

Research Article

Effects of Divergence and Convergence Stages of Kolb's Cycles of Experiential Learning on Performance of Electrical Installation Students in Nigerian Tertiary Education Level

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Abstract — This study determined the effects of divergence and convergence stages of Kolb's experiential cycle in Electrical Installation concepts on students' psychomotor performance in three (3) Nigerian Certificate in Education (NCE) (T) awarding tertiary education institutions in North East, Nigeria. Two research questions and two null hypotheses guided the study. Quasi experimental research design specifically the pretest-posttest non-equivalent was adopted for the study. The population of the study comprised of two hundred and twenty six (226) Electrical/Electronic Technology Education (EETE) students and three existing intact classes that comprised of one hundred and thirty four (134) EETE students from the three colleges formed the sample of the study. Two of the classes each were randomly assigned as experimental groups while the other one as the control group respectively. Electrical Installation Psychomotor Achievement Test (EIPAT) was used as instrument for data collection. The instrument was trail tested and the result was used to ascertain the reliability of the instrument whereas the content validity of the EIPAT was determined by three experts in the field EETE. Treatments were given to the experimental groups while the control group received normal instruction respectively for the period of three (3) weeks each. 6-hours practical activities were delivered to the students during 3-weeks laboratory sessions for each group. The experimental group were accordingly taught using the two Kolb's cycle models of experiential learning while the control group using conventional instruction. The EIPAT was administered to students as pretest and posttest for both experimental and control groups prior and after the treatment respectively. Data collected was analyzed using mean and standard deviation to answer the research questions while t-test statistics was used to test the null hypotheses at 0.05 level of significance. The results indicated that experimental groups performed better than control group and the convergence cycle was found more effective compared to the divergence approach. In conclusion the use of Kolb's learning cycle of experiential learning is powerful in the delivery of Electrical Installation concepts. Finally, the study recommends that EETE instructors should adopt the Kolb's learning cycle during practical instructions.

Keywords— Divergence, Convergence, Kolb's Cycle of Experiential Learning, Students' Performance, Electrical Installation, Tertiary Education

1. Introduction

Recently, various scholars have investigated learning styles in various disciplines but learning styles among students especially in Nigeria Institution with particular reference to Colleges of Education (Technical) have not attracted much attention in research as other disciplines. Pre-service tertiary education school teachers' learning styles is a critical research subject matter that determine their ability in solving technology education problem [1]. Technology education has become critical for viable national development in most country in the world particularly the Nigeria context. This has been transforming the life of individuals in different means for numerous years. It is indeed glaring to mention that the

pace of technological change is so rapid in this recent times hastening numerous dares in regular basis. In fact, it has compelled for the need to prepare students at the college level particularly those in the NCE (T) with the essential skills for addressing the fast growing technological demands of the current century [2]. Hence, the electrical electronic technology education programme has the technology possibilities to offer the desirable answers to the present challenges of this era. Indeed, Electrical installation is it as cabling and associated devices such as switches, distribution boards, sockets and light fittings in a structure [3]. Wiring is subject to safety standards for design and installation. Allowable wire and cable types and sizes are specified according to the circuit operating voltage and electric current

capability, with further restrictions on the environmental conditions, such as ambient temperature range, moisture levels, and exposure to sunlight and chemicals.

The basic aim of electrical installation and maintenance in colleges of education is to give training and impart the necessary skills leading to the production of Teachers of Technologist, technicians, and other skilled personnel who will be enterprising and self-reliant [4]. The possibilities of Electrical electronics technology education at the college level in offering the needed sustainability in a developing country particularly Nigeria is resonated in its objectives as enshrined in the national commission of college of education (NCCE) minimum curriculum standard. This stipulations sound very clear for colleges of education offering electrical electronic technology education for its recipients to be equip technologically. Technology education programme is purposely designed to include a multi-disciplinary and multi-dimensional curriculum, which contains various programme in which the learners can acquire various technical skills. One of the subject areas in the electrical electronic technology education is electrical installation work. As stipulated in the National Commission for Colleges of Education [5] minimum standards, the NCE(T) curriculum of electrical installation work is designed in modules which include Domestic Installation, Cable Jointing, Battery Charging and Repairs, Electrical Drawing, Industrial Installation and Electric Motors, Winding of Electrical Machines, Solid State Devices and Circuits. Technical skills consist of function, mode of operation, operational technique, maintenance technique, storage technique, calibration technique, and repairing possible damage using appropriate competency skills. Technical skills are the necessary competency in performing different types of work in corporate/ industry.

However, these objectives are yet accomplished across many of the colleges of Education (Technical). This may be due to insufficient psychomotor attainment of the students in one of the key essentials of the programme (electrical installation work). To secure the appropriate knowledge and practices in electrical installation work for instance, it necessitates the usage of promising instructional techniques and method that can allow student to gain the practical experience. Electrical Installation work aimed at providing to the trainees with the knowledge and skills to enable them carry out all types of industrial/factory electrical installations and maintenance. Furthermore, the general objectives to train graduates include to: Know different types of industrial installations. Understand the installation of different types of ducts and trunking, applying all relevant regulations and safety precautions. Understand the principles of operation of AC and DC machines and their applications. Understand various methods of controlling electrical machines. Know methods of maintaining electrical machines and equipment. Know the installation of all types of electrical machines. Diagnose faults in machines, equipment and installations. Know the installation of MICC cables. While for Winding of Electrical Machines Skills: The modules are aimed at providing the trainees with the knowledge and skills to enable them wind

or rewind AC and DC rotating/static machines up to 10KVA.

Furthermore, the general objectives to produce trainees who should be able to: Understand and apply all statutory regulations during electrical winding work. Identify and select appropriate tools and equipment used for winding jobs. Acquire skills for dismantling machine for rewinding them. Acquire skills for preparation and interpretation of winding drawings. Understand the rewinding of burnt static/rotating machines. Know the skinning/undercutting of armature, commutators and slip rings. Inspect rewound electrical machines and equipment and test for continuity, insulation, correct rotating voltage. Furthermore for Solid-State Devices and Circuits Skills: The module is aimed at making the trainees to understand the basic electronics concepts and apply this information to simple circuit. More so, its general objectives are to produce graduates who shall be able to: Understand the basic principle, characteristics and application of common electronic devices. Understand the principles of construction and operation of power supply and be able to construct simple power supply unit. Know the basic principles of design of electronic circuits.

However, Teachers play an important role to bring about transformation in educational institution. The trained and competent teachers at all levels of school education enrich the institutional capacity. The quality and level of learner achievements are determined mostly by teacher competence, sensitivity, and teacher motivation. An effective teacher education programme is essential for qualitative improvement of overall education system. To make student teachers competent, effective, and efficient it is necessary to have teacher education programme to provide various learning strategies to equip them with both pedagogical skills and subject matter knowledge. Experiential learning is one such strategy in teacher education which provides hands-on experience to put concepts and strategies into practice. Experiential Learning helps the student teachers to develop their professional abilities by reflecting on their efforts to create change within their own classroom and consequences of such actions. Is credited with the development of the Experiential Learning theory [6]. Redressing the practices of experiential learning instruction in school [7] reveals that an experiential learning activities must be well organized and structured correctly in order to strengthen the link between cognitive learning and life skills for the betterment of school-work transition. This could be one of the reasons [8, 9] mentioned that for a successful experiential learning there must be purposes reflecting learners needs, realistic experiential settings that considered the learners, the setting to provide physical and psychological thoughtfulness and challenges. Theses implies that the experiential learning must be determined and controlled by the individual for the purpose of accomplishing learners' growth and development in the context of instructional objectives. Other elements of the experiential learning as they relate instruction in electrical installation are the organized experiential learning activities reveals in the empirical works of [10, 11, 12] which says that the learners are at the central for success of the experiential

learning. The learner fundamental requirements is insight to the instruction preparation for active development of their understanding and to enable them to critically evaluate the message in the instructional context. This a critical ingredient to linking electrical installation theory to practice concepts of instruction.

Experiential Learning refers to making meaning from direct experience. Kolb describes experiential learning as a four part process, where learner is asked to engage themselves in a new experience, actively reflect on that experience, conceptualize that experience, and integrate it with past experiences. Furthermore, they must make decision that can further psychomotor and cognitive levels in electrical installation work that are often associated with the use of tools, equipment related to work as well as all technical matters for self-reliance [13]. Moreover, the Kolb's experiential learning cycle support students to use their manual dexterity to acquire practical skills using tools, equipment, machines, apparatus and instruments [14]. Meanwhile, the four stages of the learning cycle is a simple description of learning cycle that shows how experience is translated through reflection of concepts. In [15] the model interpreted into four stages namely; Feeling –Concrete Experience (CE) known as Pragmatist. Watching – Reflective Observation (RO) known as Reflector. Thinking – Abstract Conceptualization (AC) known as Theorist. Doing – Active Experimentation (AE) known as Activist. In summary, Accommodators understand facts and evidence from concrete experience and process it from active experimentation. Divergence understand facts and evidence through concrete experience and convert it through reflective observation. Assimilators understand evidence from abstract conceptualization and convert it through reflective observation. Convergence understand facts through abstract conceptualization and convert it through active experimentation. The learning styles can therefore serve as a model in evaluating the potential of departmental curriculum to match the learning styles of different students in the department.

Although, many researches were conducted covering the application of Kolb learning cycles in the form of experiential learning model in different fields of studies. In a study [16] demonstrated the Kolb's 4 – stage cycle model of experiential learning in mechanical engineering. Kolb's ideas in this study still allow students and their teachers to placed emphasize on a particular stages of the cycle that matches with their own learning and teaching styles respectively during the empirical process, as long as the teacher take the students through the entire cycle. The one point emphasis adopted yielded a promising results. Hence, a subject of debate in the literature particularly in the fields of science and technology.

Hence, testing the effect of Kolb's leaning cycles of experiential learning is the existing gap yet to be examined particularly in electrical electronic technology education. Therefore, this study proposed to fill in this research gap. Therefore the present study intend to apply Kolb's 4- stage cycle model of experiential learning in electrical installations work in order to see whether it will enable the students' to

acquire the needed skills. Therefore this research work intended to find out the effect of convergence and divergence stage of Kolb's experiential learning cycle on performance of Electrical Installation work students' at the Colleges of Education level in the North East Nigerian region. Furthermore, the paper was structured into sections where the first section formed the introduction that entailed the motivation of the authors, research objectives and hypotheses of the research, section 2 contained the related works in line with relevant literature including the theory that supported the research, section 3 cached the methods and procedures followed in the conduct of the research, section 4 housed the results and discussion of the research presented following the pattern of the objectives and hypotheses in the research and the last section 5 covers the conclusion and further scope of the research.

1.1 Research Objectives

The research focused on the effects of divergence and convergence stages of Kolb's cycles of experiential learning model on the performance of NCE electrical installation students in Nigerian tertiary education level. Specifically, the research determined:

- i) The effects of divergence stage of Kolb's experiential learning cycle on the performance of NCE electrical installation students in Nigerian tertiary education level.
- ii) The effects of convergence stage of Kolb's experiential learning cycle on the performance of NCE electrical installation students in Nigerian tertiary education level.

1.2 Research Questions

Two (2) research questions guided the conduct of this study as follows:

- i) What is the effect of divergent stage of Kolb's experiential learning cycle in electrical installation among Nigerian Certificate in Education (technical) students' performance?
- ii) What is the effect of convergence stage of Kolb's experiential learning cycle in electrical installation among Nigerian Certificate in Education (technical) students' performance?

1.3 Research Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of significance for the purpose of this study as follows:

HO₁: There is no significant differential effect between the students' psychomotor performance in electrical installation concepts that were taught by the divergent stage of Kolb's cycle of experiential learning model and those taught by the conventional method.

HO₂: There is no significant differential effect between the students' psychomotor performance in electrical installation concepts that were taught by the convergent stage of Kolb's cycle of experiential learning model and those taught by the conventional method.

1.3 Kolb's Experiential Learning and Electrical Installation Instructions

The Kolb's learning model is a predominated experiential method in practice across many discipline of human endeavour. The learning model found its root in the innovative work on the basis of learning styles in a cyclical process of learning through four stages of experimental learning named the *Kolb's experiential learning model* [17]. Virtuously described as a theory of leaning which says that human being learn from their experiences as they progress over a given lifecycle of learning, mostly on a regular basis. The theory treats thinking as one of the integral components for a concrete learning to occur. Indeed, a specific author [18] testified that an experiential theory of learning provides complete exemplary of a learning progression in a form of a multi-linear learning model for adult horizon intellectual improvement. According to the proponent of the experiential learning model [17] reported that knowledge upshots from the mixture of clutching of experience and transmuted is connected to the individual learning style. According to the experiential learning model by Kolb, the four different sections to learning are describe as the concrete experience, reflections (thinking), generalizations/principles/theories and testing based on distinct learning styles in which 'immediate or concrete experiences' provide a basis for 'observations and reflections [19]'. The observations and reflections are assimilated and distilled into 'abstract concepts' producing new implications for action which can be 'actively tested' in turn creating new experiences. The Author further explained that ideally (and by inference not always) this process represents a learning cycle or spiral where the learner 'touches all the bases', i.e., a cycle of experiencing, reflecting, thinking, and acting Immediate or concrete experiences lead to observations and reflections [19]. These reflections are then assimilated (absorbed and translated) into abstract concepts with implications for action, which the person can actively test and experiment with, which in turn enable the creation of new experiences. Kolb model therefore works on two levels - a four-stage cycle: Concrete Experience - (CE), Reflective Observation - (RO), Abstract Conceptualization - (AC) and Active Experimentation - (AE), and a four-type definition of learning styles, (each representing the combination of two preferred styles, rather than a two by-two matrix of the four-stage cycle styles), for which Kolb used the terms: Diverging (CE/RO), Assimilating (AC/RO), Converging (AC/AE) and Accommodating (CE/AE) [7].

The Kolb's model is popularly acknowledged amongst the researchers, education managers, teachers and instructors as fundamental concepts towards understanding and explaining human learning behaviour and for helping learners to pursue their learning objectives [20].in deed, this has pave way for the model as one of the predominant experiential instructional model in many fields of human endeavour mainly in science and education to improve learning abilities of students. The experiential learning model founded in the work of Kolb when compared with multiple intelligence learning model founded in the work of Gardner both aim at enhancing the intellectual growth and development of the learner and stimulate intelligence quotient for the better of critical thinking and problem solving [21]. The use of Kolb's experiential learning has becomes populous and useful in

many discipline of human endeavour, hence in electrical installation with attention to student psychomotor performance. More over the multitasking structures in the cycle has make the Kolb's experiential learning cycles to lodge various categories of learning background that were found in a typical electrical installation learning environment. Consequently, the learning model under review is characterized with specialized feature to support students' practical experiences that enhance the connection of theoretical experiences (abstract) to a wider varieties of real-world experiences. Hence, a good part and parcel of modern vocational and technical education. The practical relevance of the Kolb experiential learning for electrical installation instructions has demonstrate a research vacuum worthy for conducting this study.

2. Related Work

Numerous experiential learning cycles that proven it effectiveness in the literature worth resilience for it applications in different fields of human endeavors. As in the case of Kolb's experiential learning cycle it applications has dominant acceptance among researchers in different subject disciplines. It mostly gained acceptances among experimental empirical researchers. Many have been written based on the focus of this study as follows:

An Author [23] conducted a research on the topic "Effect of Kolb's learning cycles of experimental learning on secondary school students' academic performance and interest in the production of vegetable crops in Anambra State, Nigeria. The research was main designed to examine the effect of 4 learning cycles in the Kolb's experiential learning model on students' academic with their learning interest and performance in vegetable crop production school subject. In specific, the study determined the variation between the learning performances of the students after taught the subject by using the Kolb's model of Experiential learning cycle in the experimental group and the control group taught by using traditional method. A pre-test post-test quasi experimental design was employed where the non -equivalent group design was chosen due to the nature of the school setting to avoid disruption. The population for the study was 26,139 Senior Secondary School students of 61. Secondary schools in Awka Education zone of Anambra State. The sample for the study was all the 141 SS1 students from four sampled schools in Awka Education Zone. Purposive sampling was used to select the four schools, two from urban area and two from rural area of the same Awka Education Zone. Forty multiple choice items on vegetable crops (tomatoes, and fluted pumpkin, called vegetable crop production performance test (VCPPT) and 25 items of practical Agricultural interest inventory 16 were used as instruments for the study. Two lesson plans were developed for teaching crop production. They were validated by five experts.

The VCPPT items were developed based on the table of specification that covers seven levels of Simpson taxonomy of instructional objectives It was trial tested to determine its reliability coefficient, which was found to be 0.88 using

Kuder-Richardson formular K-R 20, and was found to be 0.82 using Cronbach alpha coefficient. Data collected were analyzed using the mean to answer all the research questions. Analysis of Covariance (ANCOVA) was used to test all the hypotheses 1, 3, 5, 6 and 7, t-test was used to test hypotheses 2 and analyses of variance was use for testing the hypothesis 4. The test of the hypotheses at 0.05 aloha values revealed that Kolb's learning cycle was effective toward improving the students' academic performance, helped in enhancing their learning ability and aroused the interest of secondary school student in learning practical Agriculture specifically vegetable crop production subject. It was established also that school location had moderating effect on the students' academic performance of during the experiment with the Kolb's learning cycle of experiential learning. In line these findings, the study recommended among others that curriculum planners in the State should embrace the Kolb's model of learning style in teaching agricultural vegetable crop production. This is due to its nature for supporting the teaching and learning in an activity-based mode. Considering the nature of the model for being so innovative. It also necessitate for the training and re-training of teachers so that to find its application in the context of secondary schools agricultural related subjects. Furthermore, the study also recommended that schools offering Agriculture in respective of being urban or rural should teach their students with a large piece of land for practical agriculture as aid using the 4 experiential learning cycles founded by Kolb., this is to help in arousing student interest in learning of practical vegetable crop production among the school localities for the betterment of students' field work learning experiences.

This study is related to the present study because both studies focus effect of Kolb's 4 - stage cycle model of experiential learning on students' performance and interest in vegetable crops production in senior secondary schools in Anambra state, Nigeria. The two studies differ in the sense that it was concerned on the Kolb's experiential learning cycle was very effective learning strategy that facilitated students' academic performance and their experiential learning interest in practical vegetable crop production..

A study [24] investigated the availability and utilization of electrical installation and maintenance works programme of technical colleges in the north - east geo-political Zone of Nigeria. Two purposes of study were examined. Two research questions were answered and two hypotheses were tested. The population of the study was 808, made up of 24 principals, 58 teachers, 18 workshop attendants and 708 students. The study chose 40% of the population as the sample for the study, which stood at 398, made up of 10 principals, 26 teachers, 10 workshop attendants and 352 students. A structured questionnaire collected data from respondents. It was validated by five experts. A trial test using the test re-test method established the coefficient of stability of the instrument which stood at 0.94. After the administration of the instrument, 440 valid copies were obtained, made up of 10 principals, 22 teachers, 10 workshop attendants and 308 final year students. Analysis of the results was carried out on the valid copies of the instrument. Mean and standard deviation

were used to answer the research questions. The analysis of variance was used to test the hypothesis at 0.05 level of significance

Findings of the study showed that equipment tools and measuring instruments were moderately available. They included conduit bending machine, battery charger, direct-on-line starter, Allen keys, A.C. meters, rheostat, installation varnish and capacitors. Consumable materials were highly available. They included ceiling roses, cables wiring nails and resistors. Students' level of utilization of equipment, tools and consumable materials during practical lessons was of moderate performance. Student's level of utilization of measuring instruments during practical lessons was low in 12 out of 15 measuring instruments. On the whole, students' level of utilization of measuring instruments during practical lessons was of low performance. A significant difference did not exist, at the chosen probability level, in the mean responses of principals, teachers and workshop attendants on the extent to which facilities for the electrical installation and maintenance works programme were available. At a 0. 05 level of significance, there was no significant difference in the mean responses of teachers, workshop attendants and students on the level of utilization of consumable materials by students during practical lessons. The study suggested among others an improvement in facilities supply and an increase in students' practical activities for enhanced performance.

This study is related to the present study because both studies focus on the availability and utilization of electrical installation and maintenance works programme of technical colleges in the north-east geo-political Zone of Nigeria. The work differs in the sense that it was conducted in technical colleges of north east but not on colleges of education.

A study conducted by [25] developed a computer-aided instruction for effective teaching of electrical and electronic devices at Nigeria certificate in education technical level in north eastern Nigeria. The purpose of this study was to develop a Computer-Aided Instruction (CAI) for teaching electrical and electronic devices at N.C.E. level in North Eastern Nigeria. A flowchart for the CAI was developed by describing the steps in words and representing them by symbols. Connections between events were represented by lines with arrowheads to show the direction or order in which they occur. The CAI was developed and written in visual basic. Net (VB, NET) targeting the Net frame work 35. The user interface was developed using Windows Presentation Foundation (WPF). Procedural programming was used and the CAI was tested by using it to teach an experimental group (S1), while control group (S2) was taught using lecture method.

The results obtained from the two groups were then compared. Two research questions and one null hypothesis guided the study. A population of 268 students was used. A total of 80 students formed the sample for the study. A purposive sampling technique was used. A researcher-made achievement test (RMAT) was used as instrument for data collection. The instrument was validated by five experts and

pilot tested outside the study area in order to establish its reliability. Reliability coefficient of 0.92 was obtained for the RMAT. The mean was used to answer research question two. Z-test was employed to test the null hypothesis at 0.05 level of significance statistical package for social sciences (SPSS) version 17 was used for the data analysis. Results of the study revealed that there was variation between the mean scores of students taught electrical and electronic devices at N.C.E. II level using CAI and students taught using lecture method.

The null hypothesis was rejected, indicating that there was a significant difference between the mean achievement of students taught electrical and electronic devices at N.C.E. II level using CAI and student's taught electrical and electronic devices at N.C.E. II level using lecture method. Students taught using CAI performed better than the students taught using lecture method. The CAI was found to be effective in teaching electrical and electronic devices at N.C.E. II level. It was recommended. That lecturers of electrical and electronics technology at N.C.E. level be encouraged to use CAI in teaching N.C.E. II electrical and electronic devices. This study is related to the present study because both studies focus on development of a computer-aided instruction for effective teaching of electrical and electronic devices at Nigeria certificate in education technical level in north eastern Nigeria. The two studies differ in the sense that it was concerned with the variation between the mean scores of students taught Electrical and Electronic Devices at N.C.E. II level using CAI and students taught using lecture method.

A study [26] evaluated students' learning style preferences among planning students in Nigeria. This is to probe whether the students meet the objectives of the department in achieving overall university philosophy. Methods/ Statistical Analysis: Kolb's Learning Style Inventory (KLSI) as effective tool in understanding students' learning styles was used to assess students' learning style. Questionnaire administered among 110, 72 and 84 students of planning department in 200, 300 and 500 levels respectively totaled 266 students. Questionnaire was designed through a discrete scoring system, recognized and grouped students into four discrete groups related with different disciplines of knowledge. The descriptive statistics and correlation were employed for the analysis. Findings: The study tried to validate the university general admission procedure and departmental curriculum. Applications/Improvements: Suggestions were made to improve university admission procedure for planning students.

This study is related to the present study because both studies focus on learning style for effective teaching of electrical installation at Nigeria certificate in education technical level in north eastern Nigeria. The two studies differ in the sense that it was concerned with the Students' Learning Style using Kolb's Learning Style Inventory in electrical electronic while is on the effect on Divergence and Convergence Models of Kolb's Learning Cycle on Students' Performance in Electrical Installation variation between the mean scores of students taught Electrical and Electronic Devices at NCE. II level.

3. Research Methodology

The study employed the quasi experimental research design. Specifically, the pre-test post-test non-equivalent control group quasi experimental was the design. The design is symbolically demonstrated in table 1 below:

Table 1. Quasi Experimental - Pre-Test Post-Test Non-Equivalent Control Group Design

G _{E1}	Y11	X1	Y12
G _{E2}	Y21	X2	Y22
G _C	Y31		Y32

G_{E1}: Experimental group 1 (Divergence Experiential Learning Stage Group)

G_{E2}: Experimental group 1 (Convergence Experiential Learning Stage Group)

G_C: Control group 1 (Conventional Experiential Learning Group) - Non randomization.

Y11, Y21 and Y31, are the first measures of the dependent variable known as pre-test results. The X1 and X2 in the initial line of Figure shows that the experimental group G_{E1} and G_{E2} has been subjected to the treatments variable respectively. The fact that X is missing from the third middle row indicates that the control group G_C received no treatment. The post-test results for the two experimental groups G_{E1} and G_{E2} (Y12 and Y22) and that of the control group G_C (Y32). The three groups in the study were named as Divergence Experiential Learning Group and Convergence Experiential Learning Group for the two experimental groups respectively while and the control group received instruction using Conventional Experiential Learning Group. The quasi-experimental design - pre-test, post-test, non-equivalent, non-randomized control group research design allowed the researchers to collect proper and pertinent information that provided important, impartial answers to the study questions which enable effective testing of the three hypotheses [27]. In another related development [28] refers to the adopted research design as experimental technique to be applied without random allocation of students into groups. These was because the researcher would try to avoid interference in the normal class setting prearranged by the authorities of school. The Pre-test conducted was applied to both the experimental and control groups in the study in order to ascertain their entrance behaviours before conducting any treatment to the groups respectively. In addition, the control group received instruction on concepts of electrical work by the use of traditional experiential learning method while for the experimental group was taught the same concepts of electrical work by using the divergence and convergence of Kolb's experiential learning style. Moreover, the mean psychomotor performance of the two group were marked, recorded and analyzed for the purpose of this experimental study.

The study was conducted in the North East, Nigeria; which is located in the Northern part of Nigeria. The area consists of six states that comprises of Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe. It has six National Certificate in Education (NCE) awarding institutions that offered NCE Electrical Electronics Technology Education (EETE). With

the population of 266 NCE III students of Colleges of Education (COE) and Federal College of Education (FCE) (technical) offering electrical electronics technology education and these are COE Hong, Adamawa State, ATAP Bauchi, Aminu Saleh COE Azare, Bauchi State, FCE (T) Gombe, Gombe State, COE Zing, Taraba State and FCE (T) Potiskum, Yobe State. The breakdown of the population is summarized in table 3.

Table 3: Population distribution of the Study

S/N	Name of Institutions	Total Number of Students
1.	COE Hong, Adamawa State	44
2.	ATAP Bauchi, Bauchi State	47
3.	F C E (T) Gombe, Gombe State	45
4.	F C E (T) Potiskum, Yobe State	41
5.	COE Zing, Taraba State	45
6.	Aminu Saleh COE Azare,	44
Total		266

Source: Field Study (2017)

The study used four existing intact classes from the six selected Colleges of Education (Technical). All N.C.E. III levels with the total of 222 students that are specialize in Electrical/Electronic Technology Education. The sample size is in conformity with the parlance of [28] who said “the lively and interesting lesson should hold in a class of less than or equal to fifty (50) students in sixty (60) minutes per single lesson in order to ensure effective teaching and learning. This shows that the class size for the five colleges of education are moderately good for effective teaching and learning.

Table 4: Sample Distribution of the Study

S/N	Name of Institutions	Total Number of Students
1.	COE Hong, Adamawa State	44
2.	ATAP Bauchi, Bauchi State	47
5.	COE Zing, Taraba State	45
Total		136

Source: Field Study (2017).

Electrical Installation Psychomotor Achievement Test (EIPAT) was used for data collection. The instrument was fashioned based on the adopted two stage of Kolb’s–cycle model. The first part is formulated based on divergence stage which consist of ten multiple choice items, the second is convergence stage which also consist of ten multiple choice items respectively. The creation of a good test is not a matter of chance but the product of the thoughtful and sound application of established principles of test construction." Although there are many different types of testing items available in use for assessing learning but the Multiple-choice questions (MCQs) was the universal and the predominantly used. It was stated that there is little or no advantages of answering essay type questions over MCQs [29, 30, 31]. Multiple-choice questions are widely used for end of course summative and standardized tests. They can also be used to diagnose learning gaps through formative assessments, and as an analysis to identify student thinking - why certain answers were selected [32]. The test items were adapted from Sanfoundry questions and answers bank on electrical installation text book by [33] and make some few changes in the positioning of the items, the researcher was aided by four

research assistants who were electrical electronics technology instructors in the colleges.

The instrument (EIPAT) was validated by three experts, pilot testing of the research instrument was carried out in a different College outside the study area but possess similar characteristic with those in main study. The two experimental groups meet twice a week for a period of three hours for each lesson The experimental group was taught using the two Kolb’s – stages of experiential learning as treatment. On the other hand, the control group was taught by using the conventional experiential learning. The topics were selected based on the current (5) approved curriculum for N.C.E. III students, the topics primarily focused on psychomotor leaning aspect. The data collected were analyzed using descriptive statistic (Mean and Standard Deviation) in order to answer the research questions. This was because mean and standard deviations has the greatest reliability than any other measures of central tendencies and the mean was used to interpret the performance [34]. The null hypotheses one - two were tested using paired sample t-test.

4. Results and Discussion

The results and discussion of this research paper were presented independently as follows:

4.1 Analysis of Results

The results of this study were presented on the basis of the analyses of the data collected in line with the aforementioned null hypotheses as follows:

Research Question One: What is the effect of divergent stage of Kolb’s experiential learning cycle in electrical installation among Nigerian Certificate in Education (technical) students’ performance?

Table 5: Effect of divergent stage of Kolb’s model of Experiential Learning in Electrical Installation concepts among NCE (T) students’ performance

Group	N	Post-test M	SD	Mean Diff	Partial Eta Sqr	Remark
Divergent Stage	44	14.16	2.85	1.24	0.196 (19.6%)	Small Effect
Control group	47	12.94	2.36			

Source: Experimental (2019)

Hint: N = Number of Students, M = Mean, S.D. = Standard Deviation

Table 5 above shows the effect of divergent stage of Kolb’s 4 – stage cycle model of experiential learning in electrical installation among Nigerian Certificate in Education (technical) students’ performance. The result from the data collected indicated the divergent stage with a total number of 44 students has a post-test mean score of 14.16 and a standard deviation of 2.85 while the control group with a total number of 47 students has a post-test mean score of 12.94 and a standard deviation of 2.36. The mean difference at the post-test for both treatment group and the control group is 2.36.

The result obtained further shows a small effect size from the partial eta squared of 0.196, signifying a 19.6% variance of the dependent variable (students' performance in electrical installation) as a result of the independent variable (divergent stage).

Research Question Two:

What is the effect of convergence stage of Kolb's experiential learning cycle in electrical installation among Nigerian Certificate in Education (technical) students' performance?

Table 6: Effect of convergence stage of Kolb's model of Experiential Learning in Electrical Installation concepts among NCE (T) students' performance

Group	N	Post-test M	S.D	Mean Diff	Partial Eta Sqr.	Remark
Convergent Stage	45	14.89	2.59	1.95	0.227	Small Effect
Control group	47	12.94	2.36		(22.7%)	

Source: Experimental (2019)

Hint: N = Number of Students, M = Mean, S.D. = Standard Deviation

Table 6 above shows the effect of convergent stage of Kolb's 4 – stage cycle model of experiential learning in electrical installation among Nigerian Certificate in Education (technical) students' performance. The result from the data collected indicated the convergent stage with a total number of 45 students has a post-test mean score of 14.89 and a standard deviation of 2.59 while the control group with a total number of 47 students has a post-test mean score of 12.94 and a standard deviation of 2.36. The mean difference at the post-test for both convergent stage and the control group is 1.95. The result further shows a small effect size from the Partial Eta Squared of 0.227, signifying a 22.7% variance of the dependent variable (students' performance in electrical installation) as a result of the independent variable (convergent stage).

Hypothesis One:

H₀₁: There is no significant differential effect between the students' psychomotor performance in electrical installation concepts that were taught by the divergent stage of Kolb's cycle of experiential learning model and those taught by the conventional method.

Table 7: Results of significant differential effects between the students' psychomotor performance in Electrical installation concepts taught by divergent stage of Kolb's learning model and those taught by the conventional method

Groups	N	Mean	S.D.	T	Df	A	P	Decision
Experimental	44	14.16	2.85	7.01	84	.05	0.01	H ₀₂ Rejected
Control	47	12.96	2.36					

Source: Field Experiment (2019)

Hint: N –Number of Students, S.D. –Standard Deviation, df – Degree of Freedom, α – Alpha value, t – t-test value, P- value

Table 7 shows the independent sample t-test that was conducted to compare the post-test mean score of students' taught using divergent stage of Kolb's cycle of experiential learning model and those taught by the traditional method.

The result from the table shows the mean score and Standard Deviation of the Experimental Group (mean = 14.16 and S.D. = 2.85) and the Control Group (mean = 12.96 and S.D. = 2.36) respectively. The P value (84) is 0.01at t-test of 7.01. The P value is less than the alpha value of 0.05 that is P < 0.05. The null hypothesis which states that there is no significant effect between the students' performance in electrical installation that were taught using divergent stage of Kolb's 4 – stage cycle model of experiential learning and those taught using conventional method is rejected. This implies that there is a significant effect between the performance in electrical installation that were taught using divergent stage of Kolb's cycle of experiential learning model compare to those taught using conventional method.

Hypothesis Two:

H₀₁: There is no significant differential effect between the students' psychomotor performance in electrical installation concepts that were taught by the convergent stage of Kolb's cycle of experiential learning model and those taught by the conventional method.

Table 8: Results of significant differential effects between the students' psychomotor performance in Electrical installation concepts taught by convergent stage of Kolb's learning model and those taught by the conventional method

Groups	N	Mean	S.D.	T	Df	A	P	Decision
Experimental	45	14.89	2.59	10.31	84	.05	0.00	H ₀₂ Rejected
Control	47	12.96	2.36					

Source: Field Experiment (2019)

Hint: N –Number of Students, S.D. –Standard Deviation, df – Degree of Freedom, α – Alpha value, t – t-test value, P- value

Table 8 shows the independent sample t-test that was conducted to compare the post-test mean score of students taught using convergent stage of Kolb's cycle of experiential learning model and those taught by the traditional method. The result from the table shows the mean score and Standard Deviation of the Experimental Group (mean = 14.89 and S.D. = 2.59) and the Control Group (mean = 12.96 and S.D. = 2.36) respectively. The P value (84) is 0.00 at t-test of 10.31. The P value is less than the alpha value of 0.05 that is P < 0.05. The null hypothesis which states that there is no significant effect between the students' performance in electrical installation that were taught using convergent stage of Kolb's 4 – stage cycle model of experiential learning and those taught using conventional method is rejected. This implies that there is a significant effect between the performance in electrical installation students' that were taught using convergent stage of Kolb's cycle of experiential learning model compare to those taught by the traditional method.

5. Discussion of Findings

The finding of this research shown that the divergent stage of Kolb's cycle of experiential learning model has a small effect in electrical installation among Nigerian Certificate in Education (technical) students' performance over the control group. This finding was affirmed by the result obtained from the analysis where the experiment has a post-test mean and

standard deviation of 14.16 and 2.85 while the control with a mean and standard deviation of 12.94 and 2.36 and finally the partial eta squared signifies the extent of the effect between the experiment and the control with only 19.6%. The finding of this study is supported by the view of [8] whose quantitative analysis showed significant enhancement of the learning outcomes of the experimental group compared with the control group. Although this study has small effect but it can be accepted they both displayed positive relationship between the variables. This finding is also in agreement with by [10] in her paper on the effect of Kolb's cycles of experiential learning model on students' academic performance revealed that the Kolb's cycles of experiential learning model was magnanimously effective in enhancing students' academic performance and also very useful in addressing students leaning interest positively in arousing their curiosity in secondary school vegetable crop agriculture practical. Similarly, in this study it was established that the divergent stage of Kolb's cycles of experiential learning model was promisingly effective during the electrical installation instruction among Nigerian Certificate in Education (technical) students' better than their counterpart that received experiential instruction using the conventional approach.

However, the test of the hypothesis, a p-value of 0.01 was observed that less than the significant value of 0.05 ($P < 0.05$). Hence, the null hypothesis which stated that there is no significant effect between the students' performance in electrical installation that were taught using divergent stage of Kolb's cycle of experiential learning model compare to those taught using conventional method is rejected and the alternate hypothesis which stated that there is a significant effect between the students' performance in electrical installation that were taught using divergent stage of Kolb's cycle of experiential learning model compare to those taught using conventional method.

The finding of this research shows that, the convergent stage of Kolb's cycle of experiential learning model has a significant effect in electrical installation among Nigerian Certificate in Education (technical) students' performance over the control group. This finding was affirmed by the result obtained from the analysis where the experiment has a post-test mean and standard deviation of 14.89 and 2.59 while the control with a mean and standard deviation of 12.94 and 2.36 and finally the partial eta squared signifies the extent of the effect between the experimental and the control with 22.7%. The finding of this study here is also in agreement with the view of [11] studied on 'Effect of Kolb's cycle of experiential learning model on students' academic performance'. The study established that the Kolb's cycles of experiential learning model happen to be an effective strategy in improving students' academic performance that enhanced the students' ability and also very megamenus in arousing students' leaning interest in vegetable crop Agriculture practical instruction at the secondary school level. it also proves in this study that the convergent stage of Kolb's cycle of experiential learning model has a small effect in electrical installation among Nigerian Certificate of Education

(technical) students' performance over the control group (the convention method).

The p-value in the t-test table value of 0.00 was below the significant value of 0.05. That is $P < 0.05$. Hence, the null hypothesis which stated that there is no significant effect between the students' performance in electrical installation that were taught using convergent stage of Kolb's cycles of experiential learning model compare to those taught using conventional method is rejected and the alternate hypothesis which stated that there is a significant effect between the students' performance in electrical installation that were taught using convergent stage of Kolb's cycle of experiential learning model compare to those taught using conventional method.

6. Conclusion and Future Scope

The application of the Kolb's cycles of experiential learning model as an instructional method of teaching practical in the Electrical Installation course was effective because Kolb's 4 – stages cycles of learning produced a significant effect on students' performance. The study also showed the converging and accommodator stages were more effective than the other two stages the approach keeps the teacher off stage and actively involved learners in lessons. The study also showed a new method of teaching students for getting higher performance in practical courses by using converging stage and accommodator stage of Kolb's cycle model of experiential learning in electrical installation engineering.

Teacher education programs should integrate the Kolb's Experiential Learning Model into the curriculum to build an awareness of various learning styles. Earnest efforts are required by the teacher educator in training student teachers in practice in teaching session and to apply this in their regular teaching. The findings of this study have a wide range of educational implications. The study revealed that the use of Kolb's Experiential Learning model is effective in enhancing the pedagogical skills of pre-service teachers. Kolb's Experiential Learning Model helped the student teachers process the experience in a better manner by reflecting upon it and thereby to develop their professional abilities. Hence, Kolb's Learning Model is useful in encouraging student teachers personal involvement in their learning activities to acquire necessary skills and knowledge required for better performance. Kolb's learning model is essential in creating a good learning environment in a manner that student teachers interest to learn more is sustained and developed effectively. Hence, the findings of the study have following implications to different levels of education.

Teacher education programs should integrate the Kolb's Experiential Learning Model into the curriculum to build an awareness of various learning styles. Earnest efforts are required by the teacher educator in training student teachers in practice in teaching session and to apply this in their regular teaching. The use of Kolb's experiential model is effective for all levels of education including all the subjects. Hence in service teachers of all levels need to be trained to .Experiential learning has been used in a variety of ways in

levels of education and it has played a strong role towards bringing work experience and ways of learning classroom settings. Kolb's Learning Model could be used by teachers to develop appropriate learning opportunities for students. It is beneficial for the teachers to become reflective teachers and enhances their skills and methods of teaching. Thus Kolb's Experiential Learning strategies help both teachers and learners to understand their areas strengths and weaknesses by giving them the opportunity to reflect upon the experiences and become more capable and proficient in their respective task towards bringing work experience and ways of learning classroom settings. Kolb's Learning Model could be used by teachers to develop appropriate learning opportunities for students. It is beneficial for the teachers to become reflective teachers and enhances their skills and methods of teaching. Thus Kolb's Experiential Learning strategies help both teachers and learners to understand their areas strengths and weaknesses by giving them the opportunity to reflect upon the experiences and become more capable and in their respective tasks.

Hence, the study recommended that Management of Federal Colleges of Education (Technical) should encourage Electrical Installation teachers to employ the Kolb's 4- stage cycle model of experiential learning in teaching practical in order to improve the student's performance more especially using Converging stage in teaching students practical courses. National Commission for Colleges of Education should organize workshop/seminar to Colleges Education (Technical) Teachers particularly Electrical Installation teachers on the effectiveness of Kolb's cycle of experiential learning model in teaching practical subjects in order to enhance the performance of student's in Electrical Installation. Federal Colleges of Education (Technical) teachers should learn how to develop lesson using the Kolb's cycle of experiential learning model especially for practical topics because Kolb's ideas still allow us, as teachers, to particularly emphasize on Converging and stages of the cycle which are more of psychomotor domains which also fit with our own learning and teaching styles, as long as we take our student's through the entire cycle in order to enhance students' performance.

Conflict of Interest

The Author concluded that the research paper be published in the IJSRMS of ISROSET Journals on the basis of their strong agreement as no conflict of interest will be stemmed in later time.

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Authors' Contributions

All the Authors partake in the research in many ways. The first Author performed the task of principal investigator that conceptualized the idea by founding the research variable and setting the experimental procedures. The second Author laid

down the proposal by performing the experiment with research assistant employed from the institutions where data was collected. The third Author also assisted during the data collection and performed the statistical works and interpretation of the analyses.

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