2018). A cognitive apprenticeship approach tofacilitating web-based collaborative problem-solving. *Educational Technology & Society,15*(4), 319-331.

Lopez, J. (2015). Secondary education guide: lecture as a teaching method. Retrieved on may, 5th 2015 from www.about.com.guide.

Lorna, G. (2013). Relationship between learning style preferences and academic performance of students in India. *International Journal of Educational Research and Technology, 2(4), 70-76.*

Maigida, J.F. (2013). Effect of cognitive apprenticeship instructional method on studentsachievements, retention and skill performance in automobile mechanic unpublished Ph.D. Thesis, Department of vocational teacher education, University of Nigeria, Nsukka.

Miller, L. (2018). Peer coaching and the perceived impact on fostering positive relationships, knowledge creation, and sharing among nursing personnel. *(*A Ph.D Thesis, University of San Francisco).

Mocinic, S. (2010). Active Teaching Strategies in Higher Education. Preliminary announcement. 7(2), 97-105.

Mundi, N.E. (2006). The state of students' academic achievement in secondary school agricultural science in Kogi State. *Teacher education journal*, 12(1), 14-19.

Myers, D.G. (2018). Socialpsychology. 7th edition. The McGrane-Hill companies, Inc., New York.

Nabors, K., Dunn, I., Tkinson, B., Hardy, D., Kuntz, A., &Herrod, A. (2018). Active learning strategies in classroom teaching: Practices of associate degree nurse educators in a Southern States *International Journal of Educational Research*3(4), 223-235.

National Board for Technical Education (NBTE). (2013). National technical certificate and examination (craft level) syllabus for engineering trades based on the modular curricularKaduna, Nigeria.

Ngugi, M. &Muthima, P. (2017). Female Participation in Technical, Vocational Education and Training Institutions (TVET) Subsector: *The Kenyan Experience Public Policy and Administration Research www.iiste.org* 7(4), 2224-5731.

Nichols, E. (2004). Learning Principles – Exploration. Retrieved on 14/12/2018 11:34pm from https://docs.Neu.edu.tr>staff>hakan.Ataturk

Nonye, A. &Nwosu, B. O (2011). the effects of instructional scaffolding on the achievement of male and female students in financial accounting in Abakaliki Urban of Ebonyi State, Nigeria. Nsukka, Falladu, Publishing Company.

Nwoke, B.I., &Akukwe, A.C. (2015). Promoting junior secondary students' achievement in algebra using algebra tiles manipulative. *International Journal of Educational Research*, *14*(3), 164 – 170

Ogbu, J. E. (2016). Influences of inadequate instructional materials and facilities in teaching and learning electrical/electronic technology education courses. *International Journal of Vocational and Technical Education,* 7(3), 20-27.

Ogbuanya, T.C.&Onatunde, E.K. (2015). Effects of cooperative mastery learning approach on students' interest towards learning technical drawing in technical colleges in Federal Capital Territory, Abuja, Nigeria. *International Journal of Educational Research, 14*(1), 40-56.

Ogbuanya, T.C &Akinduro, I.R. (2017). Effects of floating facilitator and peer tutor instructional approach of students' psychomotor achievement in electrical installation and maintenance in technical colleges in Ondo state, Nigeria. *Global Journal of Pure and Applied Mathematics* 13(6), 2347-2371.

Ogumah, B.A.O., Haruna, U.B., Sunday, A.A., &Adeniyi, T. (2019).Effect of guided inquiry teaching method on students academic performance in electrical installation and maintenance work in technical colleges in Gombe state.*Journal of Science Technology and Education,* 7(4), 344-352.

Ogundola, I. P., Abiodun, A. P., & Jonathan, O. O. (2010). Effects of constructivist instructional approach on teaching practical skills to mechanical related trade students in western Nigeria technical colleges. *International NGO Journal, 5*(3), 59–64.

Ogwo, C. E. &Nnachi C.M. (2016). Poverty Reduction through Electrical Installation Trade Skills Acquisition among Technical College students in Nigeria. *Journal of Educational Policy and Entrepreneurial Research* 3(7), 305-312.

Ohanu, I.B., Shodipe, T.O., Chukwu, D.U. and Chukwuma, J.N. (2020). Impact of behavioural factors as related to available resources on entrepreneurial intentions of electrical installation and maintenance works students. *International Journal of Engineering Education,* 36 (1), 142-154.

Olagbaju, O.O. (2017). The interplay between gender and learning styles: Implications for second language teaching. *Global Journal of Human Social Science, Linguistics and Education, 14(2), 180 - 188.*

Oluyemo, A.A., Musbabu.A., Kukwil, I.J., Anikweze, C.M. & Shaluko.Y.O. (2020).Gender differences in mathematics interest and achievement in junior secondary school students, Niger state Nigeria. *International Journal of Research and Innovation in social science,* 4(10), 2454-6186.

Omoiya, M.A. (2018).Comparative effect of three teaching techniques On Students' academic achievement, interest, and retention in Radio and Television trade-in TechnicalColleges in Kogi state.*Unpublished Ph.D.* Thesis submitted to Department of Vocational Teacher EducationUniversity of Nigeria Nsukka.

Onwuameze, N.C. (2018). Educational opportunity and inequality in Nigeria:Assessing Social Background, Gender, and Regional Effects.*Journal of Educational Research*, *5*(3), 164 – 170.

Otunga, R., Odero, I.I., &Barasa, P.L. (2018). A Handbook for Curriculum and Instruction. Eldoret: Moi Uni. Press.

Oviawe, J. I. (2010). Differential effects of three instructionalmethodsonstudents' performance in building technology in polytechnics in Nigeria (*University of Nigeria* Abstracts of thesis), 3(2), 2005-2010.

Oviawe,S.J.I., Ezeji, S.C.O., &Uwameiye, R. (2017). Comparative effectiveness of three methods on the academic performance of students in building technology in Nigerian polytechnics. *European Scientific Journal*, *11*(12), 274–285.

Owosho, J.O (2018).Effects of The constructivist Instructional Approach on Achievement and Retention of Auto mechanics Students in Technical Colleges in Lagos State.*Unpublished Ph.D. Thesis,* Department of Vocational Teacher Education, University of Nigeria Nsukka.

Oyarole, Y.A. (2019). Effects of Problem solving strategy on Students academic achievement and retention in ecological concepts among SSS in Zaria education zone, Kaduna State, Nigeria.

Oyenuga, A. (2010). Effect of a model on Technical College students interest, academicachievement in Auto mechanic, *Unpublished Ph.D. Thesis*, Department of Vocational Teacher Education, University of Nigeria Nsukka.

Ozden, M. &Gultekin, M. (2008). The effects of brain-based learning on academic achievement and retention of knowledge in a science course. Retrieved on 10th October 2018 from http://ejee.southwestern.edu.

Piper, B. &. Zuilkowski, S.S. (2015). Teacher coaching in Kenya. Examining instructional support in public and nonformal schools. *Journal of Teaching and teacher education* 4(7), 173-183.

Richman, E. I. (2014). Career Guide for the Young School Leaver. Mbaise: Hero Publishers.

Riordan, R. J., Hine, M. J., & Smith, T. C. (2019). An integrated learning approach to teaching an undergraduate information systems course. *Journal of Information Systems Education*, *28*(1), 5-15.

Samuel, W.A.(2018). Essential teaching methods for education and behavioural science. Sabcos press, 91A Azikwestreet, mile II Diobu, PH. River state.

Starkey, L. (2019). Three dimensions of student-centred education: a framework for policy and practice. *Critical Studies in Education, 60*(3), 375-390.

Stromquist, N.P. (2018). Women empowerment and education linking knowledge totransformative actions. *European Journal of Education, 50(3) 307 – 324.*

Sweeting, K.(2017). Early years Teachers' attitudes in Mathematics. M.Ed thesis. The Queensland University of Technology. The University of Haifa. http://construct.haifa.ac.il.

Tatum, H.E., Schwartz, B.M., Schimmoeller, P.A., and Perry. N. (2018). Classroom participation and student-faculty interactions: does gender matter? *The Journal of Higher Education, 84*(6), 745-768.

Teemant, A., Leland, C., & Berghoff, B. (2018). Development and validation of a measure of critical stance for instructional coaching. *Teaching and teacher education*, 39(3), 136-147.

Titus, I.E.&Sunday, O.O. (2018). Effect of problem-based teaching method on studentsacademic performance in electrical installation and maintenance works in technical colleges in Edo state. *International Journal of Development and Sustainability*, 7(2), 666-678.

Umunadi, K. E. (2009). A relational study on students' academic achievement of television technology in technical colleges in the Delta State of Nigeria. *Journal of Instructional Teacher Education, 46 (3),* 35- 47.

Vogt, F&Rogalla, M. (2011). Developing adaptive teaching competency through coaching. Teacher and Teacher Education, 25, 1051-1060.

Vygotsky, L.S. (1987). The collected works *of L.S. Vygotsky*. In R.W Rieber and A.S. Carton (Ed.) problems of general psychology. Cambridge Harvard university press.

Wandberg, R&Rohwer, J. (2017).Active teaching strategies and learning activities. Teaching health education: In language and diverse classrooms learning. Jones & Bartlett.(p:162186).

Watitwa, P. (2010). An investigation of student-related factors that affect achievement in Secondary School Biology Practicals in Teso District, Kenya.*European Scientific Journal, 9*(7), 264–275.

Yeung, R. (2015). Athletics, athletic leadership, and academic achievement. *Journal of Education and Urban Society*, 47(3), 361-387.

APPENDIX A

ELECTRICAL INSTALLATION AND MAINTENANCE WORK NABTEB RESULT

GOVERNMENT OF BAUCHI STATE

MINISTRY OF EDUCATION

P.M.B. 064, Railway Road, Bauchi.
Tel: 077-542202

Our Ref: MOE/S/EDU.30/V.I Your Ref: _____ Date: 20/5/202

Emmanual Yusuf,
Industrial and Technology Education Department,
FUT Minna,
Niger State.

RE: REQUEST FOR ELECTRICAL INSTALLATION AND MAINTENANCE PRACTICE RESULTS IN TECHNICAL COLLEGES IN BAUCHI STATE:

Your application on the above subject matter refers.

2. Find attached herewith the results summary for the Year 2016 – 2019 as requested.

3. Wishing you a successful research work, please.

Danjuma Babaji
For: Commissioner.

NABTEM RESULTS ANALYSIS FOR ELECTRICAL INSTALLATION AND MAINTENANCE IN TECHNICAL COLLEGES 2016 – 2019

S/N	NAME OF COLLEGES	2016		2017		2018		2019	
		NO. REGISTERED	NO.OF CREDIT PASS	NO. REGISTERED	NO. OF CREDIT	NO. REGISTERED	NO. OF CREDIT PASS	NO. REGISTERED	NO. OF CREDIT PASS
1.	GTC. Gumau	103	22	40	12	36	05	38	10
2.	GTC. Gamawa	60	19	57	20	70	25	55	05
3.	GDTC. Bauchi	90	23	83	21	81	-	74	-
4.	GDTC. Azare	23	10	38	19	42	20	55	16
5.	GDTC. K/Madaki	32	12	29	16	21	0	12	0.
6.	Gdtc. T/Balewa	30	09	42	13	55	05	70	25
7.	GDTC. Jama'are	14	07	26	16	28	0.	16	12
8.	GDTC. Gar	09	03	19.	11.	15	-	29	11

20/5/2021

APPENDIX B

POPULATION OF THE STUDY NTC II STUDENTS OFFERING ELECTRICAL INSTALLATION AND MAINTENANCE WORK

S/N	Colleges	Male	Female	Total
1	Government Technical College Gumau	34	7	41
2	Government Technical College Gamawa	52	0	52
3	Government Day Technical College K/Madaki	22	0	22
4	Government Day Technical College Gar	14	2	16
5	Government Day Technical College Azare	34	0	34
6	Government Day Technical College Bauchi	37	8	45
7	Government Day Technical College Jama'are	21	0	21
8	Government Day Technical College T/Balewa	27	5	32
TOTAL		**241**	**22**	**263**

Source: Students register from each Technical College for the 2020/2021 session.

APPENDIX C

ELECTRICAL INSTALLATION AND MAINTENANCE WORK ACHIEVEMENT TEST (EIMWAT).

School: ……..….

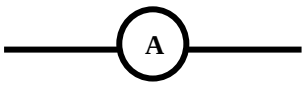
Class: …….……

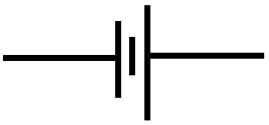
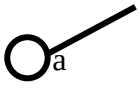
Time Allowed: ……2 Hrs…….…….

GENDER: Male ( ) Female ( )

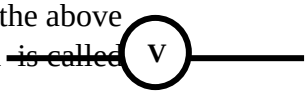
INSTRUCTION: Attempt all questions. Choose the correct answer from the alternative

Lettered A-D, circle or tick the letter that bears the option chosen by you.

1. The drawingrepresents…… 

   A. Fuse
   B. Ammeter
   C. Battery
   D. Switch
2. The diagram in the electrical drawing is….. 
   A. Breaker
   B. Battery
   C. Fuse
   D. Ammeter
3. Switch that control just one circuit is called
   A. Single pole switch
   B. Double pole switch
   C. Three pole switch
   D. Single receptacle outlet
4. A common return path for electric current or direct physical connection to the earth is called….
   A. Relay
   B. Battery
   C. Ground connection
   D. Switch
5. The diagram  is called
   A. Battery
   B. Fuse
   C. Breaker
   D. Ground connection
6. In the electrical drawing  a
   A. Push
   B. Relay
   C. Fuse

D. Switch

7. An electric switch having three terminals used to control a circuit from two different points is called
   A. Single pole switch
   B. Double pole switch
   C. Three-way switch
   D. None of the above
8. The diagram 

is called
   A. Fuse
   B. Voltmeter
   C. Ammeter
   D. Switch
9. Is a symbol of 
   A. Resistor
   B. Fuse
   C. Switch
   D. Ground connection
10. Which of the following symbols represents a capacitor
   A. 
   B. 
   C. 
   D. 
11. The correct electrical symbol for a fluorescent lamp is
   A. 
   B. 
   C. 
   D. 
12. When cables are drawn through the conduit and terminated at the switch point the system of wiring is called…….
   A. Batten wiring
   B. Cleat wiring
   C. Conduit wiring
   D. None of the above
13. Which is not a type of conduit wiring…….
   A. Rigid steel conduit
   B. Rigid non-metallic conduit
   C. Flexible conduits
   D. TRS wiring
14. …….. conduit is the one commonly used in modern domestic, commercial, and industrial wiring

A. Seam welded conduit
B. Heavy gauge screwed conduit
C. Light gauge conduit
D. Both A and B

15. Which type of wiring gives more mechanical and fire protection
    A. casing capping wiring
    B. Batten wiring
    C. Conduit wiring
    D. Cleat wiring
16. Which device is used to protect the wiring from short circuit fault?
    A. MCB
    B. Ammeter
    C. Multimeter
    D. Isolator
17. The conduit elbows are used at
    A. Tapping the connection
    B. Sharp ends
    C. Straight runs
    D. Away from walls
18. Which material is not a good conductor
    A. Aluminum
    B. Copper
    C. PVC
    D. Zink
19. Before working on a circuit you must …….. the power supply
    A. Switch on
    B. Switch off
    C. Hold
    D. Throw
20. The basic material that is used to join two pieces of conduit together in conditions where either part can be rotated is …….
    A. Running coupler
    B. Stock and dies
    C. Clips
    D. Saddles
21. The insulation of MICC cable is made up of……
    A. Mica
    B. Copper
    C. Magnesium oxide
    D. PVC
22. M.I.C.C is used for the installation of a
    A. Bungalow
    B. Shopping complex
    C. Workshop
    D. Boilerhouse

23. M.I.C.C cable is used in boiler houses because of its ability to withstand
    A. High voltage
    B. High current
    C. High temperature
    D. Cold temperature
24. The following are advantages of M.I.C.C. cable except ……
    A. The sheath provides a good earth continuity conductor
    B. Mechanically strong
    C. High current density
    D. Deteriorate with age
25. When effectively installed, the outer sheath of a M.I.C.C cable serves as an
    A. Earth return path
    B. High current density path
    C. Insulation path
    D. Earth hazardous path
26. Which of the following is wrong during the process of drawing cables into a conduit system? do not
    A. Draw in cable in long run from the center
    B. Draw in both sides separately
    C. Use a reel stand when drawing the long length of cable
    D. Use French chalk when drawing in the cable into conduits
27. Threading in conduit is done by
    A. Bending machine
    B. Stock and die
    C. Crampets
    D. Saddles
28. The main purpose of wearing a safety belt when working on a transmission line is to
    A. Prevent the trouser of the technician from falling
    B. Protect us against falling off from the ladder
    C. Prevent electric shock
    D. Prevent arrest by road safety
29. The most dangerous place to use electrical equipment is?
    A. Indoors
    B. Outdoors
    C. Near water
    D. Near other electrical equipment
30. The safest ladder to use around electricity is
    A. Wood
    B. Fiberglass
    C. Aluminum
    D. A step stool
31. The effects of an electrical shock on the body depend upon all of the following except
    A. Current
    B. Path

C. Duration
D. Bodyweight

32. Injuries from electricity can include which of the following?
    A. The electric shock that may or may not result in electrocution
    B. Falls
    C. Burns
    D. All of the above
33. Open knock outlet boxes:
    A. Must be reported and repaired as soon as possible
    B. Are permitted by OSHA
    C. Are common because replacing knockouts is expensive
    D. Pose no hazard as the electrical wiring has been rerouted
34. Insulating equipment such as electrical protective gloves found defective must be
    A. Checked and used carefully
    B. Evaluated for changes in colour or texture
    C. Thrown away and never used again
    D. Taken out of service until repaired and retested.
35. You should wear eye, head, and face protection if you are working with which of the following tools?
    A. Portable abrasive wheel tools
    B. Electric tools
    C. Pneumatic tools
    D. Liquid fuel tools
36. What violations are most commonly cited by OSHA?
    A. Hazard communications
    B. Scaffolding
    C. Fall protection
    D. Respiratory protection
37. What is meant by total pressure in a duct?
    A. Velocity pressure – static pressure
    B. Static pressure + velocity pressure
    C. Velocity pressure + suction pressure
    D. Suction pressure + discharge pressure
38. Which device is installed in ducts to control airflow?
    A. Grille
    B. Damper
    C. Diffuser
    D. Register
39. Why the glass wool insulation is avoided in ducts?
    A. Less strength
    B. High conductivity
    C. Not resistant to water
    D. Allows vapour transmission
40. Which parameter is checked if the airflow in the supply duct is reduced in the central AC plant?
    A. Condenser temperature

B. Cooling water temperature
C. Blower motor ampere/speed
D. Compressor discharge temperature

41. Which of these is the main advantage of ducting over trunking system
A. Ducting has many tappings
B. Ducting has no tappings
C. Ducting has few tapping
D. Ducting has no access for tapping
42. Which of the following installation requires the service of an armoured cable?
A. Conduit
B. Ducting
C. Domestic
D. Ceiling/overhead installation
43. Ringing tools are used for the installation
A. P.V.C
B. M.I.C.C
C. Conduit
D. Overhead wire
44. The working drawing of an electrical installation project shows all of the following except the
A. Type of installation work to be carried out
B. Type and sizes of cable
C. Complete structured design
D. Type of wiring system
45. Which of these is most important to interpret in working drawing? the
A. Tools required for the installation
B. Electrical symbols used for representation
C. Type of installation/ wiring
D. Building structure
46. Which of the following are non-statutory regulations?
A. Electricity regulation
B. Manual handling regulation
C. BS 7671
D. Provision and use of work equipment regulations
47. Which one of the following diagram types do not show individual conductors or cables but shows the sequence of equipment
A. Block
B. Circuit
C. Schematic
D. Bar chart
48. The type of trunking that can be used as a circuit protective conductor is;
A. Mini
B. PVC dado
C. Steel
D. Plastic
49. The additional cable supports should be provided in trunking where;

A. Segregation
B. There are long vertical runs
C. Trunking is made of plastic
D. The walls are made of the lightweight block

50. The following are advantages of duct except
A. Flexibility in the provision of ceiling and socket outlets in buildings
B. Provision of separate earth continuity conductor for earthing intersection boxes and outlets
C. The concealed wiring system is provided with overcome digging through the concrete floor
D. Installation can be put in place without minding the exact position of the outlets

51. What is the tool used to bend conduits?
A. Hickey
B. Coupler
C. Pipe vice
D. Bench vice

52. What is the purpose of the circuit diagram in wiring installation?
A. To show the physical position of accessories
B. To estimate the various accessories in the circuit
C. To inform the reader quickly what the circuit is designed
D. To show the schematic connection of the circuit for the specific task

53. What is the function of a circuit breaker?
A. Making contact at normal condition
B. Making contact at abnormal condition
C. Breaking automatically at abnormal condition
D. Physical breaking contact at abnormal condition

54. Which wiring is suitable for temporary installation?
A. Cleat wiring
B. Concealed wiring
C. P.V.C conduit wiring
D. Metal conduit wiring

55. How conduit pipes are specified?
A. Length in meter
B. Wall thickness in mm
C. Inner diameter in mm
D. Outer diameter in mm

56. Which of these is not a power tool safety precaution?
A. Never carry a tool by the cord or hose
B. Never yank the cord or hose to disconnect it from the receptacle.
C. Keep tools plugged in when not in use, before servicing, and when changing accessories such as blades, bits, and cutters.
D. Keep cords and hoses away from heat, oil, and sharp edges.

57. The fuse rating is expressed in terms of:
A. Voltage
B. Current

C. KVA
D. VAr

58. The electrical accessories used in wiring installation are classified according to their uses. In what classification of accessories, the ceiling rose will belong?
A. Holding
B. General
C. Safety
D. Controlling

59. Two-pin sockets should not be used in domestic wiring unless the appliance to be connected is ----------
A. Double earthed
B. Double insulated
C. Controlled by E.I.C.B
D. Controlled by M.C.B

60. Which tool is used to measure the size of the conductor?
A. Bevel gauge
B. Vernier caliper
C. Standard wire gauge
D. Depth gauge

APPENDIX D

MARKING SCHEME FOR ELECTRICAL INSTALLATION AND MAINTENANCE WORK ACHIEVEMENT TEST(EIMWAT).

1. B
2. B
3. A
4. C
5. D
6. D
7. B
8. B
9. A
10. B
11. C
12. C
13. D
14. C
15. C
16. A
17. B
18. D
19. B
20. A
21. D
22. D
23. C
24. D
25. A
26. A
27. B
28. B
29. C
30. A
31. D
32. D
33. A
34. D
35. A
36. A
37. B
38. B
39. D
40. C
41. A
42. B
43. A
44. C
45. B
46. C
47. A
48. D
49. B
50. D
51. A
52. C
53. C
54. A
55. D
56. C
57. B
58. B
59. C
60. C

APPENDIX E
EXPLORATION INSTRUCTIONAL STRATEGY LESSON PLAN
LESSON PLAN ONE

Course: Electrical Installation and Maintenance Work

Topic: Electrical Working Drawing of a Factory

Class: NTC II

Duration: 90 minutes

Specific Instructional Objectives: At the end of the lesson, students should be able to:

1. Explain the electrical working Drawing of a Factory.

2. List different types of Electrical Working Drawing of a Factory.

3. Explain at least four types of Electrical Working Drawing of a Factory.

4. Explain the key features e,g feeder cables transformer, metering, etc.

5. Identify key elements of the electrical installation.

Previous knowledge: The students are familiar with general drawing.

Instructional Strategy: Exploration instructional strategy.

Instructional Requirements: A pen, sheet of paper to jot down notes, and cardboard paper showing electrical symbols and drawings.

Step	Contents	Teacher's Activities	Exploration Activities	Students' Activities
1	Electrical Working Drawing of a Factory	Ask the students to explain for example the electrical working drawing of a factory.	An electrical drawing is a type of technical drawing that shows information about power, lighting, and communication for an engineering or architectural project. Any electrical working drawing consists of lines,	The students note closely the electrical working drawing of a factory.

			symbols, etc.	
2	Types of Electrical Working Drawing of a Factory	Ask the students to explain list the types of electrical working drawings of a factory.	Students with the help of the teacher list electrical working drawing as; block diagrams, schematic circuit diagrams, single line diagrams, pictorial diagrams, logic diagrams, and electrical floor plans.	The students note the electrical working drawing and find the types.
3	Explain the Types of Electrical Working Drawing of a Factory	Ask the students to explain the types of electrical working drawings of a factory.	The students explain the following types of electrical working drawings; - Block diagram is the type of electrical drawing that represents the principal components of a complex system form of blocks. Etc.	The students Note closely and explain the types of electrical drawings of a factory.
4	Feeder cables transformer, metering, etc	Ask the students to explain feeder, cables, transformer, and metering.	The student in the group explains feeder, cables, transformer, and metering. For example feeder- is a conductor used to transmit power.	The student note and carefully explains the feeder, cables, transformer, and metering.
5	Elements of the Electrical Installation	Ask students to list four elements or components of electrical installation.	The students with the help of the teacher list the elements as electricity meters, distribution	The students note and carefully list the elements of the electrical installation.

			board, earth fault circuit interrupter, circuits, protection against high voltage surges, etc.	
6	Evaluation	Through questioning of the students and in turn answers questions that will be put on the board.	Develop an instrument to measure performance.	Students answer the question at the end of the lesson.

LESSON PLAN TWO

Course: Electrical installation and maintenance work

Topic: Conduit wiring for Industrial Installation

Class: NTC II

Duration: 90 minutes

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

(1) Explains Conduit wiring industrial Installation

(2) List types of Conduit wiring for Industrial Installation

(3) States the advantages and disadvantages of Conduit wiring.

(4) List the materials for Conduit wiring for Industrial Installation.

(5) Carryout a simple Conduit wiring for Industrial Installation

Previous knowledge: The students are familiar with electrical drawing.

Instructional Strategy: Exploration instructional strategy

Instructional Requirements: A pen, sheet of paper to jot down notes, and cardboard paper showing diagrams of conduit wiring.

Steps	**Contents**	**Teachers' Activities**	**Exploration Activities**	**Students' Activities**
1	Conduit wiring	Ask students to define conduit wiring.	The students explore the concept of conduit wiring installation as a tube used to protect and route electrical wiring in a building or structure.	Students should note and provide the answers.
2	Types of Conduit wiring	Ask the students to list the types of conduit wiring.	The students list the types of conduits as metal conduits, aluminum conduits, and non-metal conduits.	Students to reflect and provide the answers.
3	The advantages and disadvantages of Conduit	Ask the students to states the advantages and disadvantages of	The students with the help of the teacher state the **advantages** of conduit wiring as;	The students note the question with the guide of the

	wiring	conduit wiring.	-it is a durable and very popular system. -it is the waterproof wiring system -it has long life etc **Disadvantages** -in the case of steel conduit it is expensive -fault-finding process is very difficult -It is difficult to install.	teacher the students list the advantages and disadvantages of conduit wiring.
4	The materials for Conduit wiring for Industrial Installation.	Ask the students to list the materials for conduit wiring.	The materials for conduit wiring are; galvanized iron wire, elbow, coupling, VIR or PVC cable, lock nut, clip, and junction box, etc.	The students write down the question and carefully provide the answer.
5	A simple Conduit wiring for Industrial Installation	Ask the students to make a simple conduit wiring using the material available.	The teachers demonstrate conduit wiring for students to have an idea.	The students in groups make a simple conduit wiring under the guidance of the teacher.
6	Evaluation	Through questioning of the students and in turn answers questions that will be put on the board as summary.	Develop an instrument to measure the student's performance.	The Students answer question at the end of the lesson.

LESSON PLAN THREE

Course: Electrical Installation and Maintenance Work

Topic: Installation of MICC Cable

Class: NTC II

Duration: 90 minutes

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

(1) Explains MICC cable.

(2) States the advantages and disadvantages of MICC cable.

(3) Demonstrate the installation of MICC cable.

(4) Carry out simple Installation of MICC cable.

Previous knowledge: The students are familiar with industrial installation.

Instructional Strategy: Exploration instructional strategy

Instructional Requirements: A pen, sheet of paper to jot down notes, and cardboard paper showing the diagrams MICC cable.

Steps	**Content**	**Teachers' Activities**	**Exploration Activities**	**Students' Activities**
1	MICC cable.	Ask the students to explain the MICC cable.	In groups, the students explain MICC cable. Mineral insulated copper-clad cable is a variety of electrical cables made from the copper sheath, insulated by inorganic magnesium oxide powder.	Students note and reflect on the question by explaining the MICC cable.
2	The advantages and disadvantages of MICC cable	Ask students to state the advantages and disadvantages of MICC cable.	The students state the **advantage** of **MICC** cable as; mechanical robust and resistant -copper sheathing is waterproof etc. **Disadvantages** -the price is relatively high -the flexibility is not good	Students note and provide the answers in the group.

			-cable joint at Re prone to moisture etc	
3	The installation of MICC cable.	Ask the students to explain the installation of the MICC cable.	The students explore the installation of MICC cable as for ease of installation it is recommended that the cables be completely uncoiled or removed from the reel and laid out in a straight run with the end to be pulled closest to the entry point into the support system. Etc.	Students note and reflect on the question by stating the installation of the MICC cable.
4	Termination of MICC cable	Ask the students to explain the termination of the MICC cable.	Using pliers or grips. This method has the merit of employing a tool normally carried by an electrician and does not require the use of a glad. However, if a gland is being used to terminate the cable, it must be solid onto the cable before screwing on the pot. If there is any roughness left around the end of the cable sheath from the stripping operation, remove it by lightly running the grips along the end of the sheath, etc.	Students note down and state the method of terminating MICC cable.
5	Evaluation	Through questioning of the students and in turn answers questions that will be put on the board as summary.	Develop an instrument to measure the students' performance.	The Students answer question at the end of the lesson.

LESSON PLAN FOUR

Course: Electrical Installation and Maintenance Work

Topic: Safety measures when carrying industrial and MICC cable installation.

Class: NTC II

Duration: 90 minutes

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

(1) Explain Safety measures when carrying industrial and MICC cable installation.

(2) State the reasons for using MICC cable.

(3) List tools used for its installation.

(4) Apply the Safety measures when carrying industrial and MICC cable installation.

Previous knowledge: The students are familiar with MICC cables.

Instructional Strategy: Exploration instructional strategy

Instructional Requirements: A pen, sheet of paper to jot down notes, and cardboard paper showing the diagrams of MICCcable.

Step	Content	Teachers' Activity	Exploration Activity	Students' Activity
1	Explain Safety measures when carrying industrial and MICC cable installation.	Ask the students to states safety measures when carrying industrial MICC cable installation.	The safety measures are; make sure the power is off -wear safety glasses and protective clothing -always test firs -have the right tools on hand -check your work etc	Students note and carefully states the safety measures
2	The reasons for using MICC cable	Ask the students to state the reasons for using MICC cable.	The main reason for MICC cable is to ensure during a fire that all the building emergency and essential circuits such as escape lighting, fire sensors,	Students to state the reasons for using MICC cable.

			fire alarm circuits, service lifts, water pumps, smoke extractors continue to function both during the building evacuation and the firefighting efforts.	
3	Tools used for MICC cable installation	Ask students to list the tools used for MICC cable installation.	The following are the tools for formic cable installation: X-crimper, potter, pyro ringer, pyro straightener, pyro benders, wrench, joistripper spare blade, pyro stripper, etc.	Students note and carefully think about the tools used for MICC cable installation.
4	The Safety measures when carrying industrial and MICC cable installation.	Ask the students to States the safety measures when carrying industrial and MICC cable installation.	The students search for the safety measures when carrying industrial and MICC cable installation as, check the breaker or power source and making sure the power is always off before starting any electrical work' -use a voltage tester to test the wires and connections before you begin working on them. Etc	Students carefully search for the safety measures when carrying industrial and MICC cable installation.
6	Evaluation	Through questioning the student and in turn, answers the question that will be put on the board for students to copy.	Develop an instrument to measure the student's performance.	Students answer the question at the end of the lesson.

LESSON PLAN FIVE

Course: Electrical Installation and Maintenance Work

Topic: Ducts and Trunking System

Class: NTC II

Duration: 90 minutes

Specific Instructional Objectives: At the end of the lesson, students should be able to:

(1) Explain the Ducts system.

(2) Explains the Trunking system

(3) States the difference between ducts and trunking systems.

(4) Carry out a simple installation of ducts and trunking system.

Previous knowledge: The students are familiar with different sizes of cables.

Instructional Strategy: Exploration instructional strategy

Instructional Requirements: A pen, sheet of paper to jot down notes, and cardboard paper showing different types of lamps.

Step	Content	Teachers' Activity	Exploration Activity	Students' Activity
1	Ducts system.	Ask the students to explain the wiring duct system.	The students search for the duct wiring system. As wiring ducts are used to organize and protect cables within enclosures. They typically include features that allow cables and wires to be easily re-routed and terminated within the enclosure.	Students note and explain the duct system.
2	Trunking system	Ask the students to explain the trunking system	The students explain the electrical trunking system as an enclosure usually with a rectangular	Students note the question and carefully explain

			cross-section and with one removable or hinged side that is used to protect cables and provide space for other electrical equipment.	the trunking system.
3	The difference between ducts and trunking system	Ask the students to state the difference between duct and trunking systems.	The difference between duct and trunking system; a duct is a fully enclosed tube or pipe that carries, liquid or air in and out of buildings or through the body. Whereas a trunking system is fully accessible, a rectilinear box section is used solely in lengths for the protection and routing of cables on the surface in around and out of buildings and not through a body.	Students note down the question and write down the difference between duct and trunking systems.
4	A simple installation of ducts and trunking system	The teacher divides the students into groups and asks them to demonstrate duct and trunking systems.	Students with the help of the teacher demonstrate duct and trunking systems.	Students in groups carry out a simple demonstration of the duct and trunking system under the guidance of the teacher.
6	Evaluation	Through questioning the student and in turn, answers the question that will be put on the board for students to copy.	Develop an instrument to measure the student's performance.	Students answer the question at the end of the lesson.

LESSON PLAN SIX

Course: Electrical Installation and Maintenance Work

Topic: The advantages and disadvantages of ducts and trunking in industrial installation

Class: NTC II

Duration: 90 minutes

Specific Instructional Objectives: At the end of the lesson, students should be able to:

1. List and explain the advantages and disadvantages of ducting.
2. List and explain the advantages and disadvantages of trunking.
3. Identify the different types of ducts and trunking.
4. List tools and equipment used on duct and trunking.

Previous knowledge: The students are familiar with ducts and trunking.

Instructional Strategy: Exploration instructional strategy

Instructional Requirements: A pen, sheet of paper to jot down notes, and cardboard paper showing different types of joints.

Step	Content	Teachers, Activity	Exploration Activity	Students' Activity
1	Explains the advantages and disadvantages of ducting.	The teacher asks the students to explain the advantages and disadvantages of ducting.	The students list the **advantages** of ducting system as; -The entire distribution fuse boards are installed on the walls -Connections are easily made -Duct cables are easily installed In a large building if we use the ducting system the wiring system remains the same and alterations are easily possible. **Disadvantage** -Some homes can not accommodate a	Students note and find the advantages and disadvantages of ducting.

			ducted air conditioning unit as they are so large -It is expensive	
2	Explains the advantages and disadvantages of trunking.	The teacher asks the students to explain the advantages and disadvantages of trunking.	The students search the advantages of trunking system as; the cables are enclosed in trunking there is no risk of cable insulation being damaged -Cables are safe against dust and humidity -Alternations are possible -Trunking system has a long life. Disadvantages It-Expensive compare to other wiring systems -Care and good workmanship are needed to ensure a successful installation.	Students note the question and carefully explore the advantages and disadvantages of trunking.
3	Types of ducts and trunking	The teacher asks the students to list and explain the types of trunking.	The students to list the types of duct wiring system as; -Overhead ducting -Underfloor ducting wiring -Wall-mounted/skirting ducting. Types of trunking -Aluminium stainless steel, galvanized steel, and other metals -PVC and other plastic trunking -Clip-on self-adhesive, slotted, and skirting trunking.	Students note down the question and search the types of trunking.
4	Tools and equipment used	Ask students to list the tools and	The students with the help of students	Students note and find the tools and

	on duct and trunking	equipment used on the duct and trunking system.	list tools and types of equipment for ducting and trunking as; sheet metal crimper -duct hole cutters -hand seamers -scribes - Dividers -duct stretchers -PVC trunking -PVC trunking cutter etc	equipment used on the duct and trunking system.
5	Evaluation	Through questioning the student and in turn, answers the question that will be put on the board for students to copy.	Develop an instrument to measure the student's performance.	Students answer the question at the end of the lesson.

APPENDIX F

COACHING INSTRUCTIONAL STRATEGY LESSON PLAN
LESSON PLAN ONE

Course: Electrical Installation and Maintenance Work

Topic: Electrical Working Drawing of a Factory

Class: NTC II

Duration: 90 minutes

Specific Instructional Objectives: At the end of the lesson, students should be able to:

1. Explain the electrical working Drawing of a Factory.

2. List different types of Electrical Working Drawing of a Factory.

3. Explain at least four types of Electrical Working Drawing of a Factory.

4. Explain the key features e,g feeder cables transformer, metering, etc.

5. Identify key elements of the electrical installation.

Previous knowledge: The students are familiar with general drawing.

Instructional Strategy: Coaching instructional strategy.

Instructional Requirements: A pen, sheet of paper to jot down notes, and cardboard paper showing electrical symbols and drawings.

Step	Contents	Teacher's Activities	Coaching Activities	Students' Activities
1	Electrical Working Drawing of a Factory	The teacher explains electrical drawing as a type of technical drawing that shows information about power, lighting, and communication for an engineering or architectural project. Any electrical working drawing consists of lines, symbols, etc.	The teacher guides the students to explain and discover more examples of electrical working drawings of a factory.	The students listen carefully and to the teacher and understand the topic.
2	Types of Electrical Working	The teacher lists the type of electrical working drawing as;	The teacher guides the students to state	The students note the electrical working drawing and explain

	Drawing of a Factory	block diagrams, schematic circuit diagrams, single line diagrams, pictorial diagrams, logic diagrams, and electrical floor plans.	the types of electrical working drawings of a factory.	more.
3	Explain the Types of Electrical Working Drawing of a Factory	The teacher explains the following types of electrical working drawings; -Block diagram is the type of electrical drawing that represents the principal components of a complex system form of blocks. Etc.	The student explains more with the help of the teacher.	The students listen and jot the types of electrical working drawing.
4	Feeder cables transformer, metering, etc	The teacher guides the students and explains the feeder, cables, transformer, and metering. For example feeder- is a conductor used to transmit power.	The teacher helps the students to demonstrate feeder, cables, transformer, and metering.	The student listens carefully to understand the topic.
5	Elements of the Electrical Installation	The teacher list the elements as electricity meters, distribution board, earth fault circuit interrupter, circuits, protection against high voltage surges, etc.	The students guide to list and explain the elements of electrical installation.	The students note and carefully list more elements of the electrical installation.
6	Evaluation	Through questioning of the students and in turn answers questions that will be put on the board.	Develop an instrument to measure performance.	Students answer the question at the end of the lesson.

LESSON PLAN TWO

Course: Electrical installation and maintenance work

Topic: Conduit wiring for Industrial Installation

Class: NTC II

Duration: 90 minutes

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

(1) Explains Conduit wiring industrial Installation

(2) List types of Conduit wiring for Industrial Installation

(3) States the advantages and disadvantages of Conduit wiring.

(4) List the materials for Conduit wiring for Industrial Installation.

(5) Carryout a simple Conduit wiring for Industrial Installation

Previous knowledge: The students are familiar with electrical drawing.

Instructional Strategy: Coachinginstructional strategy

Instructional Requirements: A pen, sheet of paper to jot down notes, and cardboard paper showing diagrams of conduit wiring.

Steps	**Contents**	**Teachers' Activities**	**Coaching Activities**	**Students' Activities**
1	Conduit wiring	The teacher explains the concept of conduit wiring as a tube used to protect and route electrical wiring in a building or structure.	Students explain conduit wiring under the guidance of the teacher.	Students listen and provide more explanations.
2	Types of Conduit wiring	The teacher lists the types of conduits as metal conduits, aluminum conduits, and non-metal conduits.	The teacher helps the students to state types of conduit wiring.	Students carefully identify the types of conduit wiring.
3	The advantages and	The teacher states the **advantages** of	The teacher guides the students to state	The students listen carefully

	disadvantages of Conduit wiring	conduit wiring as; - It is a durable and very popular system. -It is the waterproof wiring system -It has long life etc **Disadvantages** -In the case of steel conduit it is expensive -Fault-finding process is very difficult -It is difficult to install.	the advantages and disadvantages of conduit wiring.	and jot down notes.
4	The materials for Conduit wiring for Industrial Installation.	The materials for conduit wiring are; galvanized iron wire, elbow, coupling, VIR or PVC cable, lock nut, clip, and junction box, etc.	The teacher guides the students to list and explain materials for conduit wiring.	Students listen carefully to the teacher and list materials for conduit wiring for industrial installation.
5	A simple Conduit wiring for Industrial Installation	The teachers demonstrate conduit wiring for students to have an idea about the practicality of conduit wiring.	The teacher guides the students in the group to carry out a simple conduit wiring for industrial installation.	The students in groups make a simple conduit wiring under the guidance of the teacher.
6	Evaluation	Through questioning of the students and in turn answers questions that will be put on the board as summary.	Develop an instrument to measure the student's performance.	The Students answer question at the end of the lesson.

LESSON PLAN THREE

Course: Electrical Installation and Maintenance Work

Topic: Installation of MICC Cable

Class: NTC II

Duration: 90 minutes

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

(1) Explains MICC cable.

(2) States the advantages and disadvantages of MICC cable.

(3) Demonstrate the installation of MICC cable.

(4) Carry out simple Installation of MICC cable.

Previous knowledge: The students are familiar with industrial installation.

Instructional Strategy: Coachinginstructional strategy

Instructional Requirements: A pen, sheet of paper to jot down notes, and cardboard paper showing the diagrams MICC cable.

Steps	Content	Teachers' Activities	Coaching Activities	Students' Activities
1	MICC cable.	Theteacher explains Mineral insulated copper-clad (MICC) cable is a variety of electrical cables made from the copper sheath, insulated by inorganic magnesium oxide powder.	The teacher guides the students to learn more about MICC cable.	Listen to the teacher's explanation and understand MICC cable.
2	The advantages and disadvantages of MICC cable	The **advantage** of **MICC** cable are; -Mechanical robust and resistant -Copper sheathing is waterproof etc. **Disadvantages** -The price is relatively high -The flexibility is not good	The teacher helps the students to state the advantages and disadvantages of MICC cable.	Students note and give more advantages and disadvantages.

		-Cable joint at Reproved to moisture etc		
3	The installation of MICC cable.	The teacher explains the installation of MICC cable for ease of installation it is recommended that the cables be completely uncoiled or removed from the reel and laid out in a straight run with the end to be pulled closest to the entry point into the support system. Etc.	Students with the help of the teacher explain the installation of the MICC cable.	Students observed and listen to the installation of the MICC cable.
4	Termination of MICC cable	Using pliers or grips. This method has the merit of employing a tool normally carried by an electrician and does not require the use of a glad. However, if a gland is being used to terminate the cable, it must be solid onto the cable before screwing on the pot. If there is any roughness left around the end of the cable sheath from the stripping operation, remove it by lightly running the grips along the end of the sheath, etc.	The students will be guided by the teacher to explain the termination of the MICC cable.	The students note and carefully listen to the teacher.
5	Evaluation	Through questioning of the students and in turn answers questions that will be put on the board as summary.	Develop an instrument to measure the students' performance.	The Students answer question at the end of the lesson.

LESSON PLAN FOUR

Course: Electrical Installation and Maintenance Work

Topic: Safety measures when carrying industrial and MICC cable installation.

Class: NTC II

Duration: 90 minutes

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

(1) Explain Safety measures when carrying industrial and MICC cable installation.

(2) State the reasons for using MICC cable.

(3) List tools used for its installation.

(4) Apply the Safety measures when carrying industrial and MICC cable installation.

Previous knowledge: The students are familiar with MICC cables.

Instructional Strategy: Coachinginstructional strategy

Instructional Requirements: A pen, sheet of paper to jot down notes, and cardboard paper showing the diagrams of MICC cable.

Step	Content	Teachers' Activity	Coaching Activity	Students' Activity
1	Explain Safety measures when carrying industrial and MICC cable installation.	The safety measures are; make sure the power is off -Wear safety glasses and protective clothing -Always test first -Have the right tools on hand -Check your work etc	Guide the students to explain safety measures.	Students carefully identify the safety measures when carrying industrial and MICC cable installation.
2	The reasons for using MICC cable	The main reason for MICC cable is to ensure during a fire that all the building emergency and essential circuits such as escape lighting, fire	The teacher guides the students to discover the reasons for the use of MICC cable.	Listen to the teacher's explanation and understand the reason for using MICC cable.

		sensors, fire alarm circuits, service lifts, water pumps, smoke extractors continue to function both during the building evacuation and the firefighting efforts.		
3	Tools used for MICC cable installation	The following are the tools for formic cable installation: X-crimper, potter, pyro ringer, pyro straightener, pyro benders, wrench, joinstripper spare blade, pyro stripper, etc.	The students list more tools with the teacher's guidance.	Students note and carefully listen to the teacher.
4	The Safety measures when carrying industrial and MICC cable installation.	The students search for the safety measures when carrying industrial and MICC cable installation as, check the breaker or power source and making sure the power is always off before starting any electrical work' -use a voltage tester to test the wires and connections before you begin working on them. Etc	The teacher helps the students state the safety measures when carrying industrial and MICC cable installation.	The students listen to the teacher's explanation and ask questions for clarity.
5	Evaluation	Through questioning the student and in turn, answers the question that will be put on the board for students to copy.	Develop an instrument to measure the student's performance.	Students answer the question at the end of the lesson.

LESSON PLAN FIVE

Course: Electrical Installation and Maintenance Work

Topic: Ducts and Trunking System

Class: NTC II

Duration: 90 minutes

Specific Instructional Objectives: At the end of the lesson, students should be able to:

(1) Explain the Ducts system.

(2) Explains the Trunking system

(3) States the difference between ducts and trunking systems.

(4) Carry out a simple installation of ducts and trunking system.

Previous knowledge: The students are familiar with different sizes of cables.

Instructional Strategy: Coachinginstructional strategy

Instructional Requirements: A pen, sheet of paper to jot down notes, and cardboard paper showing different types of lamps.

Step	Content	Teachers' Activity	Coaching Activity	Students' Activity
1	Ducts system.	The teacher search for the duct wiring system. As wiring ducts are used to organize and protect cables within enclosures. They typically include features that allow cables and wires to be easily re-routed and terminated within the enclosure.	The teacher guides the students to define ducts system.	The student listens to the teacher's definition of the conduit system.
2	Trunking system	The teacher explains the electrical trunking system as an enclosure usually with a rectangular cross-section and with one removable or hinged side that is	The students define the trunking system with the guide of the teacher.	The student listens to the teacher's definition of the trunking system.

		used to protect cables and provide space for other electrical equipment.		
3	The difference between ducts and trunking system	The difference between duct and trunking system; a duct is a fully enclosed tube or pipe that carries, liquid or air in and out of buildings or through the body. Whereas a trunking system is fully accessible, a rectilinear box section is used solely in lengths for the protection and routing of cables on the surface in around and out of buildings and not through a body.	The students differentiate ducts and trunking systems with the help of the teacher.	Students carefully identify the difference between ducts and trunking systems.
4	A simple installation of ducts and trunking system	The teacher divides the students into groups and asks them to demonstrate duct and trunking systems.	Students with the help of the teacher demonstrate duct and trunking systems.	Students in groups carry out a simple demonstration of the duct and trunking system under the guidance of the teacher.
6	Evaluation	Through questioning the student and in turn, answers the question that will be put on the board for students to copy.	Develop an instrument to measure the student's performance.	Students answer the question at the end of the lesson.

LESSON PLAN SIX

Course: Electrical Installation and Maintenance Work

Topic: The advantages and disadvantages of Ducts and Trunking in industrial installation

Class: NTC II

Duration: 90 minutes

Specific Instructional Objectives: At the end of the lesson, students should be able to:

(1) List and explain the advantages and disadvantages of ducting.

(2) List and explain the advantages and disadvantages of trunking.

(3)Identify the different types of ducts and trunking.

(4)List tools and equipment used on duct and trunking.

Previous knowledge: The students are familiar with ducts and trunking.

Instructional Strategy: Coachinginstructional strategy

Instructional Requirements: A pen, sheet of paper to jot down notes, and cardboard paper showing different types of joints.

Step	Content	Teachers, Activity	Coaching Activity	Students' Activity
1	Explains the advantages and disadvantages of ducting.	The students list the **advantages** of ducting system as; -The entire distribution fuse boards are installed on the walls -Connections are easily made -Duct cables are easily installed In a large building if we use the ducting system the wiring system remains the same and alterations are easily possible. **Disadvantage** -Some homes can not accommodate a	The teacher helps the students to state the advantages and disadvantages	The students participate in stating the advantages and disadvantages of ducting.

		ducted air conditioning unit as they are so large -It is expensive.		
2	Explains the advantages and disadvantages of trunking.	The **advantages** of trunking system are; the cables are enclosed in trunking there is no risk of cable insulation being damaged -Cables are safe against dust and humidity -Alternations are possible -Trunking system has a long life. **Disadvantages** It-Expensive compare to other wiring systems -Care and good workmanship are needed to ensure a successful installation.	Help the students to explain the advantages and disadvantages of trunking,	The students participate in stating the advantages and disadvantages of trunking.
3	Types of ducts and trunking	The teacher lists the **Types of duct** wiring systems as; -Overhead ducting -Underfloor ducting wiring -Wall-mounted/skirting ducting. **Types of trunking** -Aluminium stainless steel, galvanized steel, and other metals -PVC and other plastic trunking -Clip-on self-adhesive, slotted, and skirting trunking.	The teacher guides the students to state the types of ducts and trunking.	Students should listen to the teacher's explanations and jot some notes.
4	Tools and equipment used on duct and	The students with the help of students list tools and types	The students list the tools and equipment used on duct and	Students listen carefully to the teacher and

	trunking	of equipment for ducting and trunking as; sheet metal crimper -Duct hole cutters -Hand seamers -Scribes - Dividers -Duct stretchers -PVC trunking -PVC trunking cutter etc	trunking.	understand the tools and equipment used on the duct and trunking system.
5	Evaluation	Through questioning the student and in turn, answers the question that will be put on the board for students to copy.	Develop an instrument to measure the student's performance.	Students answer the question at the end of the lesson.

APPENDIX G

ELECTRICAL INSTALLATION AND MAINTENANCE WORK INTEREST INVENTORY (EIMWII).

Dear Student,

Below is the list of items made to investigate the degree of student's interest and motivation in Electrical installation and maintenance work. 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**:

S A: Strongly Agree

A: Agree

U: Undecided

D: Disagree

SD: Strongly Disagree.

S/N	ITEMS	SA	A	U	D	SD
1	I am very interested in the content area of EIMW					
2	I think the course material in this class is useful for me to learn					
3	Understanding the subject matter of this course is very important to me.					
4	I like to know the names of the different tools and testing equipment used in electrical installation and maintenance work class practical					
5	Electrical installation and maintenance work classes increase my interest in electricity work					
6	I take interest in studying electrical installation and maintenance work classes parts and system					
7	I do volunteer to invite electrical installation and maintenance work classes teacher whenever it is time for his lesson					
8	Electrical installation and maintenance work					

	classes trade was not my choice					
9	I like teaching my friends electrical installation and maintenance work topics.					
10	I encourage my colleagues to develop an interest in electrical installation and maintenance work classes.					
11	I use to be happy when our electrical installation and maintenance work classes teacher is absent from class					
12	I usually complete my electrical installation and maintenance work classes assignment on time					
13	I do extra studies on electrical installation and maintenance work classes apart from the normal lessons					
14	I enjoy reading books on electrical installation and maintenance work classes					
15	I always copy notes during electrical installation and maintenance work classes' lessons.					
16	I like solving past question papers of electrical installation and maintenance work classes on my own					
17	In group work, I prefer recording results instead of participating in the actual task					
18	I like to work in an electrical installation and maintenance work classes industry after my graduation.					
19	Electrical installation and maintenance work classes subjects are difficult to understand					
20	I like putting on my overall during electrical installation and maintenance work practical classes.					
21	I think that EIMW is helpful for my career in the future.					
22	I think that learning EIMW is significant for my growth.					
23	I can answer all kinds of questions that teachers ask					

	in the EIMW class.					
24	I am familiar with the knowledge and skills required in EIMW.					
25	I want to learn things that are not included in EIMW textbooks.					
26	I hope to explore things about EIMW.					
27	I want to know more things about the field of EIMW.					
28	I will take part in an extracurricular training class for EIMW if I have the opportunity.					
29	I want to find various ways to complete the EIMW assignment.					
30	I use to do well in EIMW lessons.					

APPENDIX H

THE TRAININGGUIDELINES FOR ELECTRICAL INSTALLATION AND MAINTENANCE WORK TEACHERS FOR THE USE OF MODERN TECHNIQUES LESSON PLANS

These guidelines are for EIMW teachers who will make use of the strategies, teaching lesson plans to teach the students. The lesson plan consists of related skills and instructional procedures required for training individual students in EIMW when using modern instructional strategies. Each lesson plan comprises of the following areas

a. **Module:** this is the area specified in the NBTE syllabus to be taught by the teacher before the goal of providing students with knowledge and skills that will enable them to understand the theories and repair procedures involved in EIMW.
b. **Topic:** this is the content or subject matter to deal with in the module
c. Duration is the period of work the lesson is to last.
d. **Previous knowledge:** this is the knowledge or experiences the students brought into the classroom that is relevant to the topic to be taught by the teacher.
e. **Specific instructional objective:** that is, the knowledge to be gained or skills to be acquired by the students after teaching.
f. **Content:** that is the breakdown of the subject matter into smaller separate units. This will enable the students to deal with topics in small steps.
g. **Teacher's activity:** that is, those things the teacher can do in terms of specific activities that will facilitate how students understand what they are being taught. The performance of those activities by the teacher will also lead to the achievement of the objectives.
h. **Students' activity:** these are activities to be performed by the students that will lead to the achievement of the objectives. By performing these activities students will be able to gain knowledge or acquire skills stated in the objectives.

i. **Modern instructional stage:** these stages are the component stages of the 5E-Model upon which the modern lesson plans prepared will be used. The 5E implementation framework that explains different phases of a modern process that was adopted in the study is Engage, Explain, Explore, Elaborate, and Evaluate.

Training

1. Study the module and lesson plan carefully
2. Prepare thoroughly in advance, the students learning activities: by getting all the materials students will need for performing the activities ready and setting the stage for the student's activities.
3. Prepare for your roles which include guiding the students, step-by-step to work towards the objectives, provoking students to think (for themselves).

Assessment

Assess students' activities as the lesson is going on or as they perform the activities and by the end of the lesson or activities.

APPENDIX I

LETTER OF REQUEST FOR EXPERT VALIDATION OF RESEARCH INSTRUMENT

Department of Industrial and Technology Education,
The Federal University of Technology,
Minna.
P.M.B 65 Minna.
31/5/2021.

Dear Sir,

REQUEST FOR VALIDATION OF RESEARCH INSTRUMENT

I am a postgraduate student of the above-mentioned department and institution. I am researching **Effect of Exploration and Coaching Instructional Strategies on Electrical Installation and Maintenance Work Students' learning Outcome in Technical Colleges in Bauchi State.** You are kindly requested to ascertain the suitability of the questions, their appropriateness, the content area, the language clarity, and its relevance for the target population. You are also requested to examine the lesson plans to ensure that the instrument measures the stated objectives in the teaching plan. Your criticism, suggestion, and correction would highly be appreciated towards the success of this research.

Thanks.

Yours faithfully,

YUSUF, Emmanuel.
M.TECH/SSTE/2018/8841

APPENDIX J

VALIDATION CERTIFICATE

This is to certify that, the research instruments titled: Electricity Installation and Maintenance Work Achievement Test, Electrical Installation and Maintenance Work Interest Inventory, and two sets of lesson plans were validated by:

Name Dr. Maxwell E. Uchenfemho

Institution National Examinations Council

Department Department of Psychometrics

Signature and Date 10062021

Name Usman, G. A. (PhD)

Institution FUT Minna

Department ITE

Signature and Date 10/6/021

Name of Validator DR. USMAN A. N.

Area of Specialization I.T.E (WOODWORK)

Name of Institution F.U.T. MINNA

Signature Date 11/06/2021

APPENDIX K

A 60 ITEMS TABLE OF SPECIFICATIONS FOR ELECTRICAL INSTALLATION AND MAINTENANCE WORK ACHIEVEMENT TEST

			Cognitive levels						
S/N	Topics	Percentage (%)	Knowledge (25.6 %)	Comprehension (15%)	Application (16.7 %)	Analysis (15 %)	Synthesis (10%)	Evaluation (16. %)	Total questions.
1	The electrical working drawing of a factory	16.7	3	2	2	1	1	1	10
2	Conduit wiring	11.7	2	1	1	1	1	1	7
3	Installation of MICC cable	21.7	2	3	1	4	1	2	13
4	Safety measures	11.7	2	1	1	1	1	1	7
5	Ducts system	16.7	3	1	2	-	1	3	10
6	Trunking system	21.7	4	1	3	2	1	2	13
	TOTAL	**100%**	**16**	**9**	**10**	**9**	**6**	**10**	**60**

Source Researcher

APPENDIX L

KUDER-RICHASON 21 TEST RESULT FOR ELECTRICAL INSTALLATION AND MAINTENANCE WORK COGNITIVE ACHIEVEMENT TEST

Case Processing Summary

		N	%
Cases	Valid	20	100.0
	Excluded	0	.0
	Total	20	100.0

a. List-wise deletion based on all variables in the procedure.

Reliability Statistics

Kuder-Richardson 21	N of Items
.76	60

APPENDIX M

CRONBACH'S ALPHA CORRELATION TEST RESULT FOR ELECTRICAL INSTALLATION AND MAINTENANCE WORK INTEREST INVENTORY

Case Processing Summary

		N	%
Cases	Valid	20	100.0
	Excluded	0	.0
	Total	20	100.0

a. List-wise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	N of Items
.78	30

APPENDIX N

ITEM ANALYSIS RESULT FOR ELECTRICAL INSTALLATION AND MAINTENANCE WORK COGNITIVE ACHIEVEMENT TEST

Item No.	No. Students who Answered Correctly	*Item Difficulty Index	Upper Group that Passed the Item U_p	Lower Group that Passed the Item L_p	$U_p - L_p$	Discrimination Index	Remark
1.	15	0.75	11	4	7	0.35	Item is good
2.	7	0.35	3	4	-1	-0.05	Rejected
3.	13	0.65	10	3	7	0.35	Item is good
4.	13	0.65	8	5	3	0.15	Rejected
5.	16	0.80	11	5	6	0.30	Item is good
6.	14	0.70	10	4	6	0.30	Item is good
7.	12	0.60	10	2	8	0.40	Item is good
8.	10	0.50	8	2	6	0.30	Item is good
9.	11	0.55	7	4	3	0.15	Rejected
10.	13	0.65	9	4	5	0.25	Item is good
11.	12	0.60	7	5	2	0.10	Rejected
12.	11	0.55	7	4	3	0.15	Rejected
13.	10	0.50	7	3	4	0.20	Item is good
14.	14	0.70	12	2	10	0.50	Item is good
15.	13	0.65	10	3	9	0.45	Item is good
16.	12	0.60	8	4	4	0.20	Item is good
17.	10	0.50	7	3	4	0.20	Item is good
18.	13	0.65	9	4	5	0.25	Item is good
19.	12	0.60	9	3	6	0.30	Item is good
20.	8	0.40	4	4	0	0.00	Rejected
21.	10	0.50	7	3	4	0.20	Item is good
32.	12	0.60	8	4	4	0.20	Item is good
23.	11	0.55	9	3	6	0.30	Item is good
24.	7	0.35	3	4	-1	-0.05	Rejected
25.	10	0.50	8	2	6	0.30	Item is good
26.	8	0.40	3	5	-2	-0.10	Rejected
27.	12	0.60	9	3	6	0.30	Item is good
28.	7	0.35	2	5	-3	-0.15	Rejected
29.	11	0.55	8	5	5	0.25	Item is good
30.	13	0.65	9	4	5	0.25	Item is good
31.	14	0.70	11	3	8	0.40	Item is good
32.	12	0.60	9	3	6	0.30	Item is good
33.	10	0.50	8	2	6	0.00	Rejected
34.	13	0.65	11	3	8	0.40	Item is good
35.	12	0.60	10	2	8	0.40	Item is good
36.	10	0.50	7	3	4	0.20	Item is good
37.	10	0.50	8	2	6	0.30	Item is good
38.	13	0.65	9	4	5	0.25	Item is good
39.	8	0.40	4	4	0	0.00	Rejected
40.	12	0.60	9	3	6	0.30	Item is good
41.	10	0.50	7	3	4	0.20	Item is good
42.	7	0.35	4	3	1	0.05	Rejected
43.	11	0.55	9	2	7	0.35	Item is good
44.	6	0.30	2	4	-2	-0.10	Rejected
45.	7	0.35	3	4	-1	-0.05	Rejected
46.	11	0.55	9	3	6	0.30	Item is good
47.	12	0.60	10	2	8	0.40	Item is good
48.	7	0.35	4	3	1	0.05	Rejected
49.	11	0.55	8	3	5	0.25	Item is good
50.	9	0.45	7	2	5	0.25	Item is good
51.	13	0.65	10	3	7	0.35	Item is good
52.	11	0.55	9	2	7	0.35	Item is good
53.	9	0.45	4	5	1	0.05	Rejected
54.	12	0.60	8	4	4	0.20	Item is good
55.	13	0.65	10	3	7	0.35	Item is good
56.	14	0.70	10	4	6	0.30	Item is good
57.	8	0.40	3	5	-2	-0.10	Rejected

58.	12	0.60	10	2	8	0.40	Item is good
59.	15	0.75	11	4	7	0.35	Item is good
60	12	0.60	6	6	0	0.00	Rejected

Rule for accepting item

Accept if item difficulty is above 0.20

Reject if it falls below 0.19

Discrimination Index =

*U = number of upper -lower class test takers

U_p = Upper group that passed the Item

L_p= Lower group that passed the Item

18, 18, 19, 20, 21, 21, 22, 23, 25, 26, 27, 28, 29, 29, 31, 31, 32, 32, 33, 34.

Median = 26+ 27 / 2

= 26.5

Scores above 26.5 are regarded as the upper group and scores below 26.5 are regarded as the lower group.

The rule for accepting item

Items having negative discrimination or fall below 0.19are rejected and items having a discrimination index above 0.20 are regarded satisfactory for use.

APPENDIX O
Pretest, Posttest of EIMW Students Achievement and Interest

Achievement	N	Minimum	Maximum	Mean	Std. Deviation
EXPR1Pre-test	73	45.00	75.00	56.8904	7.90141
EXPR1Post test	73	65.00	88.00	78.1918	5.79189
EXPR2Pre-test	61	38.00	70.00	54.1475	6.61018
EXPR2Post test	61	50.00	90.00	75.9016	8.27386
Valid N (listwise)	61				

Descriptive Statistics

Interest	N	Minimum	Maximum	Mean	Std. Deviation
EXPRG1Pre-test	73	43.00	71.00	55.8493	5.92000
EXPRG1Post test	73	70.00	90.00	78.7671	4.60833
EXPRG2Pre-test	61	43.00	73.00	55.8852	6.26657
EXPRG2Posttest	61	70.00	91.00	80.7377	5.50425
Valid N (listwise)	61				

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
MALEEXPIPR	61	25.00	45.00	33.5246	5.13682
MALEEX1PSP	61	45.00	63.00	53.4590	4.48172
FMAEXP1PR	12	23.00	45.00	35.5000	6.68105
FMALEEXP2PS	12	43.00	58.00	53.0000	3.97721
MALEEXP2PR	51	20.00	45.00	33.2549	5.62794
MALEEXP2POS	51	43.00	65.00	55.3137	5.39811
FMEXP2PR	10	23.00	42.00	34.1200	5.87745
FMEXP2PS	10	43.00	62.00	54.6000	5.71936
Valid N (listwise)	10				

APPENDIX P

Analyses of Tests Between-Subjects Effects

Testing of Hypothesis.

Tests of Between-Subjects Effects

Dependent Variable: EXPPST

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	2798.317[a]	2	1399.159	47.013	.000
Intercept	4261.832	1	4261.832	143.202	.000
EXPPRT	2624.027	1	2624.027	88.170	.000
GROUP	12.526	1	12.526	.421	.518
Error	3898.697	131	29.761		
Total	804266.000	134			
Corrected Total	6697.015	133			

a. R Squared = .418 (Adjusted R Squared = .409)

HO2

Tests of Between-Subjects Effects

Dependent Variable: EXPRINPOST

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	20395.500[a]	2	10197.750	1502.680	.000
Intercept	856.847	1	856.847	126.260	.000
EXPINPT	2996.223	1	2996.223	441.506	.000
GROUP	17441.969	1	17441.969	2570.145	.000
Error	889.015	131	6.786		
Total	647309.000	134			
Corrected Total	21284.515	133			

a. R Squared = .958 (Adjusted R Squared = .958)

HO3

Tests of Between-Subjects Effects

Dependent Variable: POSTAC

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	2101.731[a]	2	1050.866	30.176	.000
Intercept	5383.335	1	5383.335	154.586	.000
PRTAC	2101.501	1	2101.501	60.346	.000
GENDER	15.935	1	15.935	.458	.500
Error	4561.970	131	34.824		
Total	804850.000	134			
Corrected Total	6663.701	133			

a. R Squared = .315 (Adjusted R Squared = .305)

HO4

Tests of Between-Subjects Effects

Dependent Variable: Post-Test Interest

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	1600.009[a]	2	800.005	53.788	.000
Intercept	3485.920	1	3485.920	234.373	.000
PRTINT	1596.503	1	1596.503	107.339	.000
GENDER	.122	1	.122	.008	.928
Error	1948.416	131	14.873		
Total	852371.000	134			
Corrected Total	3548.425	133			

a. R Squared = .451 (Adjusted R Squared = .443)