EFFECTS OF PRACTICE-BASED INQUIRY CYCLE ON THE PERFORMANCE OF COLLEGES OF EDUCATION (TECHNICAL) AND POLYTECHNICS STUDENTS IN BUILDING TECHNOLOGY IN NIGERIA

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DECLARATION

I hereby declare that the work in the dissertation entitled,**"Effects of Practice-Based Inquiry Cycle on the Performance of Colleges of Education (Technical) and Polytechnics Students in Building Technology in Nigeria"**has been carried out by me in the Department of Educational Foundations and Curriculum, Faculty of Education, Ahmadu Bello University, Zaria.The information derived from the literature has been duly acknowledged in the text and a list of references provided. No part of this dissertation was previously presented for another degree or diploma at this or any other institution.

_____ _____

Bashir Abubakar SABO Date

CERTIFICATION

This dissertation entitled "EFFECTS OF PRACTICE-BASED INQUIRY CYCLE ON THE PERFORMANCE OF COLLEGES OF EDUCATION (TECHNICAL) AND POLYTECHNICS STUDENTS IN BUILDING TECHNOLOGY IN NIGERIA"by BASHIR ABUBAKAR SABO meets the regulations governing the award of the degree of Doctor of Philosophy (Curriculum and Instruction) of Ahmadu Bello University and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

This research work is dedicated to my late father Alhaji Sabo MaigoroLafiya, who died on 1st of April 2003, for his foresight, support, mentorship and encouragement towards acquiring knowledge in life.

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ABSTRACT

This study investigated the "Effects of Practice-Based Inquiry Cycle on the Performance of Colleges of Education (Technical) and Polytechnics Students in Building Technology in Nigeria**"** Specifically the study; determined the effect of PBI Cycle on the general performance of Building Technology Students; ascertained the effect of PBI Cycle on Performance of the students in Building Technology Concepts; examined the effect of PBI Cycle on Building Technology Students in affective task performance in Building Technology; found out the effect of PBI Cycle on Building Technology Student in Hands-on task performance in Building Technology and compared the effects of PBI Cycle on Performance of Building Technology Students between Colleges of Education and Polytechnics in Nigeria. Five research questions and five null hypotheses were developed; literatures on learner-centered principles which are synonymous with the PBI were reviewed. Quasi experimental design with pre-test, post-test and control groups was used. The population consisted of 645 NCE II Technical students in the 2014/2015 academic session from the four purposefully selected institutions. Intact class sizes were used as the samples that received the treatment. One hundred and twenty (120) subjects were purposely selected based on full participation during treatments, thirty subjects each from the institutions. This number is adequate for analysis in an experimental research. The instrument used for data collection was Practice-Based Inquiry Student Test (PBIST) which contained 70 adapted NABTEB items in building technology, which measured performance in building technology concepts, affective task performance in building technology and hands-on task performance skills in building technology. The PBIST was validated by experts, trial tested and subjected to reliability test using PPMC and a value of 0.84 was obtained as the reliability index. Collated results were analysed using descriptive statistics, the five null hypotheses were tested using independent sample t-test at 0.05 level of significance. Hypotheses one, two, three and four were rejected because, all the p-values were less than the Alpha values , while hypothesis five was retained because the p-value was higher than the Alpha value at 95% confidence level. The findings revealed significant effect of the PBI on the performance of students in building technology concepts, affective performance tasks and hands-on task performance amongst others. The study recommended a paradigm shift to learner-centered instructions in the institutions, the injection of the PBI in teaching building technology and suggested the replication of the study in the complementary trade's subjects of the NCE (Technical) programme in Nigeria, and by implication NCCE and NBTE could use the finding during periodic curriculum reviews.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

FCE: Federal College of Education

FME: Federal Ministry of Education

MDGS: Millennium Development Goals

NBTE: National Board for Technical Education

NCCE: National Commission for Colleges of Education

NCE: Nigerian Certificate in Education

NERDC: Nigerian Educational Research Development Council

PBI: Practice-based Inquiry

PBIST: Practice-based Inquiry Student Test

UNDP: United Nations Development Programme

UNESCO: United Nations Educational Scientific and Cultural Organization

OPERATIONAL DEFINITION OF TERMS

1. NCE (Technical); The Minimum Professional Technical Teacher Qualification in Nigeria, which comprised of five trades; Automobile, Building, Electrical/Electronics, Metal and Wood Work Technology all Integrated into a Single Instructional Package, run in Colleges of Education (Technical) and some Polytechniques in Nigeria.

2. Basic Technology; A Compulsory Pre-vocational Subject offered at the Junior Secondary Schools in Nigeria which replaced Introductory Technology.

3. Minimum Standards; Curriculum document used for all NCE programmes in Nigeria, developed and periodically reviewed by the NCCE.

4. Pre-service technical teachers; Students presently offering the NCE (Technical) Programme in Colleges of Education and Polytechnics in Nigeria.

5. In-Service technical teachers; Graduates of NCE (Technical) presently teaching basic technology in junior secondary schools in Nigeria.

6. Skills; Ability to demonstrate habit of acting, thinking or behaving in a specific activity which has become natural to the individual through repetition or practice.

7. PBI cycle; A learner centered product of action research based, on realistic planning and documentation for change and improvement, where new ideas are implemented or identified problem in the teaching learning process are addressed.

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

The advancement in science and technology in most societies as well as their development paradigm lies in the quality of their technology education programme and technical dexterity of the teachers. Apart from imparting theoretical knowledge, values and norms of the society, the technical teacher has the additional responsibility of training students in relevant skills to prepare the citizens to be useful and functional members of the society. All attempts made by man to conquer his environment for sustenance were technological in nature, and the transmission of such values to coming generations became the basisfor vocational and technical education in different civilizations in the world.

The introduction of Vocational and Technical subjects into formal schools in Nigeria started in about 1842 when the Church Missionary Society(CMS) introduced subjects like Agriculture, Carpentry and Block laying in their schools. Another major stride before independence towards Vocational and Technical Education was the outcome of the Elliot Commission in 1943 which recommended the conversion of Yaba High College to a Technical institution in 1945 and the establishment of similar ones in Kaduna and Enugu.

After independence the educational system operating in the country was predominantly grammar school based which served the purpose of educational advancement and the provision of human resource for office work. But it did not address the technical requirements which could enhance technological growth in the country. The wind of change in the educational sector started with the curriculum conference of 1969 followed with the curriculum seminar of experts in 1973, the outcome of which gave gave birth to the National Policy on Education in 1977 and consequently the 6-3-3-4 system of education in Nigeria which was launched in 1982. The system came with a lot of pre-

vocational and technical packages aimed at facilitating technological growth from the grass root. Afterward reviews and renewals in the educational sector continued at different levels. However the 5th edition of the National Policy on Education (2009) revised, outlined the specific goals of technology education offered in Polytechnics and Colleges of Education (Technical) as tertiary levels to include: to provide courses of instruction and training in engineering, other technologies, applied science, business and management leading to the production of trained manpower; to provide the technical knowledge and skills necessary for agricultural, industrial, commercial and economic development of Nigeria; to give training and impart the necessary skills for the production of technicians, technologists and other skilled personnel who shall be enterprising and self-reliant, to train people who can apply scientific knowledge to solve environmental problems for the convenience of man and to give exposure on professional studies in the technologies (NPC, 2009,pg 44).

The 6-3-3-4 system was welcomed with loud ovations, but it came with twin problems of lack of adequate Technical Teachers that will teach Introductory Technology (Basic Technology) at the Junior Secondary School (Lower Basic) level, and the absence of both workshop buildings and facilities in most of the targeted schools across the country. In response, the Federal Government introduced the Technical Teachers Programme TTP both within and outside the country, National Technical Teachers Colleges(NTTC) Akoka and Gombe were converted to Federal Colleges of Education (Technical), new Colleges of Education (Technical) were established through decree 48 of 1987 at Asaba, Bichi, Gusau, Potiskum, Omoku and Umunze. Polytechnics were equally encouraged to float the NCE (Technical) programme. These colleges and polytechnics are supposed to train technical teachers at the NCE (Technical) level that will teach Introductory Technology (Basic Technology). In addition, workshops were constructed in

Junior Secondary Schools across the country, machines, equipment and tools were imported for use in the schools. All these were efforts made to address the problems that came with the then, new educational system and to facilitate our technological growth. The pre-service technical teachers trained in the colleges and polytechnics, needs adequate pedagogical and technical skills integrated into an instructional sequence, to effectively teach basic technology. These skills include the cognitive,affective and psychomotor skills required to efficiently and effectively teach the curriculum content.

The establishment of National Commission for Colleges of Education (NCCE) in 1989 came with the mandate to control all pedagogical trainings at the NCE level in the country, the commission developed and periodically reviewed the Minimum Standards (curriculum)in 1990, 1996, 2002, 2008 and 2012 but, the outcome left much to be desired in technical skill development of the NCE (Technical) students. The pre-service teachers therefore, graduate without the required technical skills to teach the basic technology subject in the lower education level in the country as found by Aina, (2008), Atsumbe, Raymond, Idris&Mele(2012). The need for technical proficiency of pre-service technical teachers inspired this study on; Effects of the Practice-Based Inquiry Cycle on the Performanceof Students in Building Technology offering the NCE(Technical) programme in Nigeria, as a frantic search foran alternative method of instruction that will improve the acquisition of technical skills in building technology in the NCE(Technical) programme.The practice based inquiry cycle is an innovative learner-centered strategy, which allows for proper planning, evaluation and re-implementation in instruction. It was used and found effective in the State Education Sector Project (SESP) of Kano as an innovative teaching methodology at the lower basic level. This strategy was up-scaled and explored in the teaching of building technology component of the NCE (Technical) programme in Nigeria.

1.2 Statement of the Problem

Both the philosophy of the NCCE Minimum Standards (curriculum), (1990-2012) on the NCE (Technical) programme and the National Policy on Education (2009) revised, stated the need for adequate skills to teach technical subjects by the pre-service technical teachers. The curriculum document further provides that, the NCE (Technical) programme is taught through lectures and practical for the technical courses. Presently the volume of the curriculum contents of the five trade subjects; automobile, building, electrical/electronics, metal work and wood work technology that made up the NCE (Technical) programme, the contact hours provided and the methods used presently in teaching building technology, (lecture methods) left much to be desired. Consequently, most of the graduates are not able to efficiently and effectively teach basic technology in Junior Secondary Schools in Nigeria, which requires cognitive, affective and hands-on skills. (Aina, 2008) and (Atsumbe et al, 2012). This has also created gap between the practical proficiency of the NCE (Technical) graduates in the instructional process and the expectations of technological progress and development of Nigeria.

The above scenario made this study to up-scaled and ascertained the effects of the practice-based inquiry cycle in teaching building technology on the performance of pre-service NCE technical teachers. The PBI was adapted and used in exposing students to technical skills in the NCE (Technical) programme as an alternative instructional method, which enhanced the acquisition of technical skills and consequently the standard of the NCE (Technical) programme in Nigeria.

The PBI is a learner based method that was used and found effective, at lower basic level in Kano. In addition, the PBI is a Hands-on method, it promotes cooperative-learning, facilitates problem-solving, eases conceptual understanding, improves critical thinking skills of students and have measurable learning outcomes. The method wasused

in the study to teach the Building Technology component ofthe NCE (Technical) programme in Nigeria, hoping that it will be an alternative instructional method that could enhance the acquisition of technical skills in Building Technology and consequently improving the standard of the NCE (Technical) programme in Nigeria.

1.3 Objectives of the Study

The following objectiveswere stated to guide the study:

1. determine the effects of Practice-based Inquiry cycle and conventional method on theperformance of NCE (Technical) students inBuilding Technologyin Colleges of Education and Polytechnics in Nigeria;
2. ascertain the effects of Practice-based Inquiry cycle and conventional method on theperformance ofNCE (Technical) students inBuilding Technology concepts in Colleges of Education and Polytechnics in Nigeria;
3. examine the effects of Practice-based Inquiry cycle and conventional method on affective tasks performance in building technology of NCE (Technical) studentsin Colleges of Education and Polytechnics in Nigeria;
4. find out the effect of Practice-based Inquiry cycle and conventional method onhands-on tasks performance in Building Technology ofNCE (Technical) students in Colleges of Education and Polytechnics in Nigeria; and
5. compare the effect of Practice-based Inquiry cycle on NCE (Technical) students inBuilding Technology between the two experimental groups(Colleges of Education and Polytechnics) in Nigeria.

1.4 Research Questions

The following research questions were raised to guide the study:

1. What is the effect of Practice-based Inquiry cycle and conventional methodon the performance ofNCE (Technical) students in Building Technologyin colleges of education and polytechnics in Nigeria?
2. What is the effect of Practice-based Inquiry cycle and conventional method on the performance of NCE (Technical) students in Building Technology concepts in colleges of education and polytechnics in Nigeria?
3. What is the effect of Practice-based Inquiry cycle and conventional method on affective tasks performance of NCE (Technical) students in Building Technology in colleges of education and polytechnics in Nigeria?
4. What is the effect of Practice-based Inquiry cycle and conventional method on hands-on tasks performance in Building Technology of NCE (Technical) students in colleges of education and polytechnics in Nigeria?
5. How does the effectof Practice-based Inquiry cycleonperformanceof NCE (Technical) students in Building Technology of the two experimental groups (colleges of education and polytechnicsin Nigeria) differ?

1.5 Hypotheses

The study developed five Null hypotheses that guided the statistical analysis. The hypotheses addressed the five research questions raised in the study.

HO_1 there is no significant difference between the effect of practice-based inquiry cycle and conventional method on performance of NCE (Technical) students in Building Technologyin colleges of education and polytechnics in Nigeria.

HO_2;There is no significant difference between the effect of practice-based inquiry cycle and conventional method on performance in Building Technology concepts of NCE (Technical) studentsin colleges of education and polytechnics in Nigeria.

HO_3;There is no significant difference between the effect of practice-based inquiry cycle and conventional method in affective tasks performance in Building Technology of NCE (Technical) students in colleges of education and polytechnics in Nigeria.

HO_4;There is no significant difference between the effect of practice-based inquiry cycle and conventional method in hands-on tasks performance in Building Technology of NCE (Technical) students in colleges of education and polytechnics in Nigeria.

HO_5; There is no significant difference between the pre-test and post-test mean (performance) deviations ofNCE (Technical) students in Building Technology taught using the Practice-based Inquiry cycle in the two experimental groups (colleges of education andpolytechnics) in Nigeria.

1.6 Basic Assumptions

The followings were the basic assumptions of the study;

1. That the curriculum package of the NCE (technical) programme as contained in the NCCE minimum standards is supposed to produce graduates students with technical skills good enough to teach basic technology and work in industries.
2. That the NCE (technical) programme is voluminous consisting of so many trades which makes implementation especially in teaching technical skills tasking.
3. That, there is the need for an alternative methodology that could enhance the acquisition of technical skills in Building Technology trade and the programme at large.
4. That polytechnics and colleges of education operate the same Curriculum document in the production of NCE Technical graduates using the same type of learning resource.

1.7 Significance of the Study

The study will be of immense benefit to lecturers and instructors in the institutions, National Commission for Colleges of Education, National Board for Technical Education and the Private Sector. The National Policy on Education has made it clear that no nation can rise above the quality of her teachers. In line with this, any technical teacher without technical skills is disabled, and may not be effective in the conduct of his duties.

This study is therefore significant, for it determined the effect on performance of students in Building Technology using a new instructional strategy (PBI). The positive outcome of the study has brought an alternative teaching method that will enhance technical skill acquisition in the programme.

Lecturers and instructors in the programme stands to benefit, because the learner-centered approach of the PBI cycle provides for planning before implementation, this makes instruction easier. It is hands on andstudents participate fully in all activities. Eventually, learning becomes easier faster and permanent which is the essence of any educational encounter. In addition the PBI method have measurable outcome hence, teachers will evaluate their performance and that of the students at the end of every training cycle.

Students have equally found learning interesting and easy due to the learner centered package; they have acquired hands-on skills and would eventually become better technical teachers. In addition the acquired skills will provide impetus for entrepreneurship and eventually leading to self- reliance on graduation.

The National Commission for Colleges of Educationand National Board for Technical Education could use the findings during curriculum reviews; the use of the Practice-based Inquiry cycle in teaching Building Technology component could be injected in the NCE

(Technical) programme as an instructional method, as well as the other trade subjects in colleges and polytechnics in Nigeria.

The private sector would consequently employ NCE (Technical) graduates with improved technical dexterity especially in Building Technology. Consequently using better supervisors in building construction sites. This will reduce incidences of collapse buildings in the country.

States Universal Basic Education Boards and proprietors of private schools by implication arethe employers of products from teacher training institutions in Nigeria. They will therefore, enroll effective and efficient teachers of Basic Technology that will nurture technology from our classrooms. The output will certainly touch the lives of all citizens.

1.8Scope of the Study

The scope of the study was limited to Colleges of Education (Technical) and Polytechnics offering the NCE (Technical) programme in Nigeria only. Theeffects of the practice based inquiry cycle on the performance of students were ascertained in the Building Technology component of the NCE (Technical) programme alone. Two colleges of education (Federal College of Education (Technical) Bichiand Federal College of Education (Technical) Gombe) and two polytechnics (Kano State Polytechnic and Hassan UsmanKatsina Polytechnic) were purposively chosen for the quasi experiment.Students in level two of the NCE (Technical) programme were used forthe study. This is because they were not new in the institutions and had therefore, stabilized in the environment, and at the same were not scheduled for students' industrial work experience scheme (SIWES) or teaching practice (TP) during the session.

The study also looked at the effect of the PBI in the performance of the students in the understanding of Building Technology concepts, building technology traits acquired

and hands-on skills acquisition of the pre-service technical teachers. It also compared the effect on the performance between colleges and polytechnics and between the experimental and control schools.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.1: Introduction

This chapter reviewed related literature that provided further understanding of the background to the study. The main objective is centered on finding the effects of Practice Based Inquiry cycle on the performance of Building Technology students in the Nigeria Certificate of Education (Technical) Programme in Nigeria. Other variables include the effect of PBI on students' performance in building technology concepts, performance in affective tasks and hands-on tasks performance.

The outline of the reviews is as follows; Conceptual Framework of the Practice based Inquiry Cycle; Theoretical Framework; Features and Flexibility of PBI Cycle; Using PBI as an enhanced Method to teach Building Technology; Sustainability of PBI as an intervention programme; The NCE (Technical) Programme in Nigeria;Building Technology Curriculum in the NCE (Technical) programme; The Concept of Skills Acquisition;Technical Skills Required by the NCE (Technical) Teachers; Safety/maintenance Skills Required by NCE(Technical) Teachers; Tools/Machine Skills Required by NCE(Technical) Teacher; Electrical/Electronics Skills Required by NCE(Technical) Teacher; Building Technology Skills Required by NCE(Technical) Teacher; ICT Skills Required by NCE(Technical) Teacher; Strategies for Teaching Technical Skills in the NCE (Technical) programme; Constant Practice using Demonstration; Guided Discovery; Inquiry and Problem Solving approach; Excursion to Project Sites; Project Method; Apprentice Instruction Model; Further Strategies that could Enhance Technical skills acquisition in the Programme; empirical studies andSummary.

2.2: Conceptual Framework

Figure 2.1,Schematic diagram of the PBI cycle, which gives the conceptual frame

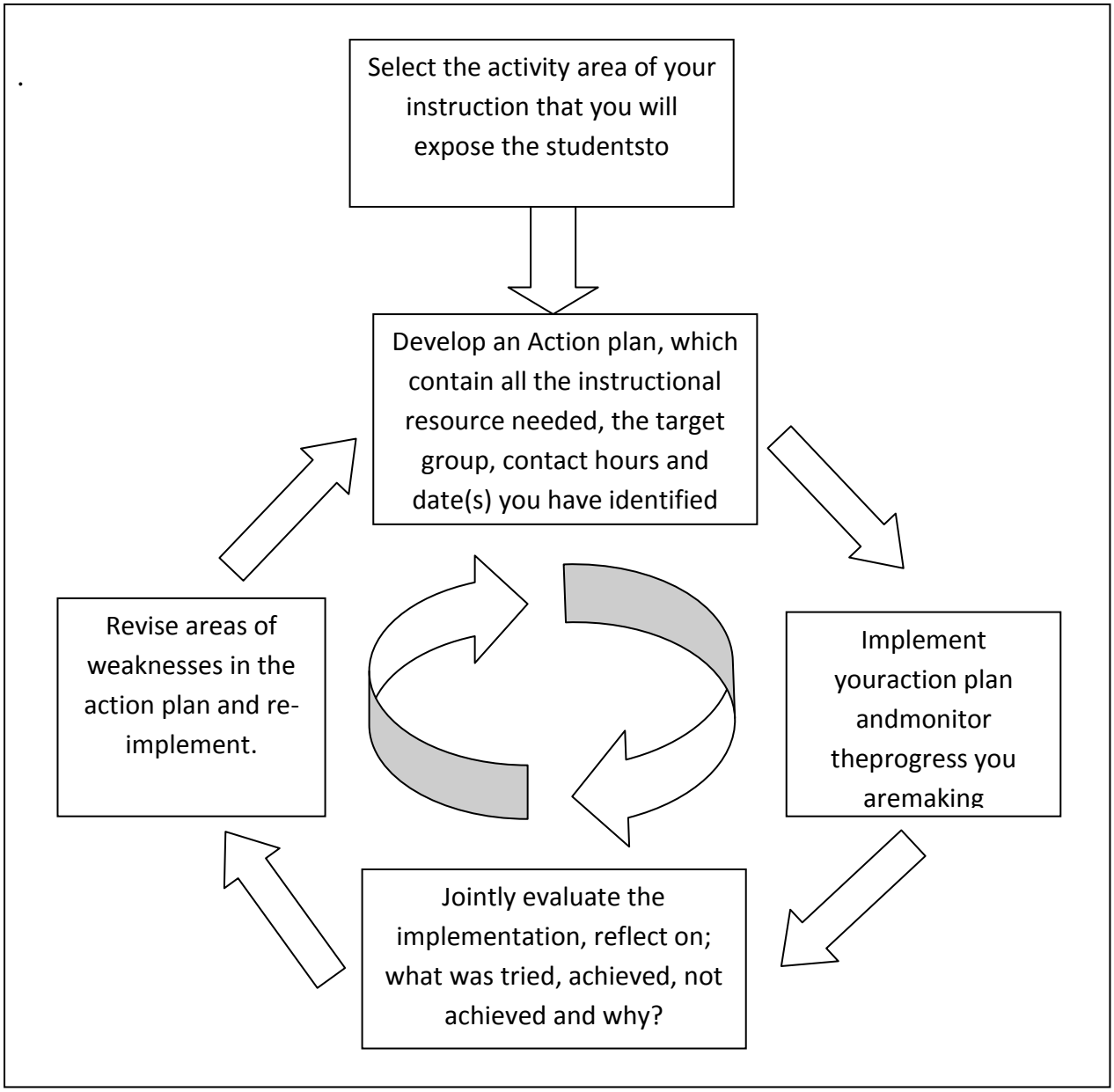

Figure 2.1 PBI CYCLE

Source: Core Module Component 2 SESP Kano participants' handbook 2008

The operation of PBIcycle starts with the identification of an instructional area that requires innovation or improvement, for example hands-on skills acquisition. The next stage is the development of an action plan that contains details of the strategy to be used to provide the expected change in hands on skills acquisition. The action plan is a table that specifies the task to be carried out, the target learners, the instructional resources needed, the time frame and identified success indicators. The third stage is the implementation of the action plan as collectively designed with the learners, strictly adhering to the time frame. The fourth stage is a reflection on the implementation of the action plan to evaluate the activities; the outcome of the evaluation will be the base for the next stage.The evaluation revolves around the following rhetories; what is tried? What is achieved? What is not achieved? Why it is not achieved? And what to do next? The last stage takes place where there is the need for a review of the action plan and re-implementation after addressing the obstacles in the original plan. But where the outcome of the evaluation in the fourth stage is positive, the documents are kept in portfolios as compendium for use in similar circumstances eventually becoming a manual for hands-on skills.

The implication of this concept to this study is significant in the area of the design and planning of hands-on activities in the teaching of building technology component of the NCE (Technical) programme. The concept starts with the identification of the instructional area that requiresintervention, here the teacher selects the type of hands-on activity he will expose the students to from the minimum standards. The next stage in the concept is the development of an action plan. This is equivalent to mobilizing all resources the teacher needs for the practical in a guided template. The next activity is the implementation which simply means the conduct of the hands-on activity in the school workshop. However, one important component of the PBI in the conceptual framework is the evaluation of the implementation to identify failures and re-implementation of the

planwhen the obstacles are cleared. All these if integrated will certainly add value in the teaching of building technology and consequently facilitates the acquisition of Building Technology skills to the pre-service technical teachers.

Practice based inquiry cycle (PBI) is a product of action research that came with the Teacher Professional Development (TPD) component, of state education sector project (SESP), which was a World Bank intervention to Kaduna, Kano and Kwara states in 2009. The intervention was aimed at assisting the states to achieve the millennium development goals in education. It is centered on realistic planning and documentation for change and improvement where new ideas are to be implemented or an identified problem in the teaching and learning process will be addressed. The teacher professional development (TPD) component of the intervention is simply a capacity building in teachers methodology focusing on the paradigm shift from the teacher centered instructional approach to learner centered techniques.

The fundamental purpose of inquiry in education as stated by Reid (2009), is to make decisions about practice that will help raise the student outcome. These decisions may include what educators learn to do in order to promote students' learning outcome. He identified some of the approaches used to include;

a. Action research, where the educator identifies an issue, gathers data in relation to the issue, analyses the data, theorizes a strategy, acts and reviews.

b. Critical dialogue, where a group of educators meet regularly and engage themselves in form of critical discussion about practice and dilemma within.

c. Classroom/workshop/workplace observations where individuals, pairs or groups can observe each other teach as a collaborative effort to explore an alternative on issues.

The main issue of this research as contained in the statement of the problem is centered on inadequacy technical skills of graduating students to effectively teach Basic

Technology at the JSS level. This problem could be resolved by adapting and injecting the provision of the PBI cycle in the planning and delivery of instruction, specifically making it a complementary hands-on activity of any of the topics taught in the Building Technology component of NCE (Technical) programme in Nigeria.

2.3 Theoretical Framework

This study is based on the Constructivist Learning Theory.This theory was chosen because all the instructional features of PBI are in tandem with the provision of constructivism as a learning theory. Many scholars in the realm of education have written extensively on constructivism as a new learning paradigm, prominent amongst them in this century are; Jean Piaget who posited that humans learn through construction of one logical structure after another and John Dewey who posited that education is grounded when he stated that " if you have doubts about how learning happens, engage in sustained inquiry, study, ponder, consider alternative possibilities and arrive at your belief's grounded evidence." He is of the view that inquiry is key to learning.

An appraisal the works of, Wnet Education (2016) and Faculty of Education University of Sydney packages on constructivism contained the position of the above scholars, and revealed further that; as a learning theory, it provides solids conceptual basis for learning. It posits that, learners are not blank slates, but rather construct their understanding and knowledge of the world through experiencing new things, reflecting and integrating new experiences with the past. The theory further considered learning to be an active technique/process where real world are explored to solve problems. The learners are guided to learn how to learn, through the exploration of their innate curiosity and potentials. They are not instructed to "reinvent the wheel" but are rather guided to discover how the wheel turns through real activities, developing hypothesis, testing theories and drawing conclusions.

The role of the teacher is still very significant, he needs the mastery of his subject matter but should be flexible and be willing to accept new knowledge discovered during interactions with his learners. His new role is to facilitate, guide, coach, prompt and reinforce inquiries and promote collaborative learning through jigsaw and other grouping strategies. The constructivist learning arena is, constructive since knowledge is acquired through construction by learners; active through experiments and hands-on activities; reflective through referral to past experiences; collaborative through interactions among peers; and inquiry based through questions and revisiting conclusions by learners.

Shortcomings of this theory include overload of knowledge, tyranny of the majority in group work and elitism due the resource required. Learning resources are often available in only privileged schools. Another weakness is the unaccountable evaluation method.

An overview of the Practice-Based Inquiry Cycle, ranging from the identification of an instructional topic, the development of an action plan which simply elaborates plans for hands-on activities to implementation and evaluation of the implemented action plan are in tandem with the principles and provision of constructivism learning theory. Therefore these principles were used in the design of the lesson plan used in both the experimental and control schools used for the study.

Further provisions of the constructivist towardslearning are outlined byGieseen, (2008) andNwafor, (2007) are as follows;

1. Constructivist learning environments provides multiple representations of reality.
2. These representations represent that complexity of the real world.
3. Knowledge construction is emphasized over knowledge reproduction
4. Authentic tasks are emphasized in meaningful context.

5. Real world settings or case-based learning is provided.
6. Thoughtful reflection on experience is encouraged.
7. It enables context and content dependent knowledge construction.
8. It supports collaboration and social negotiations among learners.
9. It facilitates discovery learning.
10. It encourages collaborative activity.
11. It supports integration and activation of prior knowledge.
12. It gives opportunities for hands-on activities(pg 75).

The Learning theory and the principles of constructivism as outlined above form the bases of the leaner centered approach paradigm in teaching and learning which the PBI cycle is in tandem with. Therefore, adapting and injecting the use of the PBI in teaching building technology in NCE (Technical) programme implies the adoption of the provisions of the constructivist learning principles in instructions. The study did not only use PBI in the experiment but all the principles of learner centeredness as contained in the attached lesson plans used for the treatment in the study. Basically a learner centered approach starts from the belief that the learner is at the entre of the learning process, and not the syllabus and as such they are self-directed, equals in the learning process along with the tutors, organizers and founders. The identifiedfeatures of the theory of learner centeredness include;

1. A welcoming, encouraging, and supportive learning atmosphere which is flexible, responsive and based on the assumption that the learners know best.
2. A real partnership between tutor and learners in designing and delivering the courses and laboratory activities.
3. An environment where learners could self-evaluate themselves and could negotiate the contents to be delivered to them.

Core module component one of the Kano (2008), State Education Sector Project participants hand book described the learner centered curriculum to be;

1. be designed according to learner needs, interest abilities and context.
2. contain material resource geared towards learner needs, interests and motivation
3. be the type that learners have opportunities to develop social, physical, aesthetic, cultural emotional and intellectual aspects of their whole persons.
4. focus on developing learners who are confident and able to take on life, work and situations.
5. have assessment systems that are flexible, holistic and none threatening to learners and teachers.

The practice-based inquiry cycle revolves around the identified traits of the learner centered theories where learners are fully involved in the selection and design of practical, and could work freely to design the action plan whether as individuals or in groups. Ogwu and Oranu (2006) quoted Kindler (1973) to have stated that, people learn "90% of what they say as they do things." This creates permanent learning and eases the work of the teacher whose new role in the teaching learning process becomes; mentoring, caring, supporting, accommodating, sharing, guiding, counseling and facilitating of the teaching and learning process.

2.4 Features and Flexibility of Practice Based Inquiry Cycle

The cycle consists of series of activities which the technical teacher could adopt to enhance his planning for class work and laboratory/workshop activities resulting in an improved outcome after delivery. The Kano State Ministry of Education (2008) participants manual of the SESP project stated this on the PBI cycle “A type of investigation and solution seeking by doing something: the stages are to identify a problem, to plan a solution, to put the solution into practice and then to evaluate it again.

This is a way of improving based on doing." The cycle consists of following five stages as contained in the manual,

- selection of the practical work/project, task or problem to be addressed f
- developing an action plan and work plan
- implementing the action plan within a given timeframe,
- evaluating the activities in the action plan
- re-implementing the identified failures,

Evaluating the activities is simply an attempt to address the following rhetorical questions;

1. What is tried?
2. What is achieved?
3. What is not achieved?
4. Why it was not achieved? and
5. What is the next activity?

Whilere-implementing the identified failures which could be as a result of materials selected or the time frame scheduled for the practical. The teachers in this case facilitate, assist, co-design the practical and give the necessary mentoring for successful execution of any agreed project. While the involvement of students in the design and selections of task makes them owners of the projects and are therefore active in all the activities. The model has a self-evaluating mechanism, could allow for group or single design and execution of practical project, it could accommodate integration to teach some or all the skills that cut across the related technical trades in the instructional package and most importantly is the flexibility in time schedule. Therefore,practical could be designed per semester and students could use any available time at their disposal to work on their projects including weekends.

The cycle was implemented at the lower basic level (primary and junior secondary schools) of the targeted schools in Kaduna, Kano and Kwara states. This study therefore experimented the practice based inquiry cycle as an enhanced methodology for teaching building technology practical in the NCE (Technical) programme. The teachers in this case facilitate, assist, co-design the learning experiences and give the necessary mentoring for successful execution of any agreed project and students become active learners. Building technology education teachers especially those in colleges that will have to develop their practical components from the minimum standards could adapt the PBI approach in all their practical classes. An Action plan which is a component of the PBI cycle that contained the details of the activities and the road map for execution could be properly stored for subsequent use in the portfolio and eventually developing a compendium that could be used as practical manual for the programme.

2.5 Using PBI as an Enhanced Method to Teach Building Technology in the NCE (Technical) Programme in Nigeria

Global shift towards science and technology has posed greater challenges to the building technology teacher, he has to cope with high number of students, operate a saturated curriculum document which perhaps did not partake in its development, work with inadequate learning resource, use ill-equipped and ill-maintained laboratories and workshops where they exist. Such teachers need versatile methodologies to effectively deliver the task before him. The teaching of building technology education programme requires more time as spelt in the minimum standards. The document specified that technical education courses will be taught using lectures and practical, every one hour of any of the courses in a trade will require three hours for practical. This is not feasible due to the volume of the curriculum contents and other complementary trade subjects of the same weight. However, this example will explore the use of the PBI in teaching a

component in building using the provision of the stages in the PBI cycle which could be adopted.

STAGE ONE
Select Task/ the Practical Activity to be conducted

The building technology teacher at this stage will select the practical from the manual where available, or develop related complementary practical activity vis-à-vis the contents in the minimum standards. There could be series of practical activities for the semester or a single one that could contain different operations leading to the acquisition of different skills. Where there are many activities they are arranged in order of priority or their pre-requisite nature. For example in pre-NCE building, you have to know types of bricks/blocks and their sizes before workshop activities on bonding of bricks and different types of bond. In whichever situation, the technical teacher will have to decide on, the steps to be taken, who will be responsible for each step, what are the resources needed and what are the actions to be taken considering the number of students, the resources available and power supply among others.

STAGE TWO

Develop an Action Plan for new Discovery or the Practical Activity Chosen

This is the most important stage of the cycle, it addresses the new methods to be used, the target learners, the learning resource needed, the time required to accomplish the activity and the indicators for success or failure. For the sake of clarity, the study used a building department course for NCE 2 in technical education titled "TED 214 construction method one", the contents of the course includes ceiling and ceiling finishes, the task here is a trial to discover ceiling production using improvised local materials within the environmental context. The action plan table 2.1 will explain better.

Table 2.1 Action Plan for the Production of Ceiling using Local Materials

TaskTarget learners,	Resources required,	Time to start,	S/ indicator
ceiling NCE 2 technical production Weighing scale	ground nut shield Arabic gum Grinder 2ftsq mold Shovel water	three weeks 3/11—24/11, 2014	driedboard

Action plan table for the production of ceiling boards

Table 2.1 contains an action plan for the production of ceiling boards using local resource The action plan is central to the PBI cycle, once it is properly done the task becomes easier. Therefore, the building technology teacher will have to appraise his plan before implementation, he should think of possible obstacles which could either be from the learners, the department, the required resource, the time frame and so on. The teacher could be guided by the following rhetorical questions;

1. Is the action plan realistic and practicable?
2. are your objectives clear?
3. Is the time frame realistic?
4. Are the required resources available?

Positive answers to these questions will facilitate smooth implementation of the cycle.

STAGE THREE
Implementation of the Developed Action Plan

At this stage, the developed action plan is being put into use. The stated date should be respected to avoid procrastination of the activity; that is the reason for selecting a definite date and span of time in the example given above. The implementation could last for a semester, a month, a week or hours depending on the activity involved. The progress is gradually monitored and recorded for reviews in the next stage.

STAGE FOUR:
Evaluation of the Implementation of the Action Plan

The progress made is ascertained in this stage, it is simply attempt to address the following questions;

- What was tried?
- What was achieved?
- What was not achieved?
- Why it was not achieved?
- What will be done next to achieve it?

The evaluation could be simplified and tabulated as shown in table 2.2 for easy assessment. Our earlier example of a building department course for NCE 2 technical is used to fill the evaluation (table 2.2)for the sake of clarity.

Table 2.2 Evaluation of the Implemented Action Plan of the PBI cycle

New method used	Success areas of Action plan	Failure areas of Action plan	Reasons for failures	Future plans
ceiling production using g/nut shield	Learners interested, resources available, department willing.	Weak Arabic gum, inadequate time for students practical	Poor, bonding qualities, saturated minimum standard	Use alternative adhesives, use weekend for the practical

STAGE FIVE
Review of the Implementation of the Action Plan

This is the last stage of the cycle; the results of the evaluation done in stage four will be reviewed. The identified obstacles that caused failures will be replaced and the action plan will be re-implemented. The most important thing to note is to realize that no plan is perfect and as such any plan can be improved upon at any point to produce better results. The reviewed action plan could be implemented with another set of students. The examples given above identified the problem of inadequate time for the practical to be

conducted within scheduled school hours and weak bonding qualities of the Arabic gum used in the practical. These are addressed for reimplementation as contained in column five of the evaluation table. If the reimplementation is successful, the action plan is labeled and kept in the portfolio for use again sometime, someday.

Teachers and Students role

The building technology teachers and other workshop personnel in this case facilitates, assist, co-design the learning experiences in the action plan and give the necessary mentoring for successful execution of any agreed project. The students naturally become active learners because of their involvement in the design and execution of the projects. Based on the above example building technology education teachers especially those in colleges that will have to develop their practical components from the minimum standards could certainly explore the PBI approach in all their practical class.

The example given is glaringly a student centered approach to teaching and learning. it is not divergent to the basic principles of learning in vocational and technical education as contained in OgwoandOranu,(2006) cited by Chukwudi and Omofonon (2013) as;

Vocational and Technical Education will be efficient in proportion as the environment in which the learner is trained is a replica of the environment he must subsequently work.

a. Effective Vocational and Technical Education training can only be given where the training jobs are carried out in the same way with same operations, the same tools and same machines as in the occupation itself.

b. Vocational and Technical Education will be effective in proportion as it trains the individual directly and specifically in the thinking and manipulative habits required in the profession itself.

c. Vocational and Technical Education will be effective in proportion as it enables the individual to capitalize his or her interests' aptitude and intrinsic intelligence to the highest possible degree.

d. Vocational and Technical Education will be effective in proportion as the specific training experiences for forming right habits of doing are those of the finished skills necessary for gainful employment.

e. For every occupation there is a minimum of productive ability, which an individual must possess in order to secure or retain employment in that occupation, If Vocational and Technical education is not taken to that point, that individual will neither be personally nor socially effective.

f. Will be socially efficient in proportion with the method of instruction, its personal relations with learners, consideration given to the particular characteristics of any particular group it serves.(pg 66)

2.6 Sustainability of PBI as an intervention programme

Sustainability of projects and programmes has become booze words in human development cycle. The world is now focused towards education for sustainable development (ESD). Rikoto (2011) cited Bruntland Commission (1987) to have defined sustainable development as programmes/projects "that meets the need of the present without compromising that of the future generation to meet their own need." Therefore, Education for sustainable development should implement programmes that are locally relevant and culturally appropriate. UNESCO (2014) described ESD as an umbrella for many forms of education that already exist and the new ones to be created, it is of the view that ESD affects all components of education such as Legislation, policy, finance, curriculum, instruction and learning amongst others. UNESSCO identified some of the essential characteristics of ESD to include;

- uses of a variety of pedagogical techniques that promote participatory learning and higher order thinking skills,
- promotes lifelong learning
- locally relevant and culturally appropriate
- based on local needs but acknowledges international effects and consequences
- engages formal, non-formal and informal education
- accommodates the evolving nature of the concept of sustainability
- addresses content, taking into account context global issues and local priorities
- is interdisciplinary, integrating other learning areas to achieve objective(pages 1and 2)

The sustainability of any education intervention programme certainly relied on the extent of compliance with the above features. The package of the practice based inquiry (PBI) cycle as presented in this study, has contained all the above features but its sustainability as an enhanced method for teaching building technology practical in the NCE (Technical) programme could depend on the following;

- the extent of understanding of the package by lecturers in Building Department and in other trade subjects of the NCE (Technical) programme
- the interest and ability of the lecturers to accept and implement change
- the availability of instructional materials in the department and College
- the ability of the lecturers to improvise alternative local instructional resource
- the flexibility of the lecturers to involve other disciplines, informal and non-formal education in instruction
- the versatility of the lecturers in learner-centered instruction and most importantly

- the willingness of the authorities of Schools and Colleges being gateways to innovations and change in their respective domain.

2.7The NCE (Technical) Programme in Nigeria

Indigenous technology is as old as man. Scholars noted that in pre-colonial Africa, vocational skills were passed from parents and master craftsmen who were expert of the vocations. Even though, with no formal training in pedagogy. The essence was to produce self-reliant citizens, promote and maintain cultural heritage, there was neither fixed time frame nor standardized curriculum, it varied with culture and the type of skill to be learnt." The coming of colonial masters witnessed the introduction of predominantly grammar school system of education where the emphasis was getting requirements for University programmes and people that will work as civil servants, hence, technical education was relegated to the background. The period between 1960 and 1990, witnessed few vocational technical institutions that mainly relied on expatriates.

The introduction of Vocational and Technical subjects into formal schools started in the year 1842 when the Church Missionary Society.(CMS) introduced subjects like Agriculture, Carpentry and Block laying in their schools (Owojobi,2003). But, the major stride before independence towards Vocational and Technical Education was the outcome of the Elliot Commission in 1943 which recommended the conversion of Yaba High College to a Technical institution in 1945 and the establishment of similar ones in Kaduna and Enugu While, the establishment of Comprehensive College Aiyetoro with the assistance of Ford foundation brought novelty to Vocational and Technical Education at the Secondary level (Owolabi,2003). However, the antecedents of Vocational and Technical Education in Nigeria gave it a disdain outlook when juxtaposed with other realm of Education, most people considered it to be an alternative for the weak ones in the school system.

For the sake of clarity,Oranu(2006) cited by shuaibu (2016) defined Vocational Education as a skilled based programme designed for a sub professional level and is based on a specific Vacation while Technical Education on the other hand facilitates the acquisition of practical and applied skills as well as basic scientific knowledge. He further gave a comprehensive definition of the concept which integrates FGN (2004), UNESCO (2002) and ILO (2002) definitions as "those aspects of the educational process involving in addition to general education the study of technologies and related sciences and the acquisition of technical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life".

After independence the educational system operating in the country was predominantly grammar based which served the purpose of educational advancement and the provision of human resource for office work, but it did not address the technical requirements which could enhance technological growth in the country, this inspired the curriculum conference of 1969 and curriculum seminar of experts in 1973, the outcome of the two activities which gave birth to the National Policy on Education in 1977 and consequently 6-3-3-4 system of education in Nigeria which was launched in 1982. The system came with a lot of pre-vocational and technical packages aimed at facilitating technological growth from the grass root. The National Policy on Education (2004) revised defined technical and vocational education as " a comprehensive term referring to those aspects of the educational process involving in addition to general education, the study of technologies and related science and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of economic and social life."

The 6-3-3-4 system was welcomed with loud ovations, but it came with twin problem of not having provided Technical Teachers that would teach Introductory

Technology (Basic Technology) at the Junior Secondary School (lower basic) level, and non-availability workshop facilities in all the nooks and crannies of the country. In response, the Technical Teachers Programme TTP both within and outside the country was introduced by Government, National Technical Teachers College (NTTC) Akoka and Gombe that were producing National Technical teachers in trade subjects were converted to Federal Colleges of Education (Technical) followed by the establishment of new ones through decree 48 of 1987 at Asaba, Bichi, Gusau, Potiskum, Omoku and Umunze. These Colleges began the paradigm shift from the production of National Technical Certificate NTC to NCE (Technical) basically trained for the teaching Introductory Technology (Basic Technology) in schools that was launched with the new educational programme. The curriculum document for the NCE (Technical) then was designed and monitored by the National Board for Technical Education (NBTE) before the Establishment of the National Commission for Colleges of Education NCCE.

The National Commission for Colleges of Education is the youngest of the three bodies established to oversee higher education system in Nigeria. It came into existence Friday January 13, 1989 with the promulgation of National Commission for Colleges of Education Act, 1989 NO, 3. The commission`s governing body consists of chairman and an appointee of each of the Federal Ministry of Education (FME) and Youth development, Federal Ministry of Finance and Economic development, State`s Ministries of Education, and Youth development, Universities of Technology, other Universities, Nigeria Union of Teachers and Nigerian Academy of Education. Others are, a personality well versed in teacher education from the National Commission for Women, three representatives of colleges of education, out of which one must be from institutions of Technical Teacher Education, another three with adequate experience of service in public private sector,

chosen on individual merit from different parts of the country and the executive secretary (Amended Decree 12, 1993 with effect from January, 1993).

The enabling Decree (now Act) No. 3 of January 1989 (amended decree No. 12 1993) mandated the Commission to perform the following functions:

a. Make recommendations on the national policy necessary for the full development of teacher education and the training of teachers.
b. Lay down minimum standards for all programmes of teacher education and accredit their certificates and other academic awards after obtaining thereof
c. Prior to the approval of the Honorable Minister of Education. Approveguidelines setting out criteria for accreditation of all Colleges of Education in Nigeria.
d. Determine the qualified teachers needs of Nigeria for the purpose of planning facilities and in particular prepare periodic master plans for the balanced and coordinated development of Colleges of Education.
e. Inquire into and advise the Federal Government on the financial needs of the Colleges to enable them meet the objectives of producing the trained qualified teachers of the country.
f. Receive block grants from the Federal Government and allocate them to the Colleges of Education.
g. Act as the agency for channeling all external aids to Colleges of Education in Nigeria.
h. Harmonize entry requirements and duration of courses at the Colleges of Education.
i. Collate, analyze and publish relevant information relating to teacher education in Nigeria.
j. Advise on and take measures to improve immediate and long term prospects of technical and business education teachers with respect to status and remuneration.

k. Provide encouragement for women to enter a wide range of pre-vocational courses in technical education.

Other functions and responsibilities of the Commission relating to the NCE (Technical) program as contained in the amended decree 12 of 1993 are to make recommendations on;

- Expanding the facilities for the training of technical and vocational teachers and ensure that these teachers are exposed, both during and after training to practical experience.
- Involve experts both in Government and industry in the design of courses relevant to technical and pre-vocational courses.

The establishment of the Commission with the mandate to control all pedagogical trainings at the NCE levels consequently, the NCCE minimum standards which became the training guide/curriculum for all Teacher Training Institutions in the country.Despite series of reviews of the minimum standards, the philosophy and objectives of the NCE (Technical) programme as contained in the 1990, 1996, 2002, 2008 and 2012 editions of the minimum standards remained as;

Philosophy

The philosophy of this programme NCE (technical) is to provide technical teachers with the intellectual and professional background adequate of teaching technical subjects and to make them adaptable to any changing situation in technological development not only in the country but the world at large.

Objectives;

1. To produce qualified technical teachers and practitioners of technology capable of teaching introductory technology in the junior secondary schools.

2. To produce technical teachers who will be able to inculcate scientific and technological attitudes and values in to the society.
3. To produce qualified technical teachers motivated to start the so much desired revolution of technological development right from the Nigeria schools
4. To prepare technical teachers so as to qualify them for a POST-NCE degree program in technical education.

The curriculum package for the NCE (Technical) programme is multifaceted, students must take courses in all the technical trades namely; Automobile technology, Building technology, Electrical/Electronic technology, Metal Work technology and Wood Work technology. They are equally expected to acquire certain level of skill in the trade subjects which should be adequate for self- reliance so as to cope with the dynamic nature of the world. Other courses in education that will make them pedagogues and general studies coursesmake the programme fully loaded. The minimum standards document provides that, the courses are taught through lectures for education and general studies courses and lectures and practical for technical courses. The brake down of the credit units allocation as contained in the 2012 minimum standard which is the document operational in colleges stated 30 credit/hours for educational courses, 18 for general studies, 6 for teaching practice and 64 for the five trade subjects.

Table 2.3 Credit hours allocation and Percentages as Contained in 2012 NCCE Minimum Standards for the NCE (Technical) Programme in Nigeria

Courses	Credit hour allocation	Percentage occupied
Education	30 credit/hrs	25.4%
General studies	18 credit/hrs	15.2%
Teaching practice	6 credits	5.1%
Technical courses 5Depts.	64 credit/hrs/5trades	54.2%, 10.8%
Total	**118 credits**	**100**

Source: 2012 Edition of the NNCE Minimum Standard.

Table 2.3 showed the credit load allocation in the NCE (Technical) programme as contained in the year 2012 NCCE reviewed Minimum Standards. Further analysis of the

document revealed that students from NCE one to three will require 39, 38 and 39 hours per week respectively for lectures and workshop practical. The lectures seem to consume all the contact hours with very lean provision for practical skill acquisition in the five trades areas, hence creating a gap between theory and workshop activities which are supposed to be complimentary. In addition the minimum standards does not contain practical schedules and manuals for the trade subjects therefore teachers decide what to teach as practical using the popular demonstration method and in few cases because of time and other constraints the project method. The resultant effects is the production of incompetent NCE (Technical) graduates that cannot teach the Basic Technology subject in the lower education level in the country (Aina, 2008 and Atsumbe etal, 2011). There is therefore the need for an effective and flexible methodology of imparting technical skills in the programme which the practice based inquiry cycle could give due its practical and learner centered features.

2.7.1 Building Technology Curriculum in the NCE (Technical) programme

Building Technology is one of the complementary trade subjects scheduled forthe NCE (Technical) programme. The 2012 reviewed NCCE Minimum Standards reduced the graduating requirements in the NCE (Technical} programme from 137 credit hours to 118 credit hours. While Technical Education which consists of five trade subjects is reduced from 77 credits to 64 credit hours. Building Technology is allocated 3 credits in NCE I, 4 credits in NCE II and 7 credits in NCE III as contained in the table 2.4.

Table 2.4 Courses and Credit hours Allocation for Building Technology in the NCE (Technical) Curriculum, NCCE Minimum Standards

LEVEL	COURSE IST SM	CR/HR	COURSE 2ND SEM	CR/HR	TOTAL
NCE I	Introduction to building construction.	2cr	Building science/materials	1cr	3cr
NCE II	Construction method one	2cr	Elementary structural Design	2cr	4cr
NCEIII	Teaching Practice		Land Surveying	1cr	
			Const. Method II	2cr	
			Building Maintenance/repairs	1cr	
			School, w/shop mngt	1cr	
			Construct mngt	2cr	7cr
	TOTAL	**4cr**		**10cr**	**14cr**

Source: 2012 NCCE Reviewed Minimum Standards

Table 2.4 is an extract of credit unit allocation and courses offered in Building Department. The philosophy and objectives of Building Technology are the same with the general philosophy and objectives of the NCE (Technical) programme, which revolves around the production of technical teachers with intellectual and professional background adequate to teach technical subjects and who are adaptable to the technological global dynamics. An appraisal of the credit load scheduled for building technology in the entire programme indicates 11.86% while the credit load allocation in relation to other trades components stands at 21.87%; this may not be adequate for any meaningful skill development considering the basic principles of vocational and technical education hence, the need for an alternative teaching methodology for which the PBI cycle could be explored for.

2.7.2 Resources and learning environment in the NCE (Technical) programme

This simply refers to things that could be used as contents and the processes that could be followed to achieve the stated objectives of the curriculum; they include human resource, written resource, media and environmental resources. The major human resources are the teachers and workshop/laboratory assistants. In General Education the

minimum standards states under academic personnel “a minimum of masters degree with teaching qualification is required for appointment as a lecturer in college of education” and in the technical education programme, a class of fifteen students for each major area of specialization will need one lecturer, one instructor, one workshop attendant and store keeper and one cleaner. This is an adequate package of human resource if properly implemented. The document also recommends unit workshop containing tools, equipment and machines in each area of specialization and a standard introductory technology workshop for the NCE (technical) programme. It further recommends generous office accommodation and a well-stocked library containing specialized books inthe ratio of one student to ten books. The fourth edition of the minimum standards has actually addressed the issue of learning resource in the technical teacher education programme. What remains is the availability of the resources in the institutions and the willingness to utilize them in instruction.

2.8Technical skills Acquisition in the NCE (Technical) Programme

All students admitted for the NCE (Technical) programme register for the same courses in NCE I and NCE II across the five trade departments, therefore, they are exposed to the same instruction in all the departments, they equally need skills in all the five trade areas, automobile technology, building technology, electrical/electronic technology, metalwork and woodwork technology. The strategy for imparting the skills may vary according to departments butall the skills required revolve around the three learning domains.

2.8.1 The Concept of Skill Acquisition

The term skill has been defined variously by different scholars. According to Okorie (2001),cited by shuaibu (2016), skills are the work people perform which can be classified into the following basic skills: communication skills, computation skills, manual

dexterity or motor skills as well as human relation skills. Hull (2007),defined skill as manual dexterity acquired through repetitive performance of an operation. In the same vein, Okorie and Ezeji (1988), as cited by shuaibu (2016), explained that to acquire a skill is to demonstrate the habit of acting, thinking or behaving in a specific activity, which has become natural to the individual through repetition or practice. Skill can be classified into three areas, namely;Technical skills,Human relation skills andConceptual skills.They further defined the three categories of skill as follows; Technical skills: The specialized tasks that enable workers to use their knowledge of tools, techniques, and procedures that are specific to their particular fields. These skills are usually trainable and can be taught to others. Technical skill can also be referred to as manipulative based. This is because technicians are mostly engaged in overt actions, which involve a lot of manipulation of materials and machines to create an effect. The skills acquired from technology are however not exclusive of the skills from science. Some scientific skills are seen in the area of technology because Science and technology are different sides of the same coin. Technical skills as listed by Nneji (2007), include: Inspecting, Selecting, Drawing, Testing, Analyzing, Assembling, Servicing, Installing, Identifying, Handling, Measuring, Diagnosing, Designing, Dismantling, and Repairing.

2.8.2 Padelford's Psychomotor Skill Acquisition Model

Padelford (1984), as cited by shehu (2016), developed psychomotor skills acquisition model used purposely in the field of vocational and technical education. The domain is categorized and presented as in the Table below. This model explains the stages involved in learning skills or exhibiting various aspects of psychomotor domain. Each stage influences the subsequent one. The model appears comprehensive in stating learning objectives because it conforms to the requirement of psychomotor behavior in terms of diversities i.e. cognitive and affective. For instance, Padelford observed that the perceiving

stage involves: sensing symbols; cue selections; translating and internalizing. These belong to the perceptual cognitive domain. The second stage of motivation involves externally and internally directed satisfaction, which belong to the perceptual and affective domain. The third stage of imitating involves mentally manipulating the forms, patterns or sequence of actions and mimicking a series of events, patterns of procedures followed. This contains perceptual, affective and cognitive domains.

The fourth stage also reflects perceptual, affective, cognitive and psychomotor domains. The fifth stage of adapting involves diagnosing, reaching, adjusting and problem solving. This also contains affective, cognitive and psychomotor domains. The sixth stage of innovating involves experimenting, expressing and symbolizing. This also contains affective, cognitive and psychomotor.

Therefore, analyzing the Padelfords' model it could be said that the first three levels are internal while the remaining three are externally observable and each stage leads to the other. Also, it could be said that the model has taken care of the fact that psychomotor behaviour contains affective and cognitive behavior. This agrees with the observations by Okorie and Ezeji (1988), Ezewu (1984), as cited by shuibu (2016), that for a skill to be psychomotor (hands-on), it must have cognitive action.

Table 2.5: Padelford Psychomotor Skills Acquisition Model

Stages	Direction`
1	*Perceiving* - Perception of the wanted skill - perceptual component of psychomotor domain;
2	*Motivation* - Involves the resolve to take part or wish to learn. It also requires setting goals on Solving a problem - perceptual and affective component of psychomotor domain;
3	*Imitating* – This stage requires the individual to be involved in some mental manipulation of forms and pattern, and for mimicking a series of events, patterns or procedures to be used. This stage represents perceptual cognitive and affective component of psychomotor domain;
4	*Performing* - Practice of the wanted skill by moving parts of the body according to the pattern the mind has visualized perceptual, affective cognitive aspect of psychomotor domain;
5	*Adapting* - Adapting new motor skills to new situations based on personal creativity, perceptual, affective, and cognitive as well as creativity aspect of psychomotor domain;
6	*Innovating* - Ability to experiment and create new forms of the learned skill, perceptual, affective, cognitive creativity aspect of psychomotor domain.

Padelford (1984; 69)

Table 2.5 is the padelford skill acquisition model showing the different level of psychomotor skill. An appraisal of this model revealed that any skill development programme requires behavioral activities in the three learning domains; cognitive, affective and psychomotor as contained in the adjusted Bloom's Taxonomy of 1956. The adjusted taxonomy by different scholars is focused towards making learning an active process. The adjustments categorized the domains into levels, gave behavior description, and outlined the activity to be trained and identified keywords (action verbs) which describe the activity to be trained or measured at each level. The details are contained in tables 2.5, 2.6 and 2.7 respectively.

2.8.3 Bloom's Taxonomy: The Three Learning Domainsvis-a-vis Technical Skills Acquisition.

A Revision of Bloom's Taxonomy of Educational (2008), in which levels five and six (synthesis and evaluation) were inserted and enriched with action verbs, established that learning is an active process. This is the reason for the different versions of the Cognitive Domain model. Table 2.6, 2.7 and 2.8 contained action verbs in the cognitive, affective and psychomotor domains respectively.

Table 2.6 Blooms taxonomy, Verbs and Activities to be measured in Cognitive Domain

Category or 'level'	Behavior descriptions	Examples of activity to be trained, or demonstration and evidence to be measured	'Key words' (verbs which describe the activity to be trained or measured at each level)
1. Remembering	Recall or recognize information	Multiple-choice test, recount facts or statistics, recall a process, rules, definitions; quote law or procedure	Arrange, define, describe, label, list, memorize, recognize, relate, reproduce, select, state
2. Understanding	Understand meaning, re-state data in one's own words, interpret, extrapolate, translate	Explain or interpret meaning from a given scenario or statement, suggest treatment, reaction or solution to given problem, create examples or metaphors	Explain, reiterate, reword, critique, classify, summarize, illustrate, translate, review, report, discuss, re-write, estimate, interpret, theorize, paraphrase, reference, example
3. Applying	Use or apply knowledge, put theory into practice, use knowledge in response to real circumstances	Put a theory into practical effect, demonstrate, solve a problem, manage an activity	Use, apply, discover, manage, execute, solve, produce, implement, construct, change, prepare, conduct, perform, react, respond, role-play
4. Analyzing	Interpret elements, organizational principles, structure, construction, internal relationships; quality,	Identify constituent parts and functions of a process or concept, or de-construct a methodology or process, making qualitative assessment of elements, relationships, values and effects; measure requirements or needs	Analyze, break down, catalogue, compare, quantify, measure, test, examine, experiment, relate, graph, diagram, plot, extrapolate, value, divide

	reliability of individual components		
5. Evaluating	Assess effectiveness of whole concepts, in relation to values, outputs, efficacy, viability; critical thinking, strategic comparison and review; judgment relating to external criteria	Review strategic options or plans in terms of efficacy, return on investment or cost-effectiveness, practicability; assess sustainability; perform a SWOT analysis in relation to alternatives; produce a financial justification for a proposition or venture, calculate the effects of a plan or strategy; perform a detailed risk analysis with recommendations and justifications	Review, justify, assess, present a case for, defend, report on, investigate, direct, appraise, argue, project-manage
6. Creating	Develop new unique structures, systems, models, approaches, ideas; creative thinking, operations	Develop plans or procedures, design solutions, integrate methods, resources, ideas, parts; create teams or new approaches, write protocols & contingencies	Develop, plan, build, create, design, organize, revise, formulate, propose, establish, assemble, integrate, re-arrange, modify

Table 2.7Blooms Taxonomy Levels and measurable Action Verbs in Affective Domain

Category or 'level'	Behavior descriptions	Examples of experience, or demonstration and evidence to be measured	'Key words' (verbs which describe the activity to be trained or measured at each level)
1. Receiving	Open to experience, willing to hear	Listen to teacher or trainer, take interest in session or learning experience, take notes, turn up, make time for learning experience, participate passively	Ask, listen, focus, attend, take part, discuss, acknowledge, hear, be open to, retain, follow, concentrate, read, do, feel
2. Responding	React and participate actively	Participate actively in group discussion, active participation in activity, interest in outcomes, enthusiasm for action, question and probe ideas, suggest interpretation	React, respond, seek clarification, interpret, clarify, provide other references and examples, contribute, question, present, cite, become animated or excited, help team, write, perform
3. Valuing	Attach values and express personal opinions	Decide worth and relevance of ideas, experiences; accept or commit to particular stance or action	Argue, challenge, debate, refute, confront, justify, persuade, criticize,
4. Organizing or Conceptualizing Values	Reconcile internal conflicts; develop value system	Qualify and quantify personal views, state personal position and reasons, state beliefs	Build, develop, formulate, defend, modify, relate, prioritize, reconcile, contrast, arrange, compare
5. Internalizing Values	Adopt belief system and philosophy	Self-reliant; behave consistently with personal value set	Act, display, influence, solve, practice,

Bloom's Taxonomy - Psychomotor Domain - (physical - skills - 'do')

The Psychomotor Domain was established to address skills development relating to the physical dimensions of accomplishing a task. Because, 'motor' skills extend beyond the originally traditionally imagined restrictions to manual and physical skills alone. The Cognitive, Affective and Psychomotor Domains complement each other in the accomplishment of any given task.

Table 2.8Levels and Measurable Action Verbs in Psychomotor Domain

Category or 'level'	Behavior descriptions	Examples of activity or demonstration and evidence to be measured	'Key words' (verbs which describe the activity to be trained or measured at each level)
1. Imitation	Copy action of another; observe and replicate	Watch teacher or trainer and repeat action, process or activity	Copy, follow, replicate, repeat, adhere, attempt, reproduce, organize, sketch, duplicate
2. Manipulation	Reproduce activity from instruction or memory	Carry out task from written or verbal instruction	Re-create, build, perform, execute, implement, acquire, conduct, operate
3. Precision	Execute skill reliably, independent of help, activity is quick, smooth, and accurate	Perform a task or activity with expertise and to high quality without assistance or instruction; able to demonstrate an activity to other learners	Demonstrate, complete, show, perfect, calibrate, control, achieve, accomplish, master, refine
4. Articulation	Adapt and integrate expertise to satisfy a new context or task	Relate and combine associated activities to develop methods to meet varying, novel requirements	Solve, adapt, combine, coordinate, revise, integrate, adapt, develop, formulate, modify, master
5. Naturalization	Instinctive, effortless, unconscious mastery of activity and related skills at strategic level	Define aim, approach and strategy for use of activities to meet strategic need	Construct, compose, create, design, specify, manage, invent, project-manage, originate

2.8.4:Conceptual skill

This refers to the capacity of the management personnel to perceive the organization as an integral unit. It also involves recognition of interdependence of different functions of the organization.It is unrealistic to say that skills can be purely physical in complete absence of cognition; it is futile to relegate technical skills to the psychomotor in the conventional Bloom's sense. This means that in acquiring skill, there is the need to demonstrate the habit of acting, thinking and behaving in a specific activity in such a way that the process becomes natural to the individual through repetition or practice. Okorie (2000), as cited by shuaibu (2016), was of the belief that acquisition of requisite skill is a means of increasing the productive power of a nation hence, the Nigerian society, should recognize the fact that every citizen should be equipped with adequate skill to contribute effectively to the welfare of the country at large and the community in particular. Therefore, industry-based skills can be accomplished through integration of new developments in the industry into the curriculum contents of the school workshops and laboratories

2.9 Techniques and Strategies for skillsteaching in Technical Education Programmes

Techniques and strategies used in practical lesson delivery in building and other trades include demonstration, field-trip, project, and apprenticeship to mention but a few. Okoro (1999), as cited by shuaibu (2016) stated that "the aim of technical education is 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." He further stated that in practical arts courses, students learn about various occupations and acquire general skills in the use of hand tools. They learn about the necessity for human being to work and are encouraged to develop good attitudes towards work. He is of the view that all technical courses irrespective of their levels and objectives must stress

practical activity, and concluded that any technical course in which a large proportion of the allotted time is not devoted to practical work, projects and experiments is not likely to be successful.

Nigerian Educational Research and Development Council (NERDC, 2007) stated this on the strategies for the acquisition of technical skills in schools and colleges:

> Practical teaching strategies in vocational and technical education can be organized through instructional processes for imparting technical skills onto learners through competency based approach in evaluation taking into cognizance the three domains of educational objectives. Practical tests, multiple choice items, structured short-answer questions and essay tests are recommended for assessment. The following strategies for improving acquisition of technical skills are recommended; constant practice using demonstration, guided discovery, problem solving, inquiry techniques, excursion to project sites, project method, scaffolding and on-the-job experience otherwise called apprenticeship (NERDC, 2007pg vi).

Similarly, Oda, Adenbe and Okwori (2012) stressed that the teaching methods applied for the development of skills and training of the students of technical schools were basically demonstration and lecture methods. This is due to insufficient facilities and teaching materials for the conduct of their lessons, therefore, the teachers have to resort to these two methods in both the theoretical and practical classes. Other similar practical teaching methods includes; practice and drill, guided discovery, inquiry and problem-solving (Igwebuike, 1995). Some the methods used to teach building technology and other trade subjects are discussed below,

Constant Practice Using Demonstration

This method is also called Practice and Drill method. Some subjects are taught through description and explanation while other subjects are taught only through practice and drill. This method is employed when the objectives of instruction specify the acquisition of skills and proficiency in performing some acts or tasks. It can be used along with other method such as lecture and demonstration. This method is used for vocational

and technical education;It is one of the learner centered methods because the learner is actively involved with the practice to develop the skills and proficiencies. The teacher determines the skills to be taught and also the criteria for assessment if the skills have been developed (NERDC, 2007).

Guided Discovery

This method provides opportunities and experiences that will enable the learners to discover facts, concept principles, methods or techniques for dealing with problems and relationships. Discovery method is based on acquisition of knowledge, skill and attitudes. It involves all the teachers' activities that minimally guide the learners towards acquiring knowledge, skills and attitudes and values through the use of his mental processes (NERDC, 2007).

Inquiry and Problem Solving

This method is closely related to discovery method. Both of them involved the use of problem solving to arrive at knowledge. But inquiry and problem solving is specifically directed towards problems, puzzles, and discrepant events. Teacher's activities in this method include; identifying problems, puzzles and discrepant events which should be interesting to the learners, providing the necessary information that will foster inquiries and assessing explanations offered by the learners to the puzzles (NERDC, 2007).

Excursion to Project Sites (Field Trip)

Field trip as a teaching method mainly focuses on first-hand information about objects, places, people or processes, to enrich, extend, validate or vitalize information from printed materials and ongoing construction sites. Other sources, or to try to uncover entirely new data (Nwachukwu, 2006).It is called a field trip. Since field trips are near real life, learning provided by them is concrete, sensory and basic. This enables students to see and observe things, places, people and processes in life setting. Field trips, according to

Nwachukwu (2006), take students away from classrooms boredom and monotony. It offers students the opportunity to know their community, to understand its problems, to appreciate its offerings and to identify themselves more with the community. Presently the resource required to organize field trip by colleges has made it difficult couple with the willingness of industries to accept request by institutions.

Project Method

Practical project means any teaching and learning activity which involves students in manipulating real objects. There is evidence that experience of carrying out practical projects can provide students with valuable insight into practice and can motivate them in continuing study (Woolnough, 1985 in Sola &Ojo, 2007).

Practical project has been widely used in workshops as a method of teaching technology education. Thus, the purpose of practical project is to develop and test students' technical skills on the basis of normal range covered by theory lesson (Garba, 1993 in Sola and Ojo, 2007). They further noted that practical project also stimulates learning and has become an important motivational factor in technology and vocational courses where mastery of skills plays an important role. Miller (2004) summarized the role of practical work in teaching and learning as:

- Practical project is an essential component of teaching and learning both for the aim of developing students' knowledge and skills.
- Practical project develop students’ knowledge and skills and often require students to link cognitive, affective and psychomotor domains of educational objectives.
- Practical project develops students on practical task design, and stimulates the students learning.

Scholars viewed that project learning increases motivation to study and help students to develop long term learning skills. Students know that they are full partners in this learning environment and share a responsibility in the learning process. They also suggested the following three benefits of project learning to students as:

- Learners develop deep, integrated 'understanding of content and process.
- The approach promotes responsibility and independent learning.
- The approach actively engages students in various types of tasks, thereby meeting the learning needs of many different students. The purpose of practical project is to develop and test student technical skills.

Apprenticeship Instructional Method

Cognitive apprenticeship is a cognitive method of teaching aimed primarily at teaching the processes that experts use to handle complex tasks. The focus of this learning through guided-experience is on cognitive and metal cognitive skills, rather than on the physical skills and process of traditional apprenticeship. Cognitive apprenticeship method, according to Collins, Brown, and Newman (2009), is an instructional innovation which was introduced to address the problem of inert knowledge. This approach is based on the underlying principle of apprenticeship learning and focuses on the use of such strategies as modeling of behavior and coaching students to mimic exact skill until they are competent in their performance. In apprenticeship method, the teacher simplifies the skill by using Scaffolding (extra help needed by students) and fading (diminishing the assistance) and allowing students complete the task through which the students are able to achieve mastery (Ogwo, 2005).

2.9.1Technical Skills Required by NCE Technical Teachers

The future of any nation rest in the hands of the caliber of its teachers because the qualities they possess and exhibit today will inevitably be reflected in the

behavior of the citizens of tomorrow. Kennedy (2010), explained technical skill as expertness, practiced, ability, dexterity and tact. It is an organized sequence of actions, proficiency executed and usually displaying a flexible but systematic temporal patterning. A well-established habit of doing technical work and acquisition of performance capability is another way of defining skill. Ali and Muhammad (2012) opined that technical skills are basic rudiments that a learner should possess in the area of his study based on the designed modules of the curricula.

For an effective teaching and learning of technical skills in the junior secondary schools, Onwioduokit, in Dike, Otunne and Echendu (2012) suggested that theUBE teachers that are supposed to teach Basic Technology, who are NCE (Technical) graduates should master performance skills required of them to impart tolearners. Examples of such skills are outlined below;

1. Manipulation Skills
    (i) Ability to handle objects
    (ii) Ability to set up apparatus correctly and with correct bearings
    (iii) Ability to manipulate objects
    (iv) Ability to draw accurately.
2. Observational Skills
    (i) Correctness of observation, that is, ability to observe correctly
    (ii) Taking correct reading with measuring instruments and
    (iii) Ability to notice errors involved during experimentation.
3. Computational Skills
    (i) Ability to relate the variables involved quantitatively
    (ii) Ability to get necessary data
    (iii) Ability to summarize the data in a graphical form, if required

(iv) Ability to undertake all calculations required, accurately and

(v) Ability to assign correct units of measurements.

For Basic Technology teachers (NCE Technical graduates) to remain relevant on their jobs, they need to possess Technical skills through seminars, workshops and conferences to bridge the gap between the previous training received and present performance level of knowledge or skills expected for working efficiently on the job depending on their determined needs. Technical skills required from NCE (Technical) graduates are discussed under the following sub headings;

Safety/Maintenance skills required by NCE Technical Teachers

Technological developments are going on at very fast rate, as such, presence of new technology has given rise to demand for training and re-training in new skills in the existing and new occupational areas in order that teachers might fit into today's and tomorrow's world of work. Uwaifo and Uwaifo (2009) recommended that the Teacher who will teach Basic Technology should be able to develop safety consciousness and appropriate skills needed. With regards to Safety and Maintenanceskills needs by technical teachers, Atsumbe, et al (2012) also stated that, Technology teachers should have mastery in Basic Technology elements which include knowledge of workshop safety rules and regulations and knowledge of the various ways to maintain tools and equipment. In addition Samson, Chukwuedo, and Godwin (2013) stated that technology teacher needskills such as ability to avoid horse play when working in the workshop, ability to avoid the use of unkempt hairs in the workshop and using the right workshop wears and goggles.

Tools /Machine Skills Required by NCE Technical Teachers

It is evident that teachers' efforts to develop tools and machines skills needed for effective teaching Basic Technology subject is necessary. This necessity will be more

appreciated when it is remembered that technological development demands adequate and relevant skills at all time.Uwaifo and Uwaifo (2009) stated that, Teacher who will teach Basic Technology should be able to develop proper use of machine tools and other equipment. This was supported by Kennedy(2010), who explained that, it is important to note that technical teachers need to update their knowledge, skills and competencies on new equipment, tools and machines different from the obsolete ones in the workshops. He further opined that, for learning-process to be effective, knowledge of subject matter as well as skills in teaching of technical subjects is essential

With regards to this,Tools and Machine skills needs by technical teachers, Atsumbe, et al (2012) also stated that Technology teacher should have mastery task elements in Basic Technology which include;

1. Demonstration of knowledge of classification of hand tools
2. Identification and uses of basic machine tools in the multipurpose workshop
3. Knowledge and correct use of woodwork tools
4. Knowledge and use of metal work tools and work holding devices
5. Demonstration of basic knowledge of applied mechanics, e.g. friction, motions, airflow mechanical advantage
6. Knowledge and correct use of drills and drilling machines in metal workshop

Electrical/Electronics Skills required by NCE Technical Teachers

Applied electrical and Electronics skills are required to meet the numerous demands and needs of Basic Technology teacher. Especially today with the advent of modern technology for production and services in the society, competent teachers who can effectively teach and run technical education programmes are highly needed.

MeanwhileAlade (2011) suggested that there is urgent need for a paradigm shift from theoretical teaching and literary application to a practical application of knowledge necessary for employment and technical skill development. With regards to applied electrical and Electronics skills needs by technical teachers, Atsumbe, et al (2012) stated that Technology teacher should have mastery task elements in basic technology which include; Knowledge of the inter-relationship between electricity and magnetism.

Samson, Chukwuedo, and Godwin (2013) also stated that some of the skills needed by Technology teacher include ability to define basic concepts in electrical and electronics, apply appropriate formulae in electrical and electronic calculations, read and interpret electronic schematics and wiring.

Building Technology skills Required by NCE Technical Teachers

Technical skills gap among technical teachers, particularly those in the area of building technology need to be urgently filled. This is in consideration of thewith rapid technological changes in Building Technology jobs that exist in our society, and the skills necessary to do the jobs. With regards to building skills needs by technical teachers,Odu (2011) is of the opinion that, teaching of Building Technology in secondary schools is too theoretical, and difficulties in imparting practical skills are caused by the teachers not possessing adequate technical skills in the subject matter. Odu, further observed that acquisition of requisite skills by Technical Teachers of building technology should include; Concept Formation, Real Life Application,Job-related Skills, Diagrams/Illustrations/Drawing skills, Care of Equipment and maintenance skills. Others includes simple construction of wood joints, casting of concrete foundation, laying of blocks/bricks, and floor tiling skills. These are to provide an opportunity for practical application in a context that is meaningful to students.

Atsumbe, et al (2012) stated that Technology teacher should have mastery task elements in Basic Technology which include;

1. Knowledge of various types of foundations, walls, floors, doors and windows
2. Identification, classification, uses and processing of wood
3. Identify and classify basic joints used in wood constructions

Adavbiele, (2013) stated thatskills shortages in Building Technology teachers are having a widespread impact on technical college artisan and craftsmen's abilities to achieve production levels, increased productivity, and meet customer demands. This indicates that, among the challenges for the technical teachers in Building Technology is to be equipped with needed technical skills or new skills in order to meet the demand of today's workplace and to improved quality of teaching.

ICT Skills Required by NCE Technical Teachers

It is no longer a question whether or not technology should be used in the classroom. The emphasis is ensuring that teachers use technology effectively to create new opportunities for students to learn and raise their achievement. The use of technology in the classroom requires teachers to be knowledgeable and competent in ICTs and to integrate them into the curriculum, align them with student learning goals, and use them to engage students in a quest for meaningful academic development.

Sam and Aduwa (2009), stated that twenty-first-century teachers are required to develop the skills that will enable them to maximize the use of the computer as a teaching resource to enhance students learning and to prepare students to master high technology in society, in which lifestyles, attitudes, and skills are challenged daily. Therefore Kano State Basic Technology Teachers need to be part of a community of practitioner of ICT-supported teaching.

2.10 Further Strategies that Could Enhance Technical Skills Acquisition

Scholars have continue to search for alternatives and strategies that could enhance technical skills acquisition in technical and vocational institutions in Nigeria. Though the yearnings are not formalized, suggestions raised at different forumsby stake holders include the followings:

Harmonization of all stakeholders in Engineering and Technology Fields

Engineers, Technologists, Technicians, Craftsmen and Artisan should accept their relevance and complementary role to each other in products' development, each cadre should value the role it has to play without prejudice, there should be understanding and unity of purpose instead of mutual rivalry among stakeholders, and same should be extended to the student bodies.

Bridging Gaps between Industries and Society

There should be symbiotic relationship between our industries and our training institutions. Kudirat (2012), in an Economic Community of West African States (ECOWAS) Workshop on Technical and Vocational Education Teachers in the Regions, expressed that the teachers will have to be re-trained periodically to bridge the gap between industry requirements and school training as the industrial requirements are the needs of the society. The (ECOWAS) Workshop was to put a mechanism in place for the renewal of Technical and Vocational Education and Training (TVET) curriculum. Furthermore, Adamu, Abdullahi and Ahmed (2009) agitated the need for the review of the technical teacher education Curriculum to incorporate the new mission that will match the rapidly changing society needs. There are therefore enough yearnings by scholars both within and outside the industrial sector on the technical proficiency of the TVET graduates. The industries should present in good time the details of the type of products the society wants so that relevant plan could be made by training institutions to achieve

such requirements in terms of research and re-training of technical human resource. The industries could also assist in the provision of training resource to supplement Government efforts.

Integrating Entrepreneurial Education at All Levels

Entrepreneurship is now introduced in all tertiary institutions in the country, this will certainly empower our students irrespective of their areas of specialization to realize the value of the knowledge and skills they have acquired while in school and suchvalues, could be exchanged for money and eventually they become self-reliant through such process. The ability to sell the values acquired is the bottom line in entrepreneurship. This should be extended to all levels of education and the mindset of the society would change towards self-reliance. Students should be encouraged and be assisted to write workable and realistic feasibility studies which they could lean on after graduation.

Decentralizing Technical Education Curriculum to Accommodate Local Contents

Equity and access to education could be achieved if the school curriculum which is the live wire for growth and technological development is made flexible to accommodate our different ideological orientations, our different technological endowments and our different levels of exposure. The philosophy and objectives of our education system should properly capture these and encourage the development of a decentralize local content science and technology curriculum with relevant scientific proof and present the products of such document to the global village, which will make us more relevant to the global village as a people.

Involving Stakeholders in Curriculum Reviews and Renewals

The dynamics of human society necessitates the need for periodic review of the guide used in TVET institutions; the essence is to make up in the inadequacies of the document and to inject new findings and discoveries. This should be done by relevant

stakeholders after a defined period. The practice of submitting fresh documents for implementation without involving relevant stakeholders in the review process should be discouraged.

Integrating the Informal Sector in Technical Education Training in Institutions.

The informal Technical Educationsector which includes privately owned workshops, in different field of technical trades could be standardized and be involved in training by our schools, arrangements could be made to engage them at specified time, learners could be permanently attached to them and most importantly they should be involved in decision making pertaining skill development strategies. The National Board for Technical Education (NBTE, 2011) stated that, in spite of the existence of over 100 Universities and over 120 Polytechnics and hundreds of Technical and Vocational Colleges, educational institutions in Nigeria have been largely disconnected from informal institutions and industries, through consistent neglect of competencies and undue emphasis on paper qualifications. This trend is further compounded by poor capacity utilization of industries.

Functional technical education has indeed helped so many countries boost employment for their citizens in both formal and informal sectors. Some of these countries include Australia, Canada, Germany, USA, Britain, India, China and Indonesia. This means that Nigeria can borrow her approaches and reforms from these countries which already have robust and functional technical education programmes and then adapt same to her own needs, given her abundant human and material resources in the informal sector. The integration could simply be achieved through collaboration and cooperation between the public and private sectors using a decentralized curriculum design process because of the need to involve as many stakeholders as possible. The commonwealth of learning

(2000) sees decentralized pattern of Curriculum development as an approach where the local communities, the individual states draft their own curriculum. The design has the following features;

- Local communities initiate the changes to suit their local needs.
- Teachers collaborate with parents to determine what the content of the learning should be
- It should be based on what is available.
- Subjects in schools could be the same but the contents may vary from school to school,
- Each zone may have a decentralized syllabus.
- The text books are not centrally approved.
- Evaluation is done separately (Commonwealth of learning,2010,Page 45)

The philosophy of the integration framework to be developed by the stakeholders should be focused towards the synergy of the technical education programmes through effective Collaboration and Cooperation of the formal and informal sector as an alternative resource for instruction in our schools.

The objectives of the framework for the integration as suggested by this study could revolve around the following tasks depending on the environment;

- Mobilization of relevant stakeholders in the development of skills acquisition strategies within and outside the formal school setting.
- Design of a formidable structure and timeframe adequate for minimum training in academics and technical proficiency for self-reliance and employability in Nigeria and the World.

- To determine appropriate standard, Autonomy and relevance vis-a-vis the existing Certificates, Diplomas and Degrees awarded in Nigeria.
- To design a befitting Course Contents that will provide first class training and standards to students.
- To develop strategies for collaborative funding of technical education programme with the private sector.
- To define the role. Value and Extent of involvement of each of the Stakeholder in the collaboration of the programmes.
- To design an implementation time line for the framework.

Making SIWES training Effective

Industries are always reluctant to accept students for Students' Industrial Work Experience Scheme (SIWES), the few Government works departments seem to be out of work. Students posted to such areas end up developing poor attitude to work instead of enhancing skills, the students end up without learning the required technical competency and other objectives of the exercise.

2.11 Implementation of the Building Technology Curriculum in NCE (T) Programme

The common wealth of learning 2010 considered curriculum implementation to entail putting into practice the officially prescribed courses of study, syllabuses and subjects. While, Nnachi(2009) sees curriculum implementation as the means of executing the intended desires of the curriculum planners. This could be likened to a building construction project where the architect presents a design containing the needs and aspirations of his client to the building engineer for execution of the project, the expectation is the translation or implementation of what is on paper to the ground. In another perspective Ekpo and Osam (2009) considered curriculum implementation as the

role of the teacher who interpret the curriculum, select subject matter, identify appropriate teaching method, integrate learning resource and evaluate the process and function involved.

Curriculum implementation on the other hand is the only process to achieve the intended change, it is essential in testing the efficacy and impact of any change hoped to be achieved in any planned or reviewed curriculum document. Fullan and Promphet (1977), remarked that effective implementation of any innovation require time, personal interaction, contacts and other forms of people based support.

The 2012 reviewed NCCE Minimum Standards which the curriculum currently in use by colleges reduced the graduating requirements in the NCE (Technical} programme from 137 credit hours to 118 credit hours. While Technical Education which consists of five trade subjects is reduced from 77 credits to 64 credit hours. Building Technology is allocated 3 credits in NCE I, 4 credits in NCE II and 7 credits in NCE III as contained in the table 2.4.

Table 2.9 Courses and Credit hours Allocation of Building Technology in the NCE (Technical) Curriculum, NCCE Minimum Standards

LEVEL	COURSE IST SEM	CR/HR	COURSE 2ND SEM	CR/HR	TOTAL
NCE I	Introduction to bldg construction.	2cr	Bldg science/materials	1cr	3cr
NCE II	Construction method one	2cr	Elementary structural Design	2cr	4cr
NCEIII	Teaching Practice		Land Surveying	1cr	
			Const. Method II	2cr	
			BldgMaint/repairs	1cr	
			Sch.w/shop mngt	1cr	
			Construct mngt	2cr	7cr
	TOTAL	**4cr**		**10cr**	**14cr**

Source: 2012 NCCE Reviewed Minimum Standards.

Table 2.9 is an extract of credit unit allocation of building technology in the NCE (Technical) programme. The philosophy and objectives of Building Technology is the

same with the general philosophy and objectives of the NCE (Technical) programme, which revolves around the production of technical teachers with intellectual and professional background adequate to teach technical subjects, who are adaptable to the technological global dynamics. An appraisal of the credit load scheduled for building technology in the entire programme indicates 11.86% while the credit load allocation in relation to other trades components stands as 21.87%.

Facilities required for the implementation of Building Technology curriculum

The NCCE minimum standards provides that any institution offering the NCE (Technical) programme should provide unit shops in each given area of specialization and equip them with the required tools and machines. In addition the institution should provide technical studio, separate integrated workshop equipped with standard introductory technology equipment (basic technology) similar with the type obtained in junior secondary schools. The unit building technology workshop should contain tools and equipment as follows

a. Block molding machine
b. Trowel
c. Spirit level
d. Building squares
e. Cold Chisels
f. Club Hammers
g. Cutting Chisels
h. Lines
i. Hawks
j. Head pans
k. Spades/ Shovels
l. Tape measures 5m-100m(steel and fibre types)
m. Hacksaws
n. Pipe Wrenches(assorted)
o. Plumbers vice

p. Painting rollers
q. Hand sprayers
r. Wheelbarrow
s. Weighing scales
t. Concrete mixers
u. Compacting factor apparatus
v. Slump cone
w. Poker/table vibrator
x. Theodolite
y. Automatic level
z. Leveling staff/Ranging poles

Human Resource

The NCCE Minimum Standard (curriculum) provides that the minimum teaching and technical support staff for a class of 15 students should consist of one lecturer, one instructor, one workshop attendant, one store keeper and one cleaner. The minimum qualification for a lecturer is a Degree in Technical Education with at least second class lower division or engineers with evidence of teaching qualification. While instructors are supposed to be HND holder with at least a lower credit pass plus teaching qualification. In addition, staff offices are supposed to be fully furnished.

Other complementaryrequirement expected from colleges offering the programme includes a standard library complex containing relevant books and E-learning resources, furnished classrooms and lecture halls. But all these left much to be desired, the workshops ill-equipped where available, the human resource are in adequate, and other complementary facilities have one defect or the other.

2.12 Curriculum innovations and change

The technical global environment in the new millennium inspired the global outlook resulting in the development of strategies, control mechanisms, reforms and renewals in the educational sectors at global and country levels so as to make-up for the

inadequacies in the educational systems. Raseek (2001) identified some of the direct challenges in the education sector and to scholars of curriculum to include; accelerated progress in science and technology, radical transformation in the field of work and the need of highly skilled manpower. Different countries embarked on reforms to scale down the effects through innovations; however teachers' readiness remained the contour in the implementation of any change.

The National Commission for Colleges of Education which housed the NCE (Technical) programme equally embarked on reviews of the minimum standards. Akale (2002) stated that, the changing economic world and the aspirations of the people lead to the introduction of innovations in the colleges as the need arises so as to adapt to global trends.Educational reform could face obstacles, which could be technical cultural or political, technical barriers to reform deal with the availability of teachers to handle the innovation, reformed education is characterize by students and teachers occupying new roles and doing new form of work, these new roles and practices of the teachers are influenced by matters in the technical and cultural dimension which are central to change.

Ben-Yunus (2008) identified inadequate personnel as part of the barriers where he stated thus, "often time's reforms are initiated without giving rise to the caliber of personnel that will implement the reforms." The Nigerian certificate in education technical programme came into being to provide technical teachers for the introductory technology subject to be taught at the junior secondary level without due consideration to the human resource angle, This became a glaring barrier in the implementation of the 6-3-3-4 educational reform and it is still retarding the success in the teaching of basic technology at the upper basic level.

The culture of a people is the whole way of life which fundamentally describes how they support their lively hood, how they take their social and physical environment,

how they view the world around them, how they relate as a community with other communities, what their past and present experiences had been and how these shape their future. Any educational innovation that will go contrary to the culture will be rejected by the teachers to avoid conflict with the people. Dauda (2007) stated that; "the socio-cultural, political, educational and ideological differences existing among the various sub-nations which constitute what is called Nigeria are so sharply opposed to each other." This could serve as a cultural barrier to national acceptance of educational innovations.

Resistance/readiness of teachers to accept change could largely depend on their involvement as stakeholders in the change process, the success or otherwise of any educational reform depends on the quality of relevant stakeholders used in the development of the working document, the stakeholders especially teachers are supposed to be involved in development, reviews, and renewals of any innovation. The Missouri department of school renewal(2009) stated this on involvement of relevant stakeholders;-

- Involve teachers in the entire process of developing guides in order to promote teacher ownership of the product.
- Where possible, involve teachers who teach different age levels from all buildingsin order to promote program continuity and articulation.
- Seek community input on overall goals of the program in order to help build community support for the curriculum.
- Involve school administrators in the process of developing guides in order to get their support in implementing the guide and in obtaining community and school board support.
- Seek student and graduate reactions to the curricula of each subject area in order to help relate the curricula better to the students' needs as they perceive them.

- Seek assistance of appropriate people from universities, other school districts, the business and scientific community, the local education authorities, and Secondary Education boardsin order to assure accuracy of content and to help make the curriculum relevant to the world of work and higher education(Missouri, curriculum service unit,2009)

The implementation of the practice based inquiry cycle will have to fully involve all the teachers and other stake holders in schools that will be sampled for the field work. The package as explained in this chapter do not conflict with any cultural provisions of the society, the study is hopeful that teachers will readily accept the PBI with ovation, since it will simplify their work and will create permanent learning in the students.

2.13 Empirical Studies

Scholars have written extensively on Vocational and Technical Education in general but very few have written on the NCE (Technical) programme in terms of the methodologies that could facilitate technical skills development of the potential graduates. Emphasis of researchers concentrated on the Technical Colleges however products of the Technical Colleges are those that significantly enroll into the NCE (Technical) programme, in addition the National Policy on Education placed all the technical and vocational programmes under the same umbrella. Therefore, the outcome of research/studies in technical and vocational education programmes in the country will always have a dovetail or cyclical effect on the NCE (Technical) programme, hence related empirical studies reviewed revolve around the technical and vocational educationparadigm.

Shuaibu (2016),conducted a study on "Strategies for Improving Students' Acquisition of Practical Skills in Electrical Installations and Maintenance Work Trade in Technical Colleges in Kano state". The study stated three objectives; three research

questions and developed three hypotheses. Descriptive survey was used as the design and the population consisted school administrators, trade teachers and students. Structured questionnaire was used for data collection and was analysed using the SPSS package. The study found guest lecture, demonstration, assignment, and project and guided discovery as strategies that will enhance skill acquisition in electrical installations and maintenance in technical colleges in kano. Similarities with this study are that both are searching for strategies that will improve technical skill acquisition and both used intact population as samples. Points of departures include the design, this study used quasi experimental design while the reviewed work used descriptive survey, the no and type of population also differs as well as the level of the study, technical colleges and colleges of education and polytechnics. The findings of the two studies established new instructional strategies.

Sawaba(2015), conducted a study on "Retraining Needs of Technical Teachers for Effective Implementation of the Basic Technology Subject in Junior Secondary Schools in Kano" This study aimed at identifying the weaknesses of the in-service teachers teaching Basic Technology inkano State JSS, where most of them are supposed to be graduates of the NCE (Technical) programme. The population of the study consisted of all Basic Technology teachers in junior secondary schools in Kano State out of which, one hundred and seventeen (117) were sampled using stratified random sampling techniques from the fourteen educational zones. Five research questions and fivehypotheses were developed, a questionnaire was used as instrument for data collection, and the data collected were analysed using descriptive statistics and Z test. The findings established the dearth need of skills in all the trade courses and recommended for retraining of the in-service teachers through seminars and workshops.

The relationship of the two studies is in the subjects for the study, the reviewed study was conducted on in-service technical teachers, while this study was conducted on

pre-service technical teachers. The outcomes of the reviewed study are part of the gaps this study wish to address. The point of departure of the two studies includes the design, while this study used quasi-experimental design; the reviewed work used survey design. The tools for the statistical analysis are almost same (t-test and z-test) however, the outcomes of the two studies are tailored towards strategies to enhance instructions at the junior secondary school.

Sabo(2015), conducted a study titled "The Extent of Synergy in the Implementation of the NCE(Technical) Programme between Colleges of Education and Polytechnics in Nigeria." The study was interested in the extent of compliance with the NCCE Minimum Standards by the institutions which are under different regulating agencies NCCE and NBTE. The Survey design was used population of the study consisted of lecturers from two Colleges of Education and two Polytechnics purposively sampled for the study, ten questionnaires were administered to the ten sampled lecturers in each of the institution, thirty one of the questionnaires were returned representing about 78% return rate. The data was analysed using descriptive statistics and Pearson product moment correlation. The null hypothesis was retained, the two institutions concur in twenty three out of the thirty seven items raised in the study.

The relationships between the two studies are in the programme and the institutions. Both studies used the Colleges of Education (Technical) and Polytechnics and the NCE (Technical) Programme in the institutions. The point of departure is in the subjects used, the reviewed study used lecturers and analysed using descriptive statistics while this study used students and analysed using t-test.The findings of the two studies established synergy in the NCE (Technical) Programme in the two institutions.

Onweh andAkpan(2014), conducted a study titled "Instructional Strategies and Students' Academic Performance in Electrical Installation in Technical Colleges in Akwa-

Ibom State: Instructional Skills for Structuring Appropriate Learning Experiences for Students" The study was interested on effect of teaching method on academic performance. Two research questions and two hypotheses were developed. The study used quasi experimental design with non-equivalent experimental and control groups. Four intact classes of the subjects were used leading to a sample size of about two hundred and thirty one subjects (231) analysed the collected data using ANOVA. The study found that subjects taught using discussions, demonstrations and inquiry methods performed better than those taught using the lecture methods, because of the Learner centered features, the study concluded that, the poor performance of students in technical education programmes is as result of poor instructional strategies used.

The two studies compared effect on performance as a result of teaching strategy, quasi experimental designs were used in the twostudies; the points of departures are in the subjects used and the statistical tool for the data analysis. The reviewed study was conducted on technical colleges and was analysed using ANOVA while, this study used NCE (Technical) Students and was analysed using t-test. Both findings are in tandem with the learner centered approach to instructions and discouraged the traditional lecture methods.

Lawal(2014),Conducted a Study on Skills Required by Teachers to Carry out Activities in Wood Workshops in Tertiary Institutions in Northwestern Nigeria. This work was interested in skill gaps in wood workshops in the North West, which included Colleges of Education and Polytechnics that train the Pre-service technical teachers. The population of the study consistedall woodwork lecturers and supporting staff in the wood workshops, the whole population was retained as the sample. Four research questions and four hypotheses were developed, Survey design was used in the analysis using descriptive

statistics and t-test. The findings revealed Needs for retraining in woodwork skills so as to effectively train the pre-service technical teachers before graduation.

The commonality of the two studies is the interest of making pre-service technical teachers more-effective teachers on graduation. But, while the reviewed work used staff as subjects for the study this work used students, the analytical tools also did not vary however, the reviewed study has established the gap the findings of this work could be adapted to fill.

Omoiya(2013), carried out a study titled; "Comparative Effect of three Teaching Techniques on Students Academic Achievement, Interest and Retention in Radio and Television Trade in Technical Colleges in Kogi State." The purpose of the study was to investigate the comparative effect of three teaching techniques Modeling, Coaching and Scaffolding on students' achievement, interest and retention in Radio and Television, which is a course at the Technical College level. The population of the study consisted of students of technical colleges in Kogi state. He developed six research questions and six hypotheses capturing the variables involved in the study. The study used quasi experimental design with non-equivalent treatment and control group design.

The findings indicated that the three teaching techniques had impacted positively on the achievement of students. But the Coaching and Scaffolding Techniques were better because of their learner centered features. The study had therefore revealed additional strategies in teaching of Vocational and Technical Education courses. The two studies concur in efforts to explore additional learner Centered Techniques for use in teaching Vocational and technical courses, The reviewed study used quasi experimental design, similarly this study used the quasi experimental technique. The point of departure of the two studies is in the population, the reviewed study used technical college students in

radio and television while this study used building technology students at the NCE (Technical) level.

Adavbiele(2013), conducted a study titled, "Technical Skill Needs of Technical Teachers in the South South Nigeria." The study identified the skill gaps between technical skill needs and technical skill possessed by technical teachers in building technology in South-South Nigeria. Descriptive survey design was used. Questionnaire and checklist were used to collect data, the total population of the study consisted of 102 respondents, which included all the building technology teachers in 35 technical colleges in South-South Nigeria. Two research questions developed for the study were;

1. What are the technical training skills needs of building technology teachers in technical colleges in South-South Nigeria?

2. What are the technical training skills possessed by building technology teachers in technical Colleges in South-South Nigeria?

The data was analyzed using relevant statistical tools, which include frequency, means, correlation and standard deviation. The study revealed that, there are skill shortages and gaps. The findings further identified technical skills needed by the building technology teachers to include; building drawing skills, surveying, landscaping, site preparation skills, ability to use machines in construction, brick and block Laying skills, others are roofing skills, masonry skills in building, concreting, reinforcement skills, carpentry and Joinery skills, final Finishes skills, and the ability to organize workshop practical.

The reviewed study justified the need for exploring strategies to improve on the methods of imparting technical skills to our teachers while at school, which is one of the areas of commonality, in addition both studies are working in the building trade. The point

of difference are in the level of the subjects for the research and the statistical tools used, the reviewed study used survey and descriptive statistics while this study to used t-test.

Ali andMuhammed (2012),carried out a research on the "Implementation of Technical and Vocational Education in Post Primary Schools in Nigeria: A Qualitative Approach." The researchers were interested in the employability of the products of vocational and technical institutions on graduation. The researchers used content analysis and survey on the Technical Colleges in Kano. The findings revealed adequate curricula content but poor implementation, less number of hours allocated for practical, inadequate time to implement both the theory and practical content of the curriculum as impediments. The study further identified the introduction of so many general subjects in the school curriculum which will not facilitate skill acquisition. The common areas of concern of the two studies are; majority of the technical colleges graduates are admitted into the NCE (Technical) programme and the need for technical skills development for employability in the Nigerian economy. The point of difference are in the level of the subjects for the research and the statistical tools used, the reviewed study used content analysis and survey while this study used quasi experimental and t-test.

Saviour, Ezekiel, and Patrick (2012), carried out a study on instructional strategies and students' skill acquisition in vegetable crop production in AkwaIbom State of Nigeria. Three research questions and three null hypotheses were used in the study. A structured questionnaire was used as the instrument for data collection from the respondents. The instrument was called Vegetable Production Experience Test (VPET) and consisted of 25-items with a four-point rating response options. Mean score was used for answering research questions. Analysis of variance and scheffe's test analysis were used in analyzing and testing the null hypotheses at 0.05 level of significance. The population of the study comprised 3205 Agricultural Science students in senior secondary schools (SS II) in

AkwaIbom State. The sample consisted of 150 senior secondary two (SS II) students selected from three intact classes in three schools out of 239 sampled in the area of study. A non-randomized pre-test and post-test control group designs were used. Results of the study revealed that the students taught using guided demonstration strategy performed better in both laying out for vegetable production and sowing skill than their counterparts in discovery learning and expository groups. The findings further revealed that gender does not significantly influence skill acquisition. Guided-demonstration strategy was recommended for adoption in both secondary and tertiary institutions since skill acquisition is the basic objective of Agricultural Education Programme. The study conducted by Saviour, Ezekiel, and Patrick (2012) was related to the present study in the sense that while Saviour, Ezekiel, and Patrick in their study determined instructional strategies and students' skill acquisition in vegetable crop production secondary school in AkwaIbom State of Nigeria, the present study up scaled and explored an instructional strategy for improving students' acquisition of practical skills in the NCE (Technical) programme.

Udofia, Ekpo, Nsa, and Akpan (2012), conducted a study on instructional variables and students' acquisition of employable skills in vocational education in Nigerian technical colleges. The study adopted a correlational survey design. The purpose of the study was to determine the influence of teacher quality, teaching methods, workshop equipment and training materials on students' acquisition of employable skills in vocational technical subjects. Three research questions were formulated and three hypotheses were tested at 0.05 level of significance in the study. The population size was 240. A random sampling technique was used to obtain a sample size of 120 students for the study. A 28-item structured questionnaire titled, Students Acquisition of Employable Skills Questionnaire (SAESQ) with a four-point rating response options were used for data

collection. Mean, Pearson Product Moment Correlation (PPMC) and Regression analysis were used for data analysis. The results indicated that there was significant relationship between teacher quality and students' acquisition of employable skills. The findings also revealed that there was significant relationship between teaching methods and students' skill acquisition. One of the recommendations called for the provision of modern workshop equipment and employment of qualified and experienced teachers for effective training of students in AkwaIbom State. The study conducted by Udofia, Ekpo, Nsa, and Akpan (2012) is related to this study in sharing teaching methods and strategies for acquisition of skills by students in vocational and technical education.

Dasmani (2011), conducted a study on challenges facing technical institute graduates in practical skill acquisition in the Upper East Region of Ghana. The purpose of the study was to explore and describe the challenges confronting technical institute graduates in practical skill acquisition. A descriptive survey was used for the study. Four research questions guided the study. Simple random and purposive sampling techniques were used for the study. A sample size of 434 was drawn from the two municipalities where the technical institutes are located. Data were collected by using a questionnaire which was based on a 4-point rating scale. Pre-testing was conducted with 24 respondents and its internal consistency reliability coefficient produced a value of 0.7018. Arithmetic mean was used for data analysis with a decision point put at 2.50. The findings of the study were inadequate supply of instructional materials, large class sizes, inadequate training facilities, and weak linkages with local industries for hands-on-experience for both instructors and trainees. It was recommended that stakeholders should complement government efforts in the provision of training resources; students to be encouraged to purchase their own basic tools with girls given special packages; institution of effective industrial attachment schemes that will enable students to identify and gain practical

knowledge required for workplace through hands-on-experience in local organizations; and improvement in instructional quality through instructor training initiatives through pre-service and in-service modes. The present study is related to the study conducted by Dasmani (2011) in the sense that strategies for improving acquisition of practical skills in vocational and technical education are explored. The points of departure include the design of the study and the programme studied.

Saba,Ma'aji, and Tsado(2011), conducted a study titled "Assessment of the pedagogical skills adopted in teaching of electrical and electronics engineering in the Universities in Northern Nigeria." A survey research design was adopted with 91 Lecturers and 371 students sampled for the study. The research question for the study was, "to determine the pedagogical skills needed by electrical and electronics engineering lecturers in instructional delivery in the Universities in Northern Nigeria". The Findings on needed pedagogical skills in teaching of electrical and electronics engineering indicated that:

- Demonstration method is more effective when teaching skills.
- Lecturers should develop clear instructional objectives.
- Students should be encouraged to do team work
- Cordial relationship should exist between teachers and students.
- Lecturers should motivate students during instruction.

The similarity with this study is in the area of the teaching strategies, the outcome of the study revealed the need for more learner centered approaches through team work and cordial relationship between teachers and learners. This study explored a strategy (PBI) in the learner centered approach to instructions. The area of differences include the population for the study and the trade subjects, the reviewed literature targeted electrical

engineering trade in the Universities while this study is in building technology trade in the polytechnics and Colleges of Education.

Ede, Miller and Bakare (2010), carried out a study on work skill improvement needs of graduates of technical colleges in machine shop practice for demand driven employment in south west zone of contemporary Nigeria. Four research questions guided the study. A survey research design was employed for the study. The population of the study was 190 graduates of metal work from industries in area of the study. The sample for the study was 56 graduates purposively sampled from three industries in the zone. Split-half technique and Cronbach alpha reliability method were adopted to determine the internal consistency of the questionnaire items; a Cronbach alpha coefficient of 0.86 was obtained. Fifty six copies of the instrument were administered. All the fifty six copies of the instrument were retrieved and analyzed using weighted mean and improvement needed index. It was found out that graduates of technical colleges need improvement in identified work skills for operations in machine shop practice, for demand driven employment in south west zone of contemporary Nigeria. It was recommended that identified work skills in which improvements are needed by the graduates be packaged and be used for retraining them in operations of machine shop practice. It was also recommended that the identified work skills should be packaged to train students of technical colleges who major in machine shop practice. Ede, Miller and Bakare's study is similar to the present study in that work skill improvement needs addressed strategies for acquisition of practical skills by students in vocational and technical sectors were involved.

Olaniyan and Lucas (2008), conducted a study titled, "challenges against implementation of introductory technology curriculum in Nigerian Junior Secondary Schools". The study used survey research design. One Hundred and Twenty-Five (125) teachers were randomly selected as sample of the population, four research questions and

four hypotheses were developed. A structured questionnaire using the likert rating scale was employed, while data collected were analyzed using Arithmetic mean (x) and reliability was tested using Kuder Richardson formula (KR-1).

The study found that, Technical Teachers need retraining on basic components of Introductory Technology through, workshops and seminars which will enhance teachers' competency in teaching theoretical and practical components of the curriculum, and consequently improving the quality of instruction to students. The study further recommended that, Technical Teacher's Training should be restructured to enhance professional development of relevant skills. The reviewed study has established the existence of a gap in the technical proficiency of the NCE technical graduates, which could be as a result of the effect of the training received while in school. This study has explored a new strategy (PBI) that could eventually enhance technical skills acquisition in colleges. The points of differences are in the level of the subjects for the research and the statistical tools used, the reviewed study used survey while this study used quasi experimental techniques.

Arrey-Ndep(1999), conducted a study on the "Responses of Administrators of Colleges of Education (Technical) in the Management of Challenges in Vocational Technical Education". The study was interested in challenges faced by heads of schools and academic units which included the delivery of instructions. The population of the study comprised of all the one hundred and ten (110) administrative heads in the eight Federal Colleges of Education (Technical). Six research questions and two hypotheses were developed and the data collected were analysed using t-test. The major finding related to this study is the emphasis of theory over practical activities by lecturers, where the study suggested specification of theory and practical contacts and adequate supply of practical materials as solutions.

The agreement of the two studies are in the institutions for the study the statistical tool used for the analysis which was t-test but, the population differs while the reviewed study used heads of administrative units, this study used students as the subjects for the study. The findings are in the same direction, planning of practical and provision of materials for hands-on activities.

2.14 Summary

The chapter started with a historical antecedent of the development of Vocational and Technical Education in Nigeria.This could be classified into the pre- colonial era where wards acquire skills from parents and local craftsmen in the community. The pre-independence period where vocational subjects were introduced in Comprehensive and Missionary Schools though, the emphasis of the schools was to train people to be able read and write which qualified them to work in colonial offices. However, The major stride before independence towards Vocational and Technical Education was the outcome of the Elliot Commission in 1943 which recommended the conversion of Yaba High College to a Technical institution in 1945 and the establishment of similar ones in Kaduna and Enugu While, the establishment of Comprehensive College Aiyetoro with the assistance of Ford foundation brought novelty to Vocational and Technical Education at the Secondary level.

The post-independence era witnessed the curriculum conference of 1969 and curriculum seminar of experts in 1973, the outcome of which gave birth to the National Policy on Education in 1977 and consequently the 6-3-3-4 system of education in Nigeria which was launched in 1982. The system came with a lot of pre-vocational and technical packages aimed at facilitating technological growth from the grass root. Colleges of Education (Technical) were established to train NCE Technical teachers to provide human resource for the new educational system. The National Commission for Colleges of Education was established to design and monitor the curriculum document of the NCE

(Technical) programme in the country amongst others. Despite series of reviews of the minimum standards, the philosophy and objectives of the NCE (Technical) programme as contained in the 1990, 1996, 2002, 2008 and 2012 editions of the minimum standards remain as; to provide technical teachers with the intellectual and professional background adequate of teaching technical subjects and to make them adaptable to any changing situation in technological development not only in the country but the world at large. NCE (Technical) students must take courses in all the technical trades namely; Automobile technology, Building technology, Electrical/Electronic technology, Metal Work technology and Wood Work technology. The credit hours required for graduation as contained in the 2012 reviewed minimum standard is 118 credits which includes 64 credits for the five trade subjects.

Building Technology is one of the five compulsory and complimentary trade subjects in the NCE (Technical) programme. It is allocated a weight of 14 credits from level one to three, it has the same philosophy and objective with the programme. The basic technique used in instruction is thelecture method. Other strategies that could be used in teaching skills are the guided discovery, inquiry and apprenticeship method. The concept of practical skill is reviewed to include both cognitive and display of manual dexterity which develop into habits of doing things.

The provisions of practice based inquiry cycle are in tandem with the constructivist learning paradigm, therefore the theoretical frame work that guided the study is constructivism.The readiness of teachers to accept change/innovation depends on the extent of their involvement as stake holders in the change process. The involvement of the teachers inadapting the PBI as a curriculum innovation will enhance instructions in their schools.

The Practice Based Inquiry cycle (PBI) revolves around learner centeredness, where teachers and learners tend to be equal in the learning activities. The cycle consists of series of activities which the building technology teacher could adopt to enhance his planning for class work and laboratory/workshop activities resulting in an improve outcome after delivery. The stages involved are, to identify a problem, to plan a solution, to put the solution into practice and then to evaluate it again. This is a way of improving based on doing, its flexibility allow for hands-on activities to be designed with an action plan to guide the implementation. The cycle was used to illustrate the teaching of a practical concept in building technology. The teachers become mentors, guides, facilitators while the students become fully involved in all activities eventually creating permanent learning in them.

Related empirical studies reviewedfocused, on teaching techniques in vocational and technical education, appraisal of implementation of introductory technology (basic technology) and skill gaps in the training. The population of the studies ranged from lower basic schools to the Universities, the statistical method used are quasi experimental, and survey designs. The findings revealed that learner centered techniques (coaching and scaffolding) to be better approaches in teaching technical skills, inadequate instructional resources and inadequate time for teaching of practical were established. The need for retraining the teachers to update their skills due to gaps was revealed as one of the findings, Therefore this study on effects of the practice based inquiry cycle on performance of building technology students in the NCE (Technical) programme is unique in adding value to the teaching methods presently being used in teaching the building component of the NCE (Technical) programme.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter contains the set-up of the research work; it describesthe research design, population and sample, instrument fordata collection and validation. The conduct of pilot study is highlighted and procedures for data collection anddata analysis are stated.

3.2 Research Design

The studywas an experiment involving different institutions from different locations. Cohen, Manion,& Morrison,(2007), identified quasi experimental design for use in educational experimentation, in a natural setting other than the laboratory. ThePre-testPost-test, control and experimental non-equivalent groups design was used. In this design, there was a pre-test, to both the control and the experimental groups at the beginning of the study whilethe experimental groups received thetreatment, which was using thePractice-based Inquiry cycle to teach selected topics in building technology for six weeks, in the experimental schools by the researcher. The control groups were equally taught the same topics using the conventional lecture method that has been in practice. All the groups (control and experimental) were afterwards subjected to a Post-test using the same items earlier Pre-tested at the beginning of the study.

The research was carried out without affecting the academic programme of the institutions selected for the study, and the existing classes of the subjects. The study used

twoinstitutions for the control and two institutions for the experimental group that received the treatment. The design of the experiment is represented in figure 3.1

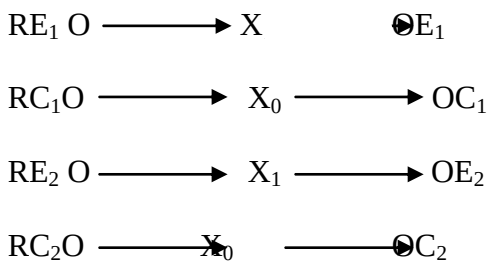

Figure 3.1 Research Design Illustrations

- RE_1O stands for experimental group one
- RC_1O stands for control group one
- RE_2O stands for experimental group 2
- RC_2O stands for control group 2
- X stands for treatment

- OE_1 stands for pre-test and post- test scores experimental group one
- OC_1 stands for pre-test and post-test scores control groupone
- OE_2 stands for pre-test and post-test scores experimental group two
- OC_2 stands for pre-test and post-test scores control group two

3.3 Population

The population for this study comprisedallregular NCE II (Technical) studentsin the 2014/2015 academic session in Colleges of Education (Technical) Bichi and Gombe,

Hassan UsmanKatsina Polytechnic and Kano State Polytechnic,numbering six hundred and forty-five (645). All the institutions offer the NCE (Technical) programme

Table 3.1Population of the Study

S/N	Institutions	NCEII (Technical) students
1	Federal College of Education (technical) Bichi	220
2	Federal College of Education (Technical) Gombe	247
3	Kano State Polytechnic, Kano	70
4	Hassan UsmanKatsina Polytechnic, Katsina	108
	Total	**645**

Source:Deans Offices of the Institutions (2014/2015 session)

Table 3.1 contained the population of the study as obtained from the institutions used for both the experimental and control groups.

3.4 Sample and Sampling Techniques

Intact class sizes of the population totaling 645 were used as samplefor the treatment. Purposive sampling techniquewas used in the choice of the institutions to allow the researcher to effectively carry out the study being an experimental design. The sampled institutions have all the characteristics being sought for the study. This is in line with,Cohen,Lawrence and Keith (2007).In addition, there are few colleges of education and polytechnics offering the NCE (Technical) programme in Nigeria.

Table 3.2 Sample for the study

S/N	Institutions	Intact class size

1	Federal College of Education (technical) Bichi	220
2	Federal College of Education (Technical) Gombe	247
3	Kano State Polytechnic, Kano	70
4	Hassan UsmanKatsina Polytechnic, Katsina	108
	Total	**645**

Source: Deans Offices of the Institutions (2014/2015 session)

Table 3.2 is the sample for the study, which is the same with the population since intact class size, was used being an experimental study.

3.4.1 Homogeneity of samples

The sampled institution used the same curriculum which is the NCCE Minimum Standards. By implication they employ the same category of staff, admit students with same entry qualifications, are subjected to the same monitoring and periodic accreditation exercise and as much as possible operate in almost the same type of learning environment. The institutions are therefore homogenous. In addition the NCE II (Technical) students used for the study, had attended NCE I and had obtained the minimum points to register for NCE II courses. They were fully on ground because they could only be posted out for students' industrial work experience scheme and teaching practice on completion of NCE II as contained in the NCCE Minimum Standards.

3.5 Instrumentation

A teacher made performance test measuring Building Technology skills Practice-based Inquiry Student Test (PBIST),was developed and used for the pre-test and post-test in both the control and experimental institutions. The topics used in the treatment were; Setting out of simple building plans, Foundations, Walls and basic safety skills required in building technology. These topics are contained in the (NCCE) minimum standards (curriculum) for NCE II (Technical) students. The test items consisted of seventy multiple

choice items measuring Building Technology skills in the three learning domains, cognitive, affective and psychomotor. The first 23 items measured skills in building technology concepts, 27 items measured affective tasks performance skills and 20 items measured hands-on tasks performance skills.The items were sourced from past National Board for Technical and Business Examination (NABTEB) question papers, and wereadapted using actions verbs that measureperformance in learning as contained in the improved Bloom taxonomy of measurable verbs in the three learning domains.

The treatment package was designed for six weeks with two weeks slated for each of the topic using separate lesson plans for the control and experimental groups. The lesson plans were designedusing activity based approach which complements PBI. The first week of contact in every topic was used for classroom activity while the second week was used for hands-onactivities planned in the treatment. Basic safety issues were already integrated with each of the topics in the treatment,see appendix III. However, before the treatment started one week was used for familiarization and administering of the pre-test and similarly, one week was used for post- test and wrap-up of the field activity after the sixth week of treatment.

3.5.1 Validity of the Instrument

The validity of any instrument involves the extent of suitability and appropriateness of the instrument in measuring what it really intends to measure rather than some other variablesUzoaglu (2011), The teacher made performance test (PBIST) developed for the pre-test and post-test, were sourced and adapted from past questions of an already validated examination from a nationally recognized examination body (NABTEB). In addition the items were further moderated by the researcher's supervisors, Principal and Chief lecturers in Building Technology, Measurement and Evaluation, English and Technical Education within and outside the Faculty of Education Ahmadu

Bello University Zaria. This has been the standard of the NCCE for moderation of all examinations in the NCE (Technical) programme. The outcome of the validation improved the construct of the items, simplified vague questions and suggested for the removal of section B, of the PBIST which were short phrases items, since they werealready captured in the objective items. This reduced the items from one hundred to seventy items used for the pilot study.

3.5.2 Pilot Study

To determine the reliability of the study and the internal consistency of the developed teacher made performance test PBISTused in the pre-test and post-test of the study, a pilot study was conducted at AbubakarTatari Polytechnic Bauchi. The institution offered the NCE(Technical) programme and was not included in the purposive sample for the study. The NCE II (Technical) students were used, ninety four(94) of the students participated in the test and the result was used to determine the reliability coefficient of the study.

3.5.3Reliability of the Instrument

The result of the test items obtained during pilot study was computed to determine the reliability coefficient using Pearson Product Moment Correlation (PPMC). The SPSS packagewas used to obtain the reliability indexof 0.84which indicates good reliability of the instrument used for the study.

3.6 Procedures for Data Collection

An introduction letter from the Department of Educational Foundations and Curriculum, ABU Zaria was collected, the letter introduced the researcher and the objective of the research to the institutions purposively sampled for the study.The Pre-test was conducted in the first week after familiarization and interactions with some of the

lecturers, students and other stakeholders in the technical education programme of the institutions.

Two research assistants from the workshop support staff of each of the school were trained on the first day. The research assistants in the control schools were trained on how to conduct the pre-test and post-test activities. While the assistants from the experimental schools were trained on how to conduct the pre and post-tests, develop and score a check-list of resource needed for the hands-on activities and how to support students during the experiments. See attached appendix

The treatment package was delivered for six weeks in the experimental schools Federal College of Education (Technical) Bichi and Kano State Polytechnics by the researcher. The selected topics were equally taught using normal lecture method in the control schools Federal College of Education (Technical) Gombe and Hassan UsmanKastina Polytechnic.Normal class hours were used with little consensus in the control schools due to the distance but the experimental schools are just few kilometers apart which made meeting up with contact hours much easier for the researcher. The pre-test and pos-test items were marked over 70, each correct response to an item attracted one mark and the results were collated for analysis.

3.6.1 Treatment plan/ procedure

Table 3.3 below contained the treatment schedule as carried out by the researcher, the treatment was done from the second to the seventh week while, the first and last weeks were used for familiarization and pre and post tests

Table 3.3 Schedule for the Treatment Package

S/N	PERIOD	ACTIVITY	REMARKS
1	1st week	Familiarization and pre-test	Successful in both exp. & cont. sch.
2	2nd week	Instruction on Setting out of simple building plans	Conducted in both exp.& cont. sch.
3	3rd week	Hands-on activity; setting out of simple building plan	Conducted in exp.sch. while lect. Continued in cont. sch.
4	4rdweek	Instruction on foundations	Conducted in both exp. & cont. sch.
5	5th week	Hands-on activity; workability test of foundation concrete	Conducted in exp. Sch. While lect. continued in control sch.
6	6th week	Instruction on walls	Conducted in both exp.& cont. sch.
7	7th week	Hands-on activity; construction of stretcher bond walls	Conducted in exp. Sch. While lecture continued in control sch.
8	8th week	Post-test and wrap-up	Successful in both exp. & cont. sch.

Table 3.3 outlined the scheduled of treatment carried in both experimental and control schools by the researcher.

3.7 Procedures for Data Analysis

The sample size used for the analysis consisted of one hundred and twenty(120) NCE II (Technical) students, 30 students each purposely selected based on full attendance during treatment sessions and lecture attendance in both the experimental and control schools respectively. This sample has taken cognizance of the recommended sample population accepted to be sufficient for experimental research, by Fraenkel and Wallen

(2000), Ogunleye (2000), and Kerlinger and Lee (2005) as cited by peni (2016). In addition, Currier (1984), in Lusford and Lusford (1995) equally cited by peni (2016), observed that, at least 15 - 30 subjects should be gathered for experimental studies involving comparison of groups.

The data collected wereanalyzed using descriptive statistics; mean, standard deviation,line and scatter plot graphs.These were used to response to the research questions raised in the study. The hypotheses developed inrelation to the research questions were tested using t-test statisticsat 0.05 level of significance that is 95% confidence level. The SPSS package 22.0 was used for the computation. The variables tested included; the effects of PBI on performance in building technology concepts, affective tasks performance in building technology, hands-on tasks performance in Building Technology and the synergy in the experimental schools.

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSIONS

4.1 Introduction

This chapter presents the analysis of the data collected from the quasi-experiment onEffects of Practice-based Inquiry cycle on the performance of Building Technology students, in colleges of education (experimental and control groups one) and Polytechnics (experimental and control groups two)in Nigeria, using appropriate statistical tools. The presentation started with the research questions; collated results from the two experimental and control groups were analyzed separately using descriptive statistics; mean, standard deviation, line and scatter plot graphs in response to the research questions. Thefive null hypotheses formulated from the objectives of the study in relation to the research questions, were tested using independent sample t-test. All the hypotheses were tested at 95% confidence level that is 0.05 level of significance.

4.2 Response to Research Questions

Research question one: What is the effect of Practice-based Inquiry cycle and conventional method on the Performance of NCE (Technical) students in Building Technology in colleges of education and polytechnics in Nigeria?

In response to this research question the thirty purposefully selected students' pre-test and post-test scores of the colleges of education and polytechnics were analyzed indicating the values obtained in both the control and experimental groups as contained in table 4.1.

Table 4.1 General mean performance scores of the experimental and control groups

Status	N	Pre-test mean	t-test mean	Mean difference	Std. pre.	Std. post
Exp. group I	30	25.53	35.07	9.53	7.82451	6.76162
Cont. group I	30	24.57	29.27	4.70	6.68340	7.95649
Exp. group II	30	23.23	31.43	8.20	6.83643	7.74901
Con.group II	30	23.00	29.30	6.30	6.19232	5.76045

Table 4.1 contained the performance of the pre and post-tests from both control and experimental schools. The results showed thatthe performance mean scores of the post-test in the two experimental groups 35.07 and 31.43 are higher than the performance mean scores obtained in the pre-test of 25.53 and 23.23 respectively, with a mean difference of 9.53 and 8.2 as indicated in the table. Similarly the performance means and mean differences of the two experimental groups are higher than the ones obtained in the two control groups as shown in table 4.1.The outcome indicates positive effect of the PBI on the performance of the students in Building Technology in colleges of education and polytechnics in Nigeria. This result is vividly displayed graphically in figures 4.1, 4.2, 4.3 and 4.4 respectively for the experimental and control groups.

The line graphs with red indicating post-test values and blue indicating pre-test values in the figures for experimental and control groups respectively have given clear illustration of positive performance in the experimental schools where the treatments were given. The red values are in the upper continuum as shown with wider margins, while in

the control group some of the values have merged with each other indicating poor performance in the control schools where the conventional teaching methods were used.

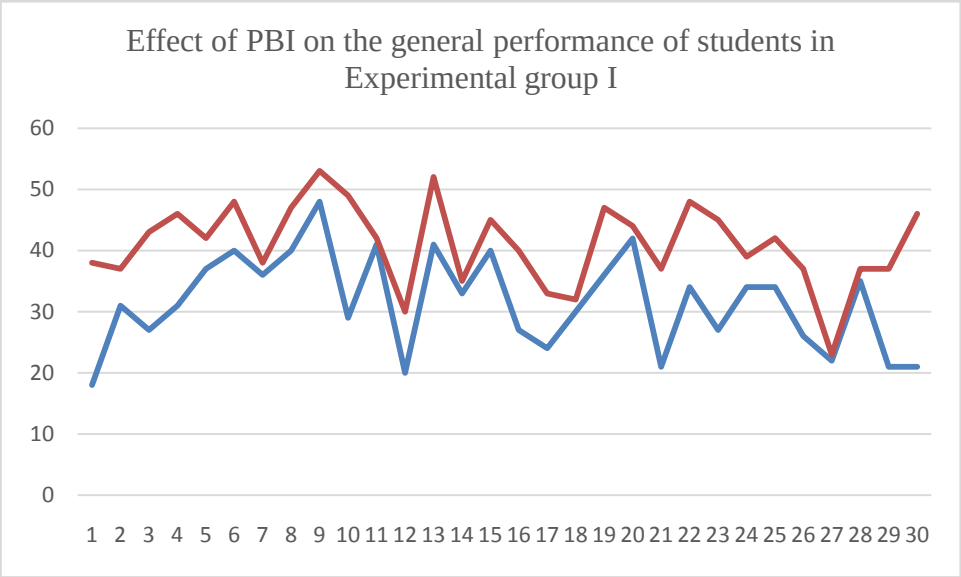

Figure 4.1 Line Graph of the effect of PBI on performance

Red graph line indicates post-test values, while blue indicates pre-test values. This showed enhanced performance after treatment with PBI method of instruction.

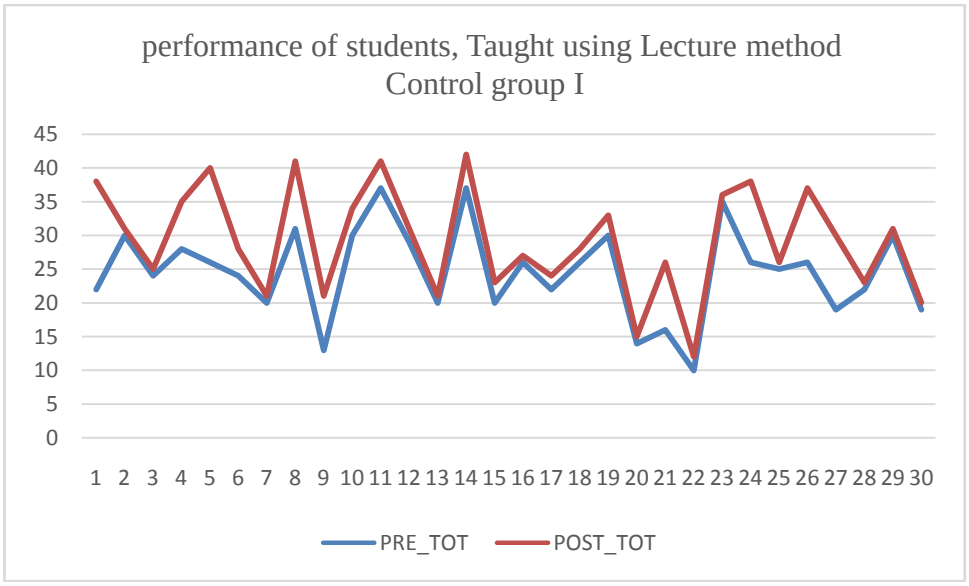

Figure 4.2 Line graph of performance in control group I

Red graph line indicates post-test values, while blue indicates pre-test values. This showed an insignificant difference in the control group.

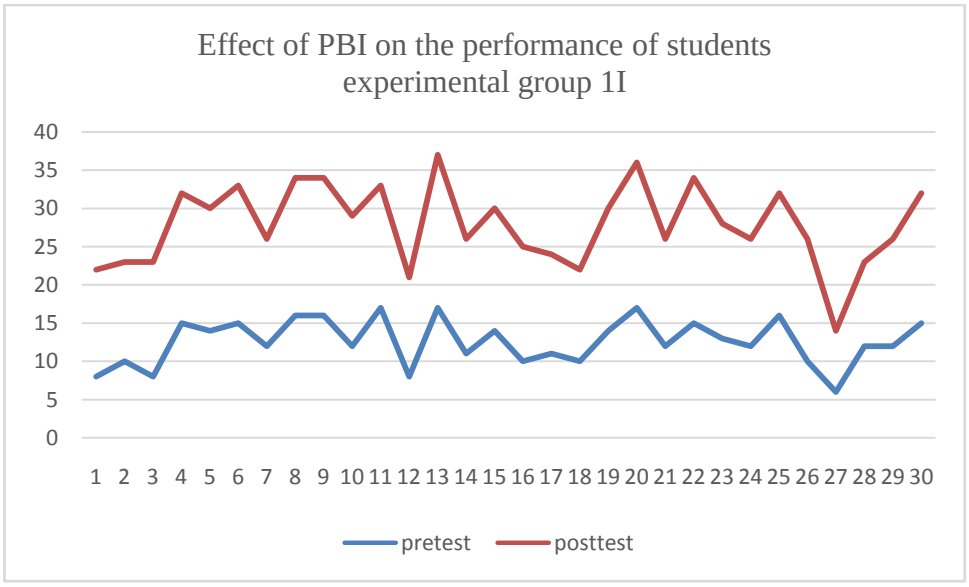

Figure 4.3 Line graph of Performance scores in Experimental Group II

Red graph line indicates post-test values, while blue indicates pre-test values. This showed enhanced performance after treatment with PBI method of instruction

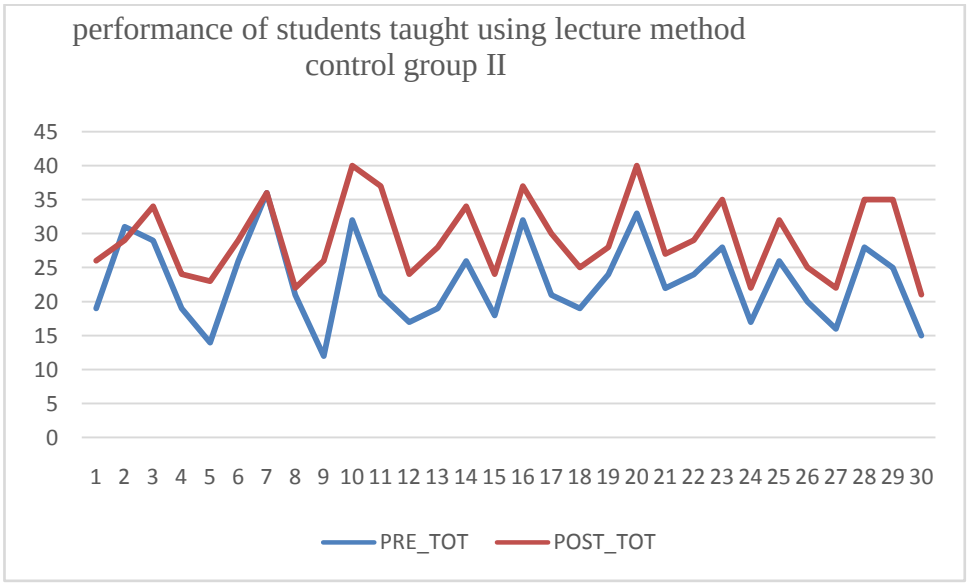

Figure 4.4 line graphs of performance scores in Control Group II

Red graph line indicates post-test values, while blue indicates pre-test values. This showed an insignificant difference in the control group.

6. **Research Question two;**what is the effect of Practice-based Inquiry cycle and conventional method on NCE (Technical) students in Building Technology concepts in colleges of education and polytechnics in Nigeria?

In response to the research question, the pre-test and post-test scores of the items in the instrument, that measured performance in Building Technology concepts in the experimental and control groups are analyzed and the summary is in table 4.2;

Table 4.2 Performance Means inBuilding Technology Concepts

Status	N	Pre-test mean	Post-test mean	Mean difference	Std. pre	Std. post
Exp. group I	30	10.67	13.43	2.77	3.20	2.80
Cont. group I	30	8.90	10.17	1.27	2.06	2.85
Exp. group II	30	10.60	12.80	2.2	3.54	2.37
Cont. group II	30	8.13	9.87	1.73	2.75	2.74

Table 4.2 indicates that the performance mean of the post-tests in the two experimental groups (13.43 and 12.80) are higher than their respective pre-test mean performance (10.67 and 10.60). In addition the scores are equally higher than the post test scores of the two control groups (10.17 and 9.87) respectively, as contained in table 4.2. This outcome indicate positive effects of the PBI in enhanced performance of the students in building technology concepts,as vividly shown in the line graphs, in figures4.5, 4.6, 4.7 and 4.8 respectively with red indicating post-test results and blue indicating the pre-test.

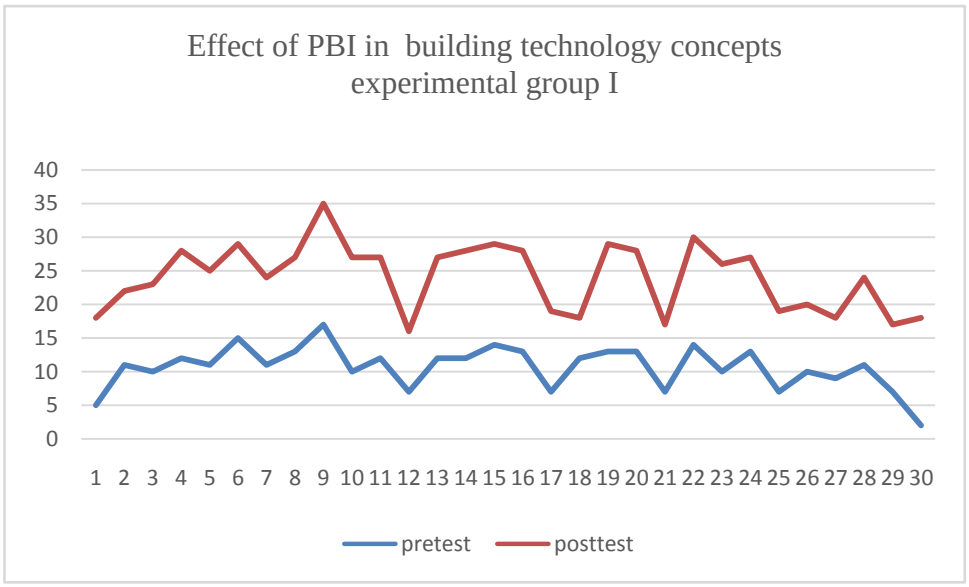

Figure 4.5 Line graph showing performance in building technology concept experimental group 1

Red graph line indicates post-test values, while blue indicates pre-test values. This showed enhanced performance after treatment with PBI method of instruction

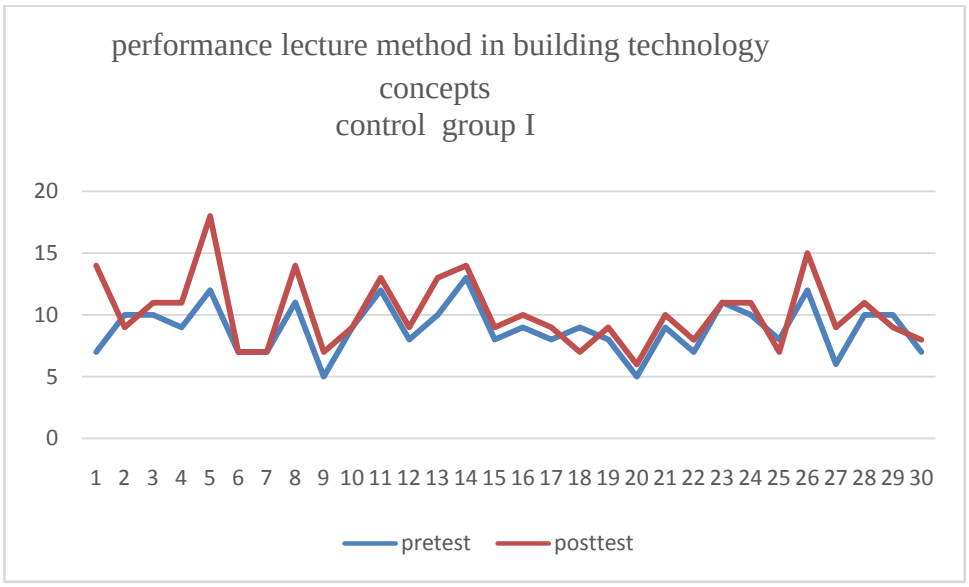

Figure 4.6 line graphs of performance scores in building technology concepts of students taught using lecture method in control group I.

Red graph line indicates post-test values, while blue indicates pre-test values. This showed an insignificant difference in the control group.

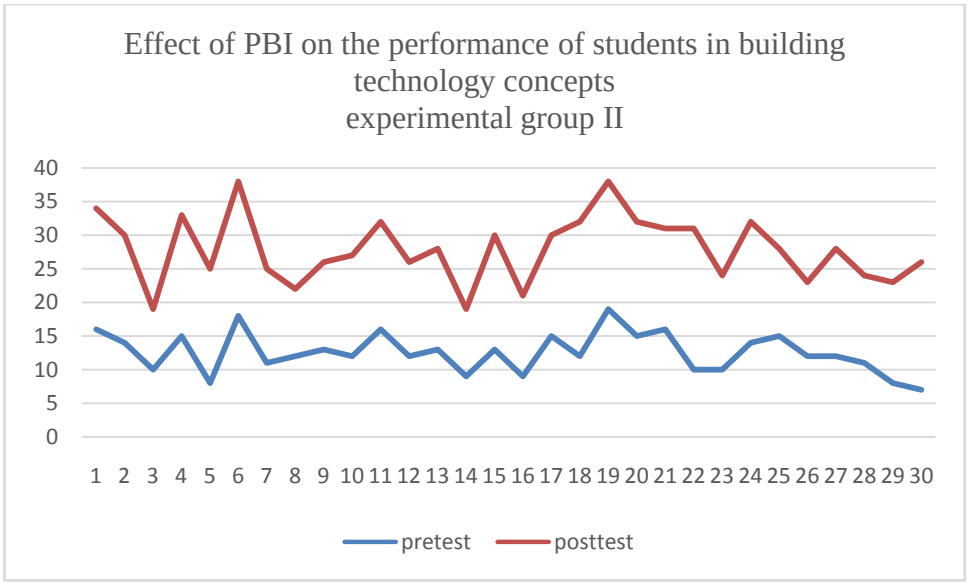

Figure 4.7 Line graph showing performance inbuilding technology concept experimental group II

Red graph line indicates post-test values, while blue indicates pre-test values. This showed enhanced performance after treatment with PBI method of instruction.

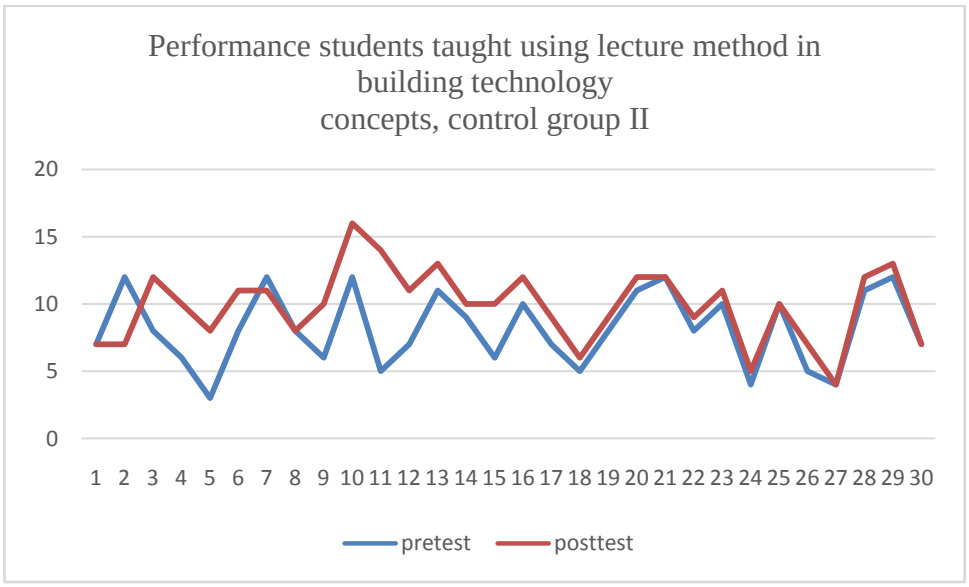

Figure 4.8 line graphs of performance score of students taught using lecture method in control group II.

Red graph line indicates post-test values, while blue indicates pre-test values. This showed an insignificant difference in the control group.

Research Question Three: What is the effect of Practice-based Inquiry cycle and conventional method on affective tasks performance of NCE (Technical) students in Building Technology in colleges of education and polytechnics in Nigeria.

The classified items in the instrument that are tailored towards measuring affective tasks in the experimental and control groups were analysed. The performance means were obtained and the results are reflected in table 4.3.

Table 4.3 Performance Meansin Affective tasks in Building Technology

Status	N	Pre-test mean	Post-test mean	Mean difference	Std. pre	Std. post
Exp. group I	30	12.60	15.30	2.7	3.01	2.56
Cont. group I	30	11.00	12.87	1.87	2.83	3.910
Exp. group II	30	12.56	15.33	2.76	2.99	3.12
Cont. group II	30	9.13	10.40	1.27	2.92	2.73

Table 4.3 contained the result of performance on affective task in both the experimental and control schools. The results in the table indicates positive effect of the PBI in enhancing affective tasks performance in Building Technology in the pre-service teachers, because the post-test performance mean values of the two experimental groups (15.30 and 15.33) are greater than the performance mean values in the pre-tests (12.60 and 12.57) respectively. Furthermore, the values are equally greater than the post-test performance mean values of the two control groups (10.77 and 10.40) respectively. This result is further illustrated with line graphs in figures; 4.9, 4.10, 4.11 and 4.12 respectively. Red line indicates post-test values and blue line indicates pre-test values in the figures. The illustrations showed positive performance in the experimental schools where the treatments were given, the red values are in the upper continuum as shown with wider margins with the blue.

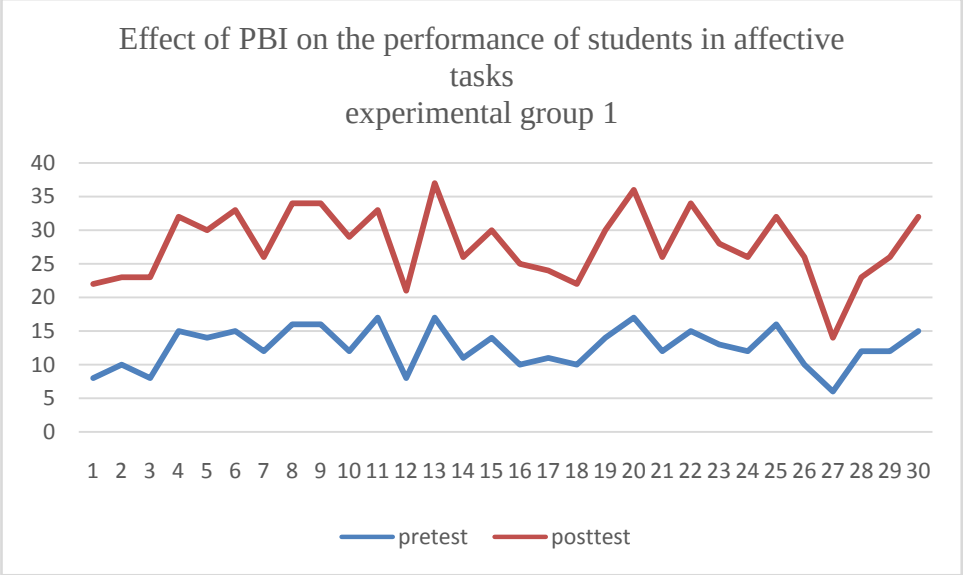

Figure 4.9, Line graph showing performance scores in affective tasks in building technology.

Red graph line indicates post-test values, while blue indicates pre-test values. This showed enhanced performance after treatment with PBI method of instruction.

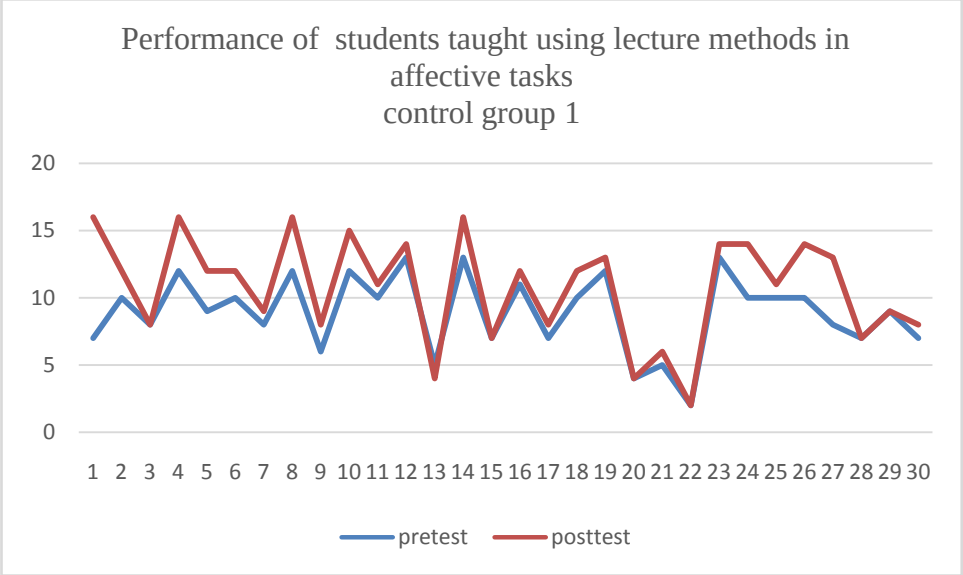

Figure 4.10 line graphs of performance scores of students taught using lecture method in control group I

Red graph line indicates post-test values, while blue indicates pre-test values. This showed an insignificant difference in the control group.

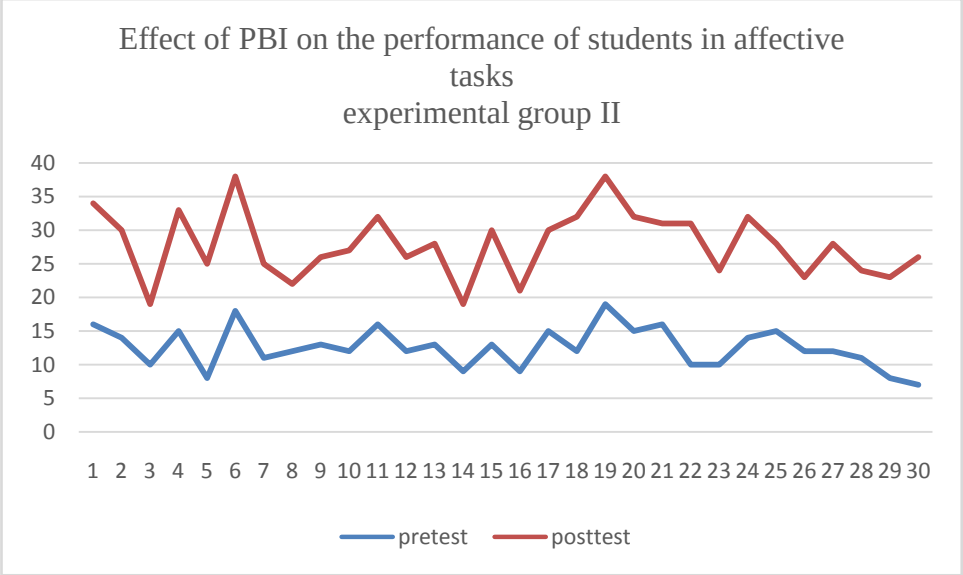

Figure 4.11 Line graph showing performance scores in developing building technology Traits experimental group II

Red graph line indicates post-test values, while blue indicates pre-test values. This showed enhanced performance after treatment with PBI method of instruction

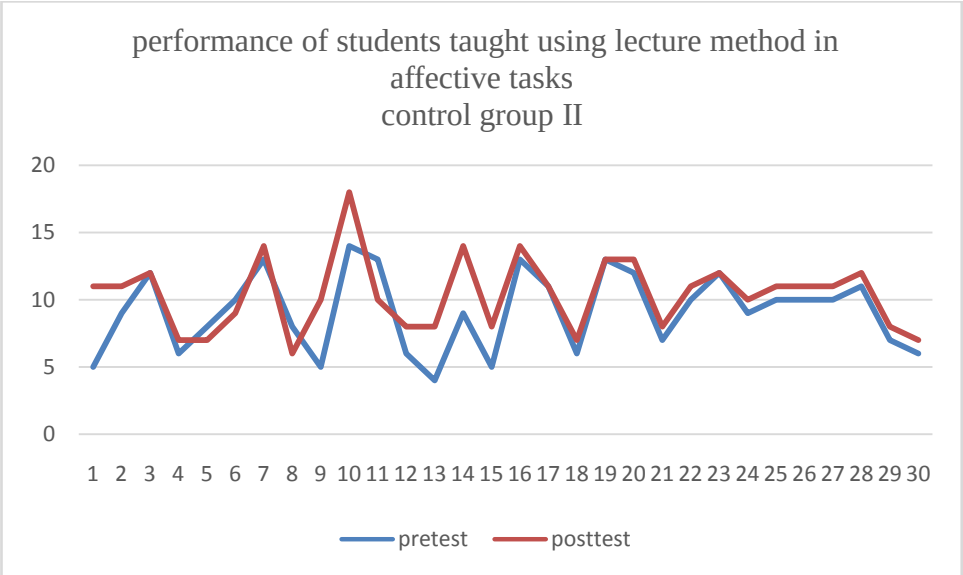

Figure 4.12 line graphs of performance scores of students taught using lecture method in control group II

Red graph line indicates post-test values, while blue indicates pre-test values. This showed an insignificant difference in the control group.

Research Question Four: What is the effect of Practice-based Inquiry cycle and conventional method on hands-on tasks performance in Building Technology of NCE (Technical) students in colleges of education and polytechnics in Nigeria?

The last batches of the items in the instrument were focused towards hands-on tasks performance, the scores in these items were analysed and the performances of both the control and experimental groups were summarized in table 4.4.

Table 4.4 Performance Means in Hands-on tasks in Building Technology

Status	N	Pre-test mean	Post-test mean	Mean difference	Std. pre	Std. post
Exp. group I	30	8.26	12.33	4.06	3.59	3.03
Cont. group I	30	6.76	8.33	1.56	3.02	3.23
Exp. group II	30	8.07	11.30	3.23	2.86	3.14
Cont. group II	30	5.73	9.03	3.30	2.65	2.63

Table 4.4 is the summary of results on hands-on tasks performance. Itindicates that the performance mean values of the post-tests in the two experimental groups (12.33 and 11.30) are higher than the values obtained in their respective post-test mean performances(8.26 and 8.07). This outcome indicate positive effects of PBI in hands-on tasks performance in Building Technology by NCE (Technical) students in colleges and polytechnics, as vividly shown in line graphs, in figures4.13, 4.14, 4.15& 4.16 respectively. The red line in the figures indicate post-test results and blue line indicate the pre-test results.

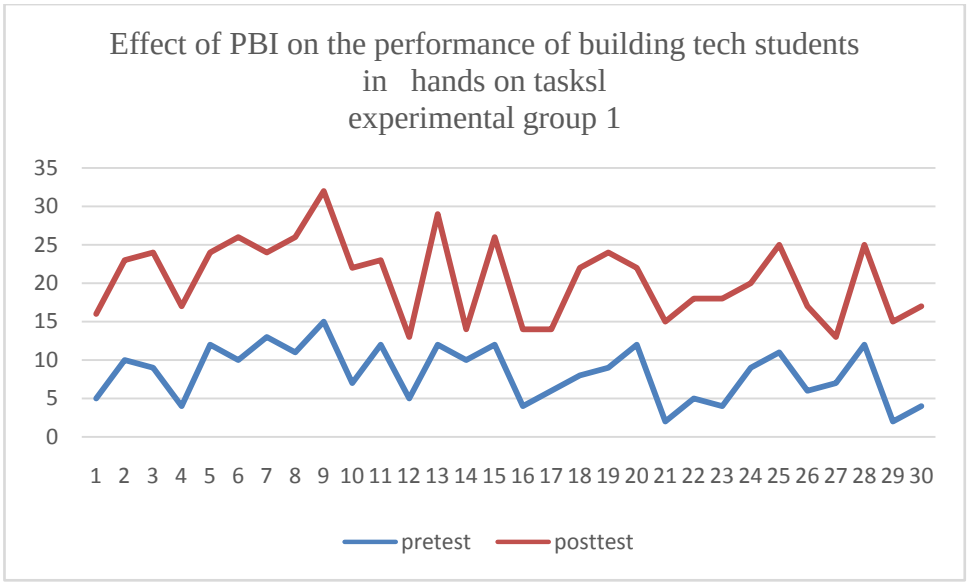

Figure 4.13 Line graphs of Performance Scores in Hands-on tasks in Building Technology Experimental Group I

Red graph line indicates post-test values, while blue indicate pre-test values. This showed enhanced performance after treatment with PBI method of instruction

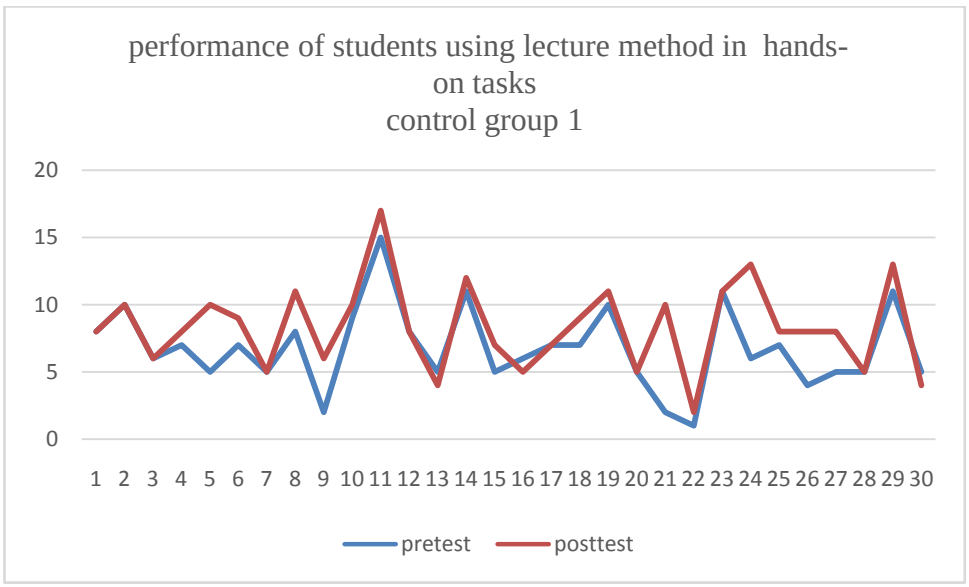

Figure 4.14 Line graphs of Performance Scores in Hands-on tasks in building technology Control Group I, Lecture method

Red graph line indicates post-test values, while blue indicate pre-test values. This showed an insignificant difference in the control group.

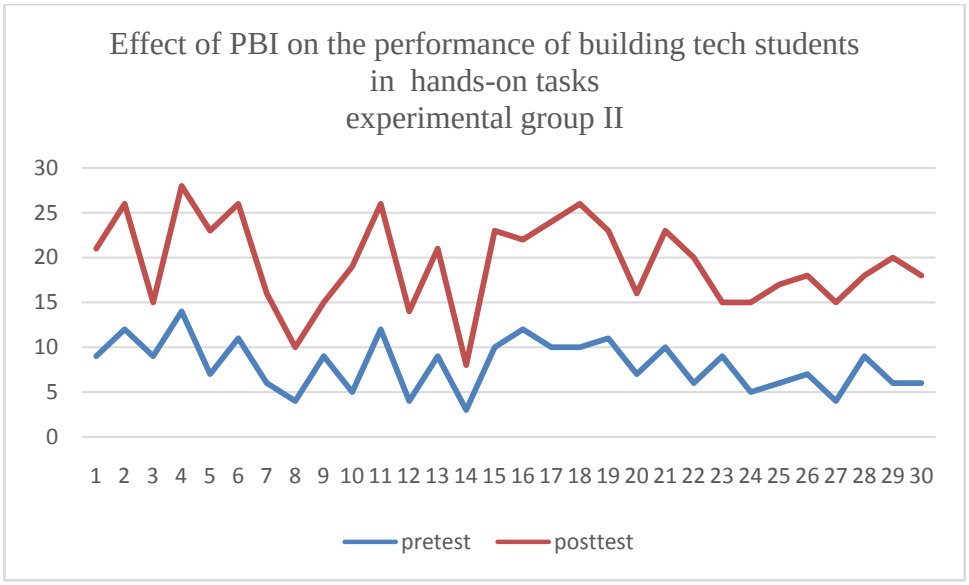

Figure 4.15 Line graphs of Performance scores in Hands-on tasks in Building Technology Experimental Group II

Red graph line indicate post-test values, while blue indicate pre-test value, This showed enhanced performance after treatment with PBI method of instruction.

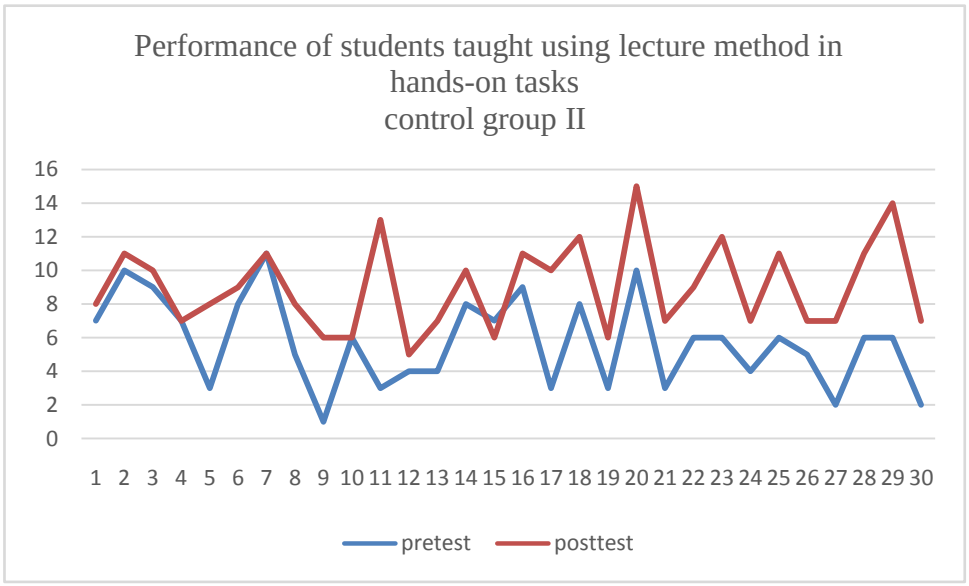

Figure 4.16 Line graphs of Performance scores in Hands-on tasks of Students Taught Using Lecture method in Control Group II

Red graph line indicate post-test values, while blue indicate pre-test values. This showed an insignificant difference in the control group.

Research Question Five: How does the effect of Practice-based Inquiry Cycle on Performance of NCE (Technical) Students in Building Technology of the two experimental groups (Colleges of Education and Polytechnics in Nigeria) differ?

The differences in performance between the pre-test and post-test (deviations) of each subject in experimental group one were compared with pre-test and post-test (deviations) of each subject in experimental group two. The result of the analysis is in table 4.5.

Table 4.5 General Performance Deviation mean of the two experimental groups.

Status	N	Mean	Std Deviation	Mean difference
Exp. group I	30	9.2000	6.00804	1.0000
Exp. Group II	30	8.2000	7.25116	

Table 4.5 shows the outcome of the performance deviations from the two experimental schools. The results indicate that, the difference between mean deviations of performance in the two experimental groups is 1.000. This difference is not any significant, it implied that, there was a marginal difference in the performance of subjects from colleges of education and polytechnics, as vividly illustrated with the scatter plot graph in figure 4.17 and line graph in figure 4.18 respectively.

The red dots in the scatter graph are for experimental group one while the blue dots are for experimental group two. The dots have reasonably spread over the graph, while the red dots are higher indicating the group with slightly higher performance. The display by the line graph in figure 4.18 showedalmost the same pattern in both the groups but in different colors indicating the little difference of the two experimental groups.

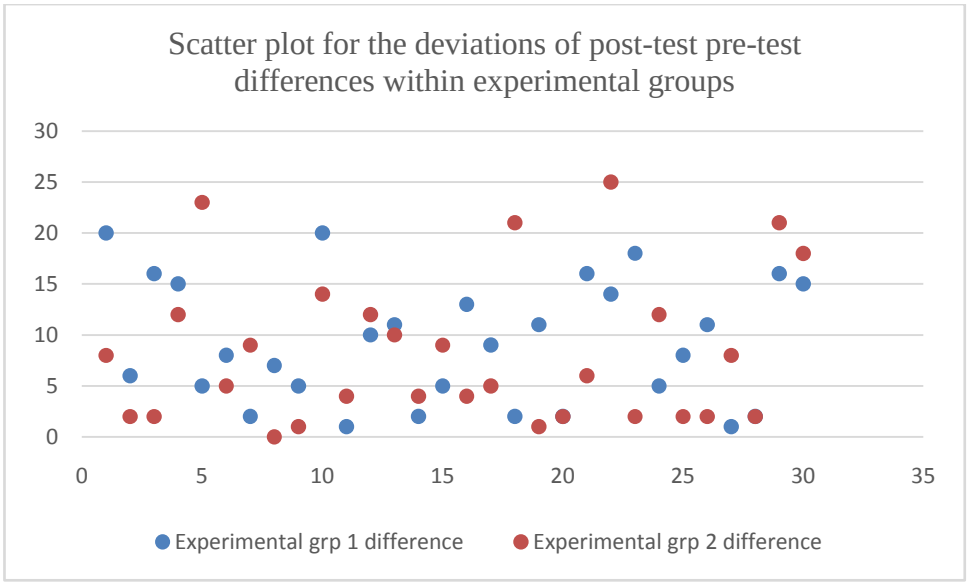

Figure 4.17 Scatter plots graph of the deviations within the two experimental groups.

The red dots in the scatter graph are for experimental group one while the blue dots are for experimental group two. The dots have reasonably spread over the graph indicating synergy.

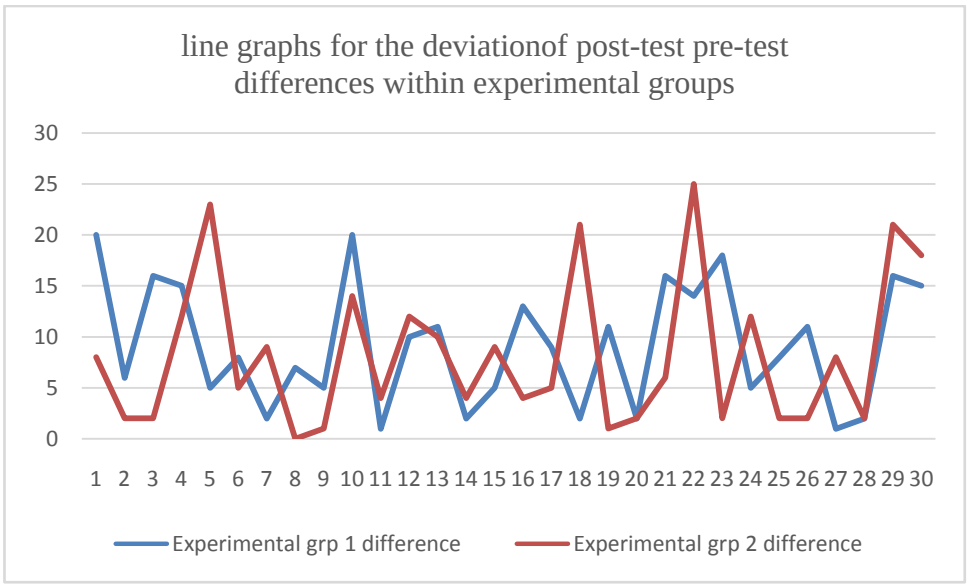

Figure 4.18 line graph of the deviations within the two experimental groups

The displays by the line graphs are equally showing almost the same pattern in both the groupsfurther indication of synergy between the experimental groups.

4.3 Hypothesis Testing

The fivenull hypotheses formulated from the objectives of the study in relation to the research questions, were tested using independent sample t-test, all the hypotheses were tested at 95% confidence level that is 0.05 level of significance. P-values were compared with Alpha values (0.05) and absolute t-values were compared with the critical values in rejecting or accepting the stated null hypothesis.

Hypothesis one: There is no significant difference between the effects of practice-based inquiry cycle and conventional method on performance of NCE (Technical) students in Building Technology in colleges of education (technical) and polytechnics in Nigeria.

Hypothesis one was tested at 0.05 level of significance using the independent sample t-test in the two experimental groups and the outcome of the analysis are contained in tables4.7 and 4.8 respectively for the two groups.

Table 4.6: Independent Sample t-test on the General Performance of Students Taught Building Technology using the PBI Method in Experimental Group one

Status	N	Mean	Std Deviation	Std Error	t-value	DF	P-value	Decision
Pre-test	30	31.53	7.82	1.89	-5.049	58	0.001	Reject hypothesis
Post-test	30	41.07	6.76	1.89				

P<α (0.05), absolutet-value >tcrit.(2.000) at DF of 58, Hence, reject null hypothesis

Table 4.6 shows t(58) = 5.049, p <(0.05). The null hypothesis is therefore rejected based on the above evidence, indicating significant impact in the performance of students taught Building Technology using PBI in colleges of education (technical) in Nigeria.This confirms the positive effect of the PBI as an enhanced method of instruction that could be used in the institutions.

Table 4.7: Independent Sample t-test on the General Performance of Students Taught Building Technology using PBI Method in Experimental Group two

Status	N	Mean	Std Deviation	Std Error	t-value	DF	P-value	Decision
Pre-test	30	31.23	6.84	1.89	-4.34	58	.001	Reject hypothesis
Post-test	30	39.43	7.74	1.89				

P<α (0.05), absolute t-value>t crit. (2.000) at DF of 58, Hence, reject null hypothesis

Table 4.7 indicates that, t(58) = 4.34, p<(0.05). Based on the above evidence, the null hypothesis is rejected indicating significant impact in the performance of students taught building technology using the PBI in polytechnics in Nigeria.This confirms the positive effect of the PBI as an enhanced method of instruction in building technology that could be adopted in the institutions for the NCE (Technical) programme.

Hypothesis two: There is no significant difference between the effects of practice-based inquiry cycle and conventional method on performance in building technology concepts of NCE (Technical) students in colleges of education (technical) and Polytechnics in Nigeria.

The stated hypothesiswas equally tested at 0.05 level of significance using the independent sample t-test in the two experimental groups and the results obtained from the analysis is contained in table 4.8 and 4.9.

Table 4.8: Independent Sample t-test on the Performance of Students taught using the PBI Method in Building Technology Concepts,Experimental Group one

Status	N	Mean	Std Deviation	Std error	t-value	DF	p-value	Decision
Pre-test	30	10.67	3.20	0.78	-3.56	58	.001	Reject hypothesis
Post-test	30	13.43	2.80	0.78				

P<α (0.05), absolute t-value > t crit.(2.000) at DF of 58, Hence, reject null hypothesis

Table 4.8 showst(58) = 3.56, p<(0.05). The null hypothesis is therefore rejected based on the above evidence, which means there is a significant difference between the pre-test and post-test performance of students taught using the PBI in performance of Building Technology concepts in colleges of education in Nigeria. This depicted

furtherconfirmation of the positive impact of the PBI as an enhanced method of instruction that could be used in the institutions.

Table 4.9 Independent Sample t-test on the Performance of Students Taught using PBI Method in Building Technology Concepts, Experimental Group Two.

Status	N	Mean	Std Deviation	Std error	t-value((critical)	DF	p-value	Decision
Pre-test	30	10.60	3.54	0.78	-2.83	58	0.006	Reject
Post-test	30	12.80	2.37	0.78			Hypot.	

P<α (0.05), absolute t-value > t crit.(2.000) at DF of 58, Hence, reject null hypothesis

Table 4.9 showst(58) = 2.83,p <(0.05). Based on this result, the null hypothesis is rejected, which means there is a significant difference between the pre-test, post-test performance of NCE (Technical) students taught using the PBI in the understanding of Building Technology concepts in colleges and polytechnics in Nigeria. The enhanced performance was due to the positive effect of the PBI as an enhanced method of instruction used in the study.

Hypothesis three: There is no significant difference between the effects of practice-based inquiry cycle and conventional method in affective tasks performance in Building Technology of NCE (Technical) students in colleges of education (technical) and polytechnics in Nigeria.

Hypothesisthree wasinterested in affective tasks performance as a result of the instruction using PBI. It was tested at 0.05 level of significance using the independent sample t-test in the two experimental groups.

Table 4.10 Independent Sample t-test on the Performance of Students taught using the PBI Method inAffective Tasks Experimental Group One

Status	N	Mean	Std Deviation	Std error	t-value	DF	p-value	Decision
Pre-test	30	12.60	3.03	0.72	-3.74	58	.001	Reject hypothesis
Post-test	30	15.30	2.56	0.72				

P<α (0.05), absolute t-value > t crit.(2.000) at DF of 58, Hence, reject null hypothesis

Table 4.10 shows that,t(58) = 3.74, p <(0.05). Based on this reason, the null hypothesis was rejected, which implies significant difference between the pre-test, post-test performance of students taught building technology using the PBI in developing building technology traits in colleges of education (technical) in Nigeria. This further confirmed the positive effect of the PBI as an enhanced method of instruction that could be used by the institutions.

Table 4.11 Independent Sample t-test on the Performance of Students Taught using the PBI Method inAffective Tasks, Experimental Group Two

Status	N	Mean	Std Deviation	Std error	t-value(critical)	DF	p-Decn. value
Pre-test	30	12.56	2.99	0.79			.001
					-3.51	58	Reject
Post-test	30	15.33	3.12	0.79			Hypo.

P<α (0.05), absolute t-value > t crit.(2.000) at DF of 58, Hence, reject null hypothesis

Table 4.11 above shows that,t(58) = 3.51, p<(0.05). Based on this result, the null hypothesis was therefore rejected, which means significant differences between pre-test, post-test performance of students taught Building Technology using PBI inaffective tasks in polytechnics in Nigeria. This further confirmed the positive effect of PBI as an enhanced method of instruction in building technology for use in the institutions.

Hypothesis Four: There is no significant difference between the effects of practice-based inquiry cycle and conventional method in hands-on tasks performance in Building Technology of NCE (Technical) students in colleges of education (technical) and polytechnics in Nigeria.Hypothesis four, tested hands-on tasks performance, which is one of the crucial issues in the programme. The hypothesis was tested at 0.05 level of significance using the independent sample t-test in the two experimental groups, as contained in tables 4.12 and 4.13.

Table 4.12Independent Sample t-test on the performance of Students Taught using the PBI Method in Hands-on tasks in Building Technology, Experimental Group One.

Status	N	Mean	Std Deviation	Std error	t-value(critical)	DF	p-Decn. value
Pre-test	30	8.27	3.59	0.86			Reject
					-4.74	58	.001
Post-test	30	12.33	3.03	0.86			Hypot.

P<α (0.05), absolute t-value > t crit(2.000) at DF of 58, Hence, reject null hypothesis

Table 12 shows that, t(58) = 4.74, p< (0.05). Based on the above evidence, the null hypothesis was rejected, which implies that there was significant difference between the pre-test, post-test performance of students taught Building Technology using the PBI in the acquisition of hands-on skills in Building Technology in colleges of education (technical) in Nigeria. This implied significant impact of the PBI as an enhanced method of instruction in the institutions which facilitated the hands-on of skill acquisition as evident in this study.

Table 4.13 Independent Sample t-test on the Performance of Students taught using PBI Method in Hands-on tasks performance in Building Technology, Experimental Group Two.

Status	N	Mean	Std Deviation	Std error	t-value(critical)	DF	p-Decn. Value
Pre-test	30	8.07	2.86	0.77			Reject
					-4.17	58	0.001 hypoth.
Post-test	30	11.30	3.14	0.77			

P<α (0.05), absolute t-value > t crit.(2.000) at DF of 58, Hence, reject null hypothesis

Table 4.13 indicates that, t(58) = 4.17, p<(0.05). Based on this result, the null hypothesis was rejected, which means significant difference exists between the pre-test, post-test performance of students taught using PBI in hands-on tasks in building technology in Polytechnics in Nigeria. This is an evidence of the positive effect of the PBI as an enhanced method of instruction in the institutions thatfast tracked hands-on tasks performance in the study.

Hypothesis Five: There is no significant difference between the pre-test and post-test mean (performance) deviations of NCE (Technical) students in Building Technology taught using the Practice-based Inquiry cycle in the two experimental groups, (colleges of education and polytechnics) in Nigeria.

To test this hypothesis,the pre-tests, post-tests scores deviations of the performance of each subject in the two experimental groupswere juxtaposed and computed using the independent sample t-test and the hypothesis was tested at 0.05 level of significance. The outcome is in table 4.14.

Table 4.14 Independent Sample t-test of the Pre-tests and Post-tests Deviations of the two experimental groups

Status	N	Mean	Std Deviation	Std error	t-value	DF	p-Decn. value
Experimental group I	30	9.20	6.01	1.72			Accept
					0.58	58	.563 hypo.
Experimental group II	30	8.20	7.25	1.72			

P>α (0.05), absolute t-value < t crit.(2.000) at DF of 58, Hence, accept the null hypothesis

Table 4.14 indicates that, t(58) = 0.58, p>(0.05). Based on this result,the null hypothesis is accepted, which means there no significant difference between the performances of students in Building Technology is taught using the PBI in colleges of

education (technical) and polytechnics in Nigeria. Though there is a mean difference of one it is not significant to reject the null hypothesis. The difference may be as a result of unforeseen error. This indicates that the application of the treatment was as much as possible the same in the two experimental groups and there was synergy in the two learning environments.

4.4 Summary of Major Findings

The major findings of the study based on the data analysis and test of the hypotheses formulated for the study are presented below:

1. The finding showed a significant difference between the pre-test, post-test mean performance scores of 9.53 and 8.20 from the two experimental groups respectively.

2. The results of the pre-test, post-test mean performance scores of the two experimental groups on performance in Building Technology concepts indicates a mean difference of 2.17 and 2.70 respectively.

3. The analysis of the third research question on affective tasks performance in Building Technology, gave a pre-test, post-test mean performance differences of 2.70 and 2.76 from the two experimental groups respectively,

4. The finding on hands-on tasks performance showed a significant difference between the pre-test, post-test mean performance scores of 4.06 and 3.23 from the two experimental groups respectively.

5. The finding on synergy between the two experimental groups showed that, there were no significant differences between the pre-test and post-test performance (deviations) of each subject in experimental group one, with the pre-test and post-test performance (deviations) of each subject in experimental group two.

4.5 Discussionof Findings

PBI cycle is synonymous with learner centered instructional strategy which many scholars in education and curriculum in particular, are advocating for its adoption in instruction because of the outstanding advantages of its principles as summarized by; Nwafor (2007), to include knowledge construction is emphasized over knowledge reproduction, supports collaboration and social negotiations among learners, facilitate discovery learning, encourage collaborative activity, supports integration and activation of prior knowledge among others.

The first finding revealed significant effect of PBI on both the colleges of education and polytechnics running the NCE (Technical) programme in Nigeria. This was evident by the response to the research question one, in table 4.1showing a pre-test/post-test mean differences of 9.5 and 8.2 in the two experimental groups, and the line graphs in figures 4.1 to 4.4 showing wide gap between pre-test/post-tests performances in experimental groups and little gap between pre-test/post-test performances in control groups. This result was confirmed by the rejection of null hypothesis one since the p-value was less than theα-value of 0.05.This first finding is in agreement with the work ofOmoiya (2013), who compared the Effect of three Teaching Techniques in Technical Colleges in Kogi State. The teaching techniques compared were; modeling; coaching and scaffolding. The study found that the coaching and scaffolding techniques had greater impacts on the students' performance because of the learner centered features they possessed. Similarly, Onweh andAkpan (2014) conducted a study on Instructional Strategies and Students' Academic Performance in Electrical Installations in Technical Colleges in Akwa-Ibom State. The study compared four teaching strategies; discussions, demonstrations, inquiry and lecture methods. The least performance was obtained from the results of lecture

methods, while discussion and demonstration recorded very high performances because, they are learner centered focused and activity based.

This positive effect of PBI on the performance of the students in Building Technology is attributed to the friendly and flexible features of the package where the learners are involved in the planning and execution of the instructional programme. The finding supports PBI in the frantic search of teaching strategy that will enhance general performance of our pre-service technical teachers who will consequently add value to the teaching and learning of Basic Technology inUpper Basic Schools in Nigeria.

The National Commission for Colleges of Education (NCCE, 2012) after the release of the reviewed Minimum Standard published Quality Indicators for Teacher Educators. The document was jointly developed with the Commonwealth and ESSPIN; it contained a self-Accreditation Toolkit as a follow up to the Minimum Standards. Areas of interest for self-evaluation in the institutions as contained in the toolkit includes: lecture plans, delivery process and the learning resources.These issues are in tandem with the features of PBI cycle. Instructions cannot be delivered using the PBI without an action plancontaining an outline of activities including the resources required for implementation.Therefore, adopting PBI in instruction as carried out during this study,will not only enhance general performance of the pre-service technical teachers in Building Technology, but will also serve as a proactive measure towards self-accreditation of the NCE (Technical) programme in colleges of education and polytechnics in Nigeria.

Effects of PBI on the performance of pre-service technical teachers in Building Technology is mutually inclusive of thestudents' performance in Building Technology concepts, which was found to be positive as indicated in table 4.2 with pre-test/post-testperformance mean differences of 2.8 and 2.2 from the respective experimental groups. Thisis vividly shown in figures 4.5 to 4.8 where the line graphs of the pre-test/post-

testperformance scores in the experimental groups are wide and those of the control groups have almost merged. This second finding was further confirmed by the rejection of the stated null hypothesis two because; the p-value was less than the α-value of 0.05signifying positive impact of PBI on the performance of the students in Building Technology concepts.

Secondly, the performance in Building Technology includes the effects of PBIin affective tasks performance of the pre-service technical teachers towards Building Technologywhich could facilitatedeveloping building technology traits as contained in the third finding. This is evident in table 4.3 showing a pre-test/post-test mean performance differences of 2.7 & 2.8 from the two experimental groups respectively, and illustrated in figures 4.9 to 4.12, where the line graphs of the pre-test/post-test in the experimental groups were wide while those in the control groups were almost on each other. This result was followed by the rejection of the null hypothesis three, since the p-values was less than the α-value of 0.05 indicating positive outcome in affective tasks performance in Building Technology by the pre-service technical teachers.

Thirdly, the performance of the pre-service technical teachers in building technology is mutually inclusive of thestudents' outcome in hands-on tasks performancein both colleges of education and polytechnics as contained in table 4.4 with pre-test/post-test mean performance differences of 4.1 and 3.2 from the two experimental groups. The finding was graphically shown in figures 4.13 to 4.16 respectively. The line graphs of the pre-test/post-test scores in the experimental groups were wide apart while those in the control groups almost merged. The finding was consolidated by the rejection of null hypothesis four,since the p-value was less than the α-value of 0.05.

Performances of the students in Building Technology concepts, affective tasks and hands-on tasks in building technology as established by this study are in tandem with the

needs of Vocational and Technical Education programmes in general. Though, these performances could be compartmentalized into cognitive, affectiveand psychomotor activities, they remain complementary to each other in any learner centered instructional strategy like PBI. This is in line withPadelford (1984), as contained in Shehu (2016) model of psychomotor skill development. This view is also shared with,Ezeji andOkorie (1988) as cited by shuaibu (2016). Therefore, adopting PBI as an instructional strategy as carried out by this study involved integrating and streamlining learning activities in the cognitive, affective and psychomotor domain into an instructional package that is learner based.

Findings two, three and four as appraised above, could be linked to the findings of Saba, Maaji and Tsado (2011), who assessed the pedagogical skills needed in teaching Electrical Engineering in Universities in Nigeria and concluded that; Lecturers should develop clear instructional objectives, students should be encouraged to do team work, cordial relationship should exist between teachers and students, lecturers should motivate students during instruction. These findings containthe basic principles of the learner centered instruction which are in agreement with the features of PBI used in the study.In additionArrey-ndep (1999) studiedresponses of administrators of colleges of education (Technical) in the Management of Challenges.The study found out the need for proper planning, scheduling of theory and practical activities and provision of resource materials, these findings are pre-requisite to the use of PBI as an instructional strategy.

Technical skills gap in building technology of both service and pre-service teachers that requires re-training of technical teachers in the field, and halting further production of technically disabled teachers by training institutions, is already established by works of Olaniya and Lucas (2008), Atsumbe et al., (2012), Adavbiele (2013), Lawal (2014) and Sawaba (2015). All these studies have established gaps in building technology skills which

PBI could be explored to address, due to the planning, implementation, evaluation, re-implementation and general flexibility of PBI as experienced during the field work of this study.

Narrating the field experiences of the study which the PBI was used as a strategy that could facilitate bridging of the established gaps in building technology skillAfter developing the action plan with the experimental groups, which is a component of PBI that gives an outline of the hands-on activities, the students were guided on howto evaluate themselves, this prompted some of the practical groups to re-implement the hands-on activity after identifying their failures. In this case the problem of absence of practical manuals and inadequate planning of resource is solved with the adoption of the PBI. To address the problem of contact hours especially for hands-on activities, the last designed hands-on activity which was the construction of simple stretcher bond using bricks was flexibly timed, students were allowed to go to the workshops at their own convenient time to conduct the hands-on activity with the assistance of workshop support officers. Because of this flexibility the students worked during weekends, break-time and lecture intervals. Therefore adapting PBI in this direction has solved the problem of inadequate contact modes for hands-on activities which eventually raised the general performance in building technology of pre-service technical teachers used in the study.

The fifth finding showed the performances of the pre-service technical teachers in colleges of education and polytechnics taught Building Technology using PBIas almost the same. This was evident by the response to the research question five, in tables 4.5 showing a mean difference of only 1.00 between the two experimental groups. The finding was vividly shown in scatter plot graphs in figure 4.17 showing even scatter of dots in the experimental groups and a line graph in figure 4.18 showing very close relationship between the line of the performances of the two experimental groups. The result was

confirmed by the acceptance of null hypothesis five, since the p-value was greater than the α-value of 0.05.Thefinding is in agreement with the work of Sabo (2015), who studied the extent of synergy in the implementation of the minimum standards between colleges of education and polytechnics and found that, The polytechnics and colleges of education concurred on the availability of workshops, provision of alternative power source, use of the same operational guide which is the NCCE minimum standards, moderators for examinations and accreditation exercise. However, complementary ingredients in the school workshop which facilitate technical skill acquisition such as practical manual, guides, schematics and routine maintenance schedule, for the equipment and machines available in the workshop obtained negative weighted means in both polytechnics and colleges of education.

In essence finding five, indicated consistency during the conduct of the study by the researcher and the support staff. It also indicated synergy in the learning environments where the studies were conducted though controlled by two different monitoring agencies NCCE and NBTE.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter provides the summary of the experiment, the findings and conclusion reached and recommendations on how the outcome of the research could be utilized into meaningful output.Suggestions for further research in related areas of the study which this work could not capture are equally made.

5.2 Summary

The development of Nigeria in science and technology like mostdeveloped societies in the world lies in the quality of our technology education programmes and technical dexterity of our teachers.The then 6-3-3-4 system was welcomed with loud ovations in Nigeria, but it came with the problem of lack of Technical Teachers that will teach Introductory Technology now Basic Technology at the JSS level. Part of the response by theNigerian government was the establishment of Colleges of Education (Technical) amongst others. The colleges were expected to produce the NCE (Technical) teachers for the programme, in which Building Technology trade is a complimentary component.But the lecture method used presently in teaching Building Technology and other trade subjects in the NCE (Technical) programme left much to be desired. Consequently, most of the graduates are not able to efficiently and effectively teach Basic Technology in the lower basic schools in Nigeria.

This study on, Effects of Practice-based Inquiry Cycle on the Performance of Building Technology Students in Colleges of Education (Technical) and Polytechnics in Nigeria was conducted in search of an alternative instructional strategy that will enhance the performance of pre-service NCE technical teachers in Building Technology with the following objectives;determine the effect of PBI Cycle on the performance of Building Technology students in colleges of education and polytechnics in Nigeria;ascertainthe

effect of PBI cycle on the performance of Building Technology students in Building Technology Concepts in colleges of education and polytechnics in Nigeria;examinethe effect of PBI cycle on Building Technology students in affective tasks performance in Building Technology in colleges of education and polytechnics in Nigeria;find out the effect of PBI cycle on Building Technology students in hands-on tasks performance in Building Technology in colleges of education and polytechnics in Nigeria; andcompare the effect of PBI cycle on performance of Building Technology students between colleges of education and polytechnics in Nigeria.Five (5) research questions and five (5) null hypotheses were developed to arrive at the findings of the study.

The literature reviewed the constructivist learning theory, learner centered principles, concepts and related empirical works which provided further understanding of PBI cycle and variablesraised in the study. The research used quasi experimental design with pre-test and post-test of the experimental and control groups. Two colleges of education were purposefully selected as experimental and control groups one, and two polytechnics were purposefully selected as experimental and control groups two respectively.The population of the study comprised six hundred and forty five (645) NCE II Technical students in the 2014/2015 normal academic session from the four selected institutions. Intact class sizes were used asthe sample that received the treatment. One hundred and twenty subjects (120), thirty subjects (30) eachwere purposefully selected from each of the institution based on full attendance during treatment sessions and were used for the analysis of data.The instrument used for data collection was PBIST which contained seventy (70) adapted NABTEB items in building technology which measured performance of students in building technology concepts, affective tasks performance and hands-on tasks performance. The PBIST was validated by experts, trial tested and

subjected to reliability test using PPMC and a value of 0.84 was obtained as the reliability index.

The treatments were given in the two experimental schools while normal lectures were delivered in the control schools after the pre-test,the subjects were post-tested using same items after the treatment. Collated results from the two experimental and control groups were analyzed separately using descriptive statistics; mean, standard deviation, line and scatter plot graphs. The five null hypotheses formulated from the objectives of the study in relation to the research questions were tested using independent sample t-test. The hypotheses were tested at 95% confidence level that is 0.05 level of significance. Hypotheses one, two, three, and four were rejected, while hypothesis five was accepted.The findings revealed positive impact on the performance of the NCE (Technical) students in both colleges and polytechnics as a result of the use of PBI, specifically their performance in building technology concepts; affective tasks performance and hands-on tasks performance were enhanced. The findings also establishedsynergy between the two experimental groups that received the treatmentsin colleges and polytechnics. The study has contributed to knowledge in establishing PBI for use as a *new instructional strategy*, for technical skills acquisition in the Building Technology trade component of the NCE (Technical) programme.

5.3 Conclusion

Based on the outcome of the study, the data analyzed and the hypotheses tested, the study concluded that, the use of PBI cycle in the teaching of Building Technology component of the NCE (Technical) programme has impacted positively on the general performance of the students in Building Technology, it has improved their performancein Building Technology concepts, it has enhanced their affective tasks performance and equallyraised their hands-on tasks performance in Building Technology. The study also

established relative synergy between the two experimental groups that received the treatment, and by extension in the running of the NCE (Technical) programme between polytechnics and colleges of education.

The gaps of producing effective NCE (Technical) teachers to handle Basic Technology in our junior secondary schools, could be bridged by adapting and integrating the Practice-based Inquiry cycle in the teaching of Building Technology, and other related trade components of the NCE (Technical) programme in colleges of education and polytechnics in Nigeria. By so doing, the instructional potentials of the pre-service teachers will be improved, their technical dexterity will be enhanced, and eventually the students will be effective and efficient Basic Technology teachers in our classrooms, and technically proficient resource for our industries on graduation.

5.4 Implicationsof Findings

The application ofthe findings of this study will facilitate the work of Lecturers and supporting staff in the NCE (Technical) programme. The learner-centered approach of the PBI cycle provides for planning before implementation. This makes instruction easier and students participate fully in all activities. As a result, learning becomes easier, faster and permanent which is the essence of any educational encounter. In addition, the PBI method has measurable outcome hence, teachers will evaluate their performance and that of the students at the end of every training cycle.

By application of the findings of this study, students will find learning interesting and easy, they will have better understanding of Building Technology concepts, and they will develop positive attitudes towards building technology and will acquire hands-on skills,which will eventually make them become effective and efficient technical teachers on graduation.

By implication the National Commission for Colleges of Education (NCCE), could use the findings of this study during curriculum reviews, and inject the use of the practice based inquiry cycle in teaching building technology component of the NCE (Technical) programme in particular and other trades subjects of the NCE (Technical) programme in general. The commission can also use the findings as checks for quality in Technical Teacher Education especially in the areas of lecture plans, delivery process, skills acquisition and the learning resources as contained in the self-accreditation toolkit of the Commission.

Also, the private sector would consequently employ NCE (Technical) graduates with improved technical dexterity especially in Building Technology that will work as supervisors in building construction sites, thereby reducing incidences of substandard building structures and collapse of buildings in the country.

5.5:Recommendations

Based on the findings of this study, the following recommendations have been proffered:

1. The NCCE and NBTE could make categorical policy statement instructing the paradigm shiftto learner-centered instruction in the NCE (Technical) programme, run in colleges of education and polytechnics in Nigeria.
2. The use of PBI could be injectedas a curriculum innovation, in the teaching of building technology component of the NCE (Technical) programme in colleges of education and polytechnics in Nigeria.
3. Heads of institutions and academic units could encourage lecturers and supporting staff to always plan their lessons into activities before delivery and explore the use of alternative contact modes in hands-on activities.

4. The existing synergy in the implementation of the NCCE minimum standards between colleges of education and polytechnics running the NCE (Technical) programme be sustained, and be improved through periodic consultation with stake-holders to review issues relating to the implementation of the programme.
5. Colleges and polytechnics are encouraged to provide adequate learning resources, because, effectiveness of PBI, and learner centered instruction lies on the availability of material resources to carry out the hands-on activities

5.6:Suggestions for further studies

Thevolume of knowledge is eternal; hence scholars and researchers only swim in their areas of interest or needs, leaving obvious gaps for further work. This study therefore suggests that;

1. This study is replicated to determine the effect of the PBI on the performance of students in the remaining four complementary trades (Automobile, Electrical/Electronics, Metal and Wood work Technology) that makes up the NCE (Technical) programme in Nigeria. This will provide a strong base for its adoption as an instructional strategy during curriculumreview conference.
2. Vocational Education programmes in colleges and polytechnics other than the NCE (Technical), such as agricultural education, home economics, office technology and fine art, could undertake similar studies with the hope of adapting the PBI as an alternative learner centered instructional strategy in their respective units.
3. Further studiesbe carried out to explore the flexibility of PBI in addressing the inadequate contact modes for hands-on activities in the NCE (Technical) programme.This will provide synergy on the conduct of practical activities in the programme.

5.7 Limitation of the Study

This study was limited to only the colleges of education (Technical) and polytechnics running the NCE (Technical) programme in Nigeria. The effect of Practice-based Inquiry cycle was determined on the performance of students in Building Technology only. Further studies as suggested should be conducted in the other complementary trades of the NCE (Technical) programme in Nigeria.

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APPENDIX I

Ahmadu Bello University Zaria,
Faculty of Education,
Department of Foundations& Curriculum Studies.
August, 2015.

The Dean,
School of Technical Education
Kano State Polytechnic, Kano.

Dear Sir;

REQUEST FOR ASSISTANCE

I am a Ph. D student of the above named university, undertaking a research on; '**Effects of Practice-based Inquiry Cycle on the Performance of Colleges of Education (Technical) and Polytechnics Students in Building Technology in Nigeria'**

I hereby request for your assistance towards a hitch free experiment. I guarantee that, the results will be used for the purpose of the study only.

I remain grateful for your anticipated concern towards the development of Education.

Yours Faithfully,

Bashir Sabo Abubakar
Mobile No.: 08032077437
Email: Shelter-wares123@yahoo.com.

APPENDIX II
PRE-TEST AND POST TEST ITEMS FOR THE CONTROL AND EXPERIMENTAL SCHOOLS PBIST

PERFORMANCE TEST IN BUILDING TECHNOLOGY

INSTITUTION;----------DATE----------

REGISTRATION NO;----------

INSTRUCTION; you are please expected to select the most appropriate option from (A-D) as a response to the question or statement made. Time 1:30 hrs

1. Accident prevention in the workshop is best achieved through;
   A. Carelessness B. Walking bare footed C. Using correct tools
   D. Lack of concentration

2. Identify the tool NOT used for laying blocks?
   A. Bolster B. Block trowel C. Builders' square D. Scotch hammer.

3. Determine the foundation suitable for stable soil in Nigeria?
   A. Raft foundation B. Strip foundation C.Pilled foundation D. Stepped foundation.

4. Decide which of the equipment/tool is not relevant in site preparation?
   A. DumperB. Bulldozer C. Cutlass D. Spade

5. Cleaning trowel after use is best preferred with?
   A. oil B.Soap C. Salt D.Water

6. Point out the tool not required by the construction trade?
   A.TrowelB.Scraper C. Pumice D.Hacksaw.

7. Which of the followings does not convince you to be a property of a good block?
   A.StrengthB.Durability C.Cohesion D. Size

8. What precaution should be taken to prevent collapse of excavation on a weak soil?
   A.ScaffoldingB.Timbering C.Tanking D.Retendering.

9. Choose which of these wall finishes is NOT made of concrete?
   A. Feather edge B.Parallel coping C.Brick on edge coping D. Saddleback

10. In design of site layout, all the following factors must be considered EXCEPT
    A. Horse play activities B. Movement of people and materials
    C. Security D.Accommodation for staff and storage of materials.

11. 'Dead load' is determined by?
    A. Amount of load that can be carried by the soil
    B. Load of all floors, walls and partition
    C. Load of contents of premises, snow and rain D. Load of party wall.

12. Routine maintenance of tools/equipment involves
A.Servicing tools/equipment at regular intervals.
B. Repairing tools/equipment when they develop fault
C. Replacing faulty parts in the tools/equipment
D. Maintaining a constant check on tools/equipment

13. The purpose of foundation is to transmit load in such a way as to avoid
A. Eccentric loading B.Uneven settlement C. Equal settlement
D. Concentric load

14. The function of hardcore is to
A. Prevent dampness in floors
B. Provide a firm working surface on wet sites
C. Check termite actions in timber ground floors
D. Enable the over site concrete harden quickly

15. Determine which of these wall types provides the greatest thermal and sound insulation?
A. Fender wall B. Cavity wall C. Solid block wall D. Solid brick wall

16. The following tools are recognized for concrete work EXCEPT;
A.Spray gun B. The head pan C. The spirit level D. Trowel

17. The concrete mixer is managed to have a very long life span through?
A. Purchase from a big company B. Positioned on a flat base
C. Always cleaned and lubricated after use D. Sold out at old age

18. The following tools are specified for wall construction EXCEPT,
A. The spirit level B.Hawk C. Block trowel D. Spray gun

19. Select out the strategy NOT required in school workshop safety;
A.display of safety posters B. display of safety jingles
C. display of safety precautions D. display of finished projects

20. Segregation of concrete could be controlled by?
A. Purchasing concrete in the factory B. Appropriate Transportation
C. Purchasing of ready-mix concrete D. Mixing concrete in tilling mixer

21. The purpose of rendering to a surface is to
A. Accelerate hydration and hardening
B. Give it good appearance and make it weather proof
C. Increase the bond to the surface
D. Improve the suction of the background

22. Which of these is adopted to promote good bond for smooth backgrounds?
A. Roughening the surface with rough abrasive.
B. Toweling the surface after the initial set.
C. Hacking the surface to provide mechanical key
D. Creating a good surface with sand paper.

23. Which of these is NOT the purpose of rendering?
A. Weather proofing B.Durability C.Non-slip qualities D.Appearance.

24. It is necessary to clear the turf and vegetable soil from the land upon which the building structure will stand because of;
A. High bearing capacity
B. Unreliable bearing capacity
C. Unbearable bearing capacity
D. Suitability of the bearing capacity.

25. Careful planning of the site before work commences is necessary to avoid or prevent unnecessary A.Labor cost B. Authority cost C. Working cost D. Extra cost

26. One of the functions of ground floor of a building is to
A. Prevent the growth of vegetables B. Support its own weight.
C. Bridge the specific span economically D. Give access into the house.

27. The purposes of foundations are, EXCEPT to;
A. Distribute the total weight of the building to the ground
B. Accommodate services C. Resist damp penetration
D. Prevent the growth of vegetable.

28. Non-load bearing walls are walls that support the weight of
A. Itself B. Other walls C.The floor D.Damp proof course.

29. Which of the following is NOT a factor influencing the choice of foundation?
A. Nature of soil which the building will rest B. Pressure of water in subsoil
C. Possible effect of atmosphere on the soil such as rain and frost D. Climate.

30. An agreed characteristic of mass concrete is that it?
A. Can carry any load in a structure B. Is weak in tension but strong in compression
C. Has a high tensile strength. D. Is economical and so resist shear stress.

31. Bulk cement are best stored in A. Air tight shed B. Store that is moisture proof
C. Large tins that are well sealed D. Silos

32. Which of the following is not a type of compacting equipment?
A. Poker vibrator B. Form vibrator C.Surface vibrator D. Step vibrator.

33. When refilling trenches, the soil being replaced should
A. Be saturated with water B. Have the same moisture content as the surrounding soil. C. Be completely dry. D. Be swept clean.

34. Which of the following processes ends first in cement/concrete works?
A. Hydration B.Setting C.Hardening D. Curing

35. Damp proof course in solid ground floors is usually placed
A. At any convenient point above ground level B. 150mm below ground level
C. At the same level as the upper surface of the floor
D. Below the lowest timber member

36. The "matrix" is a term used for cement because of its
A. Color B.Resilient qualities C. Binding qualities D. Offensive odors

37. "Slurry" is a term used in the manufacture of A. Bars B.Cement C. Additives
D. Paints.

38. What is the disadvantage of cement stored in bags compared to cement stored in silos?
A. Not economical. B. Reduction in quantity and in quality.
C. Change in color. D. Deterioration is fast if stored for too long.

39. Identify the appropriate ingredients for concrete mixture?
A. Hard rock made from cement.
B. Mixture of sand, cement and water in a fixed ratio
C. Mixture of sand, cement, gravel and water in a fixed ratio
D. Mixture of sand and cement.

40. Which of the following is NOT an applaud feature of a good foundation?
A. Buckle under load B. Withstand the presence of ground water
C. Withstand soil movement D. Resist destruction by roots of trees.

41. A load bearing wall is best described as a wall that
A. Transfers weight to the foundation base B. Supports dead and imposed loads
C. Are built in between columns D. Support its own weight.

42. The term given to the various recognized arrangement in brick wall is
A. Ranging B.Raking C.Bounding D. Bonding

43. Block work may be supported above opening in a wall by
A. Column B.Concrete C.Lintel D. Wall plate

44. Openings are provided in walls of a building for the following reasons EXCEPT
A. Entrance/exit of occupants B.Ventilation C.Privacy D. Lighting

45. Rendering is an application of a mix to mainly
A. Floors B.Ceilings C.Walls D.External walls.

46. In building drawing, which of the following will be drawn first? The
A. Sectional view B. Front view C. Plan D. Rear view

47. The function of D.P.C. in a building is to
A. Make the building more strong B. Make it easy for roofing
C. Make the foundation to carry the load
D.Prevent water from entering the room from the wall around foundation level.

48. Lintel beams are constructed?
A. Below windows and doors B. On top of roofs and windows
C. To bridge doors and windows D. Bridge windows only

49. Which of these statements is correct about approving a building plan?
A. It requires all necessary drawings of the building.
B. No needs to produce the floor plan of the building.
C. The client draws everything himself. D. It is finally a proof by the surveyor.

50. Which of the statements is true about beam? It
A. Supports the ground water B. Supports the upper floor
C. Is a mixture of sand and water only D. Is always smaller than lintel

51. Ability to set out permanent positions of foundations and walls are secured by the use of?
A.Profile board B. Alignment C. Setting out D. Building line

52. Accurate smoothening of the surface of renderings is best achieved with?
A. Trowel B. Wooden float C. Boning rod D. Cleat

53. The most commonly used floor finish in Nigeria is
A. Cement screed B.Granolithic concrete C.Woodblock D. Terrazzo

54. Obtaining proportion mix ratio 1:3 used in plastering of internal walls, weigh?
A. 1 part of sand to 3 parts of cement.
B. 1 part of Portland cement to 3 parts of bitumen
C.1 part of Portland cement to 3 parts of fine sand
D.1 part of Portland cement to 3 parts of coarse sand

55. Calculate how many pieces of 100mm x 100mm ceramic wall tiles will be required to cover a wall area of 4.8m^2 allowing 10% wastage?
A. 480 tiles B. 528 tiles C.432 tilesD. 4800 tiles

56. With ease, steel square is commonly used for
A. Cutting of bricks B. Leveling blocks C. Checking right angle of a wall
D. Ranging.

57. To set the width of building foundations in relation to the thickness of the wall(T) measure? A.2T B.1.5T C.1T D. 3T

58. Sought out tool/material not appropriate for setting out simple building plan?
A. dumper B.Pegs C. The builder’s square D.The builders' line and pin.

59. Decide on the appropriate level of damp proof course in a wall above ground?
A. 100mm B.150mm C.200mm D. 250mm

60. Aligning brick to accurate level is best achieved with?
A. Straight-edge B. Line and pins C.Spirit level D.Boning rods.

61. Select common bond for block work used in Nigeria?
A. Stretcher bond B. Header bond C. Flemish bond D. English bond

62. Materials on site during batching are measured by?
A.Heavy and lightweight batching. B. Internal and external batching
C. Standard and non-standard batching D. Volume and weigh batching

63. To secure permanent line markers when setting-out buildings, it is appropriate to use.
A. Construction line B. Building line C.Profile line D. Base line

64. The 3:4:5 method of setting-out can best be carried out by
A. Three persons with three pegs and correct tape readings.
B. Four persons with four pegs and correct tape readings.
C. Five persons with five pegs and correct tape readings.
D. Six persons with six pegs and correct tape readings.

65. Fixing door and window frames to the wall may be carried out using
A. Hasp and staple B.Hinges C. Cramps D. Barrel bolts.

66. Specify which of these substances would NOT facilitate workability?
A. Plasticizer B.Lime C.Masonry cement D. Bitumen

67. Which of the followings does not align with acceptable method of curing concrete?
A. Covering with a layer of sand upon which water is sprinkled
B. Coating the surface with liquid bitumen
C.Pouring water on concrete for 7 days.
D. Covering with plastic sheeting.

68. The function of water in a mix is to
A. Offset setting expansion B. Increase the workability and cohesion
C. Lubricate the movement of particles during mixing
D. Reduce shrinkage and subsequent checks.

69. Conventional sizes of blocks produced in Nigeria are;
A.200mm by 200mm by 450mm B. 119mm by 125mm by 450mm
C. 180mm by 220mm by 450mm D. 225mm by 225mm by 450mm

70. Checks after setting out of building plan are essential EXCEPT on;
A.diagonals B. measurements C. angles D. tools

APPENDIX 11I

LESSON PLAN ONE

School:- Experimental Schools 1&2, FCE (T) Bichi and Kanopoly
Name of Researcher:-Bashir Abubakar Sabo
Registration No:- Ph.D /EDU/4525/2011-2012
Topic: - Setting out Simple Building Plan.
Level: - NCE II Technical
Duration:- 2 hours
Date: - Week one (June/July 2015)

Instructional Resources; Measuring tape, line and pin, sketches, pegs (fig 6) attached

Instructional Objectives;at the end of the instruction students should be able to:

I. Define setting out.

ii. State the techniques used for Setting Out.

iii. List materials used for Setting Out.

iv. State safety precautions to be taken in Setting Out.

Review and focus/ Previous Experiences. The teacher with the students reviews common building tools, basic safety precautions, and site clearance, which is aimed at removing vegetable soil, and turf on site to provide a reliable bearing capacity of soil and to prevent unwanted happening. Afterwards the students are grouped into manageable sizes.

Activity1. Definition of Setting out;

The teacher instructs students to attempt a definition of setting out and to compare the definition with members of the group.

Model definition,setting out: is simply the transfer of a building drawing plan of any proposed building structure, to the actual size on the ground. This done taking into consideration of the established building line by the local authorities and other environmental conditions of the site.

Activity 2,

Techniques for setting out, the teacher instructs the students to;

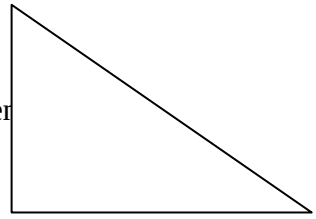
In group, state Pythagoras theorem commonly used in geometry/mathematics.

The Pythagoras theorem stated that; In a right angled triangle the square of the hypotenuse is equal to the sum of the squares of the two opposite sides.

$a^2 = b^2 + c^2$, Where a is the hypothesis b, the adjacent & c the opposite side.

Setting out of building plan which are mostly at right angle (90^o) to established building lines are based on the basic 3:4:5: method, which simply implies that the first reference point could be established at 90^o using the 3:4:5 method, and all the remaining lines could be geometrically established. (fig.2&3) attached.

b. opp.aa. hypoter



c. adj.

However, the dumping level could also be used to establish building lines and accurate angles.

Activity 3,

Tools/equipment used for setting out: Students are instructed to list the equipment and tools used for setting out.

1. Builders' square, Measuring tape. Builders' line, Pegs, Profile boards, hammers, Nails, Shovels, diggers and blocks.

Activity 4,

Checks on Setting Out. The teacher explains strategies of conducting checks after setting out of building as;

- Study the drawings and scales used properly.
- Then check overall measurement after setting out.
- Check the diagonals.

- Confirm angle using 3:4:5 method

Activity 5,

Evaluation Task; the teacher evaluates the lesson by simple questions such as;

Define setting out?

Identify tools used for setting out?

Sketch some of the tools used in setting out?

LESSON PLAN TWO (HANDS-ON ACTIVITY)

Schools:- Experimental Schools 1&2, FCE (T) Bichi and Kanopoly
Name of Researcher:- Bashir, Abubakar Sabo
Reg.No:- Ph.D/EDU/4525/2011-2012
Topic: - Setting out Simple building Plan.
Level: - NCE II Technical
Duration:- 2 hours
Date: - Week two(JUNE/JULY 2015)

Instructional Resources; sketched plan of one bedroom, builders square, lines and pins, shovels diggers, measuring tapes and pegs. (fig I&6) attached

Instructional objectives: The students will be guided to carry out the following activities.

1. Set out simple Building Plan

ii. Conduct simple checks after Setting Out

Review and focus/ Previous Experiences.

The teacher with the students reviews common building tools, basic safety precautions, site clearance which is aimed at removing vegetable soil and turf on site. The essence of the activity is to provide a reliable bearing capacity of soil to adequately receive the foundation. The previous lesson on setting out was equally reviewed.

Value Addition:-

The students will be exposed to setting out of simple building plans using the provision of the Practice Based Inquiry cycle (PBI). The PBI is the new knowledge expected to be added to the teaching learning process in the NCE (Technical) programme..

Activity I,

The teacher and research assistants guide the students to develop action plans in their groups, which is the first stage of the PBI cycle.

Action plan for setting out simple building plan

TASK	TARGET LEARNERS	RESOURCES REQUIRED	TIME/DATE	S/INDICATOR
Setting out Simple plan	NCE II TECH.	Bldg plan, line and pin profile boards, square, Measuring tape, pegs Hammer, nails, blocks Digger and shovels	One weekSet- out 11th-18th June 2015	simple bldg plan

Activity 2,

Checks on The Action Plan, The groups are guided to response to the following rhetorical questions, positive response indicates good plan.

i. Is the action plan realistic and practicable?

ii. Are the required resources available for use?

iii. Is the time frame realistic?

Activity 3,

Implementation of the Action Plan,

The students in groups are guided to implement the developed action plan, which is to set out simple building plan, using the sketch attached. They will be assisted by workshop technicians, research assistants and lecturers.

Activity 4;

Evaluation of The Action Plan, after the implementation (setting out), the exercise is evaluated jointly with students for future actions. It is done using the table below.

Evaluation of the action plan

TASK	SUCCESS AREAS OF AC	FAILURES OF AC	REASONS	FUTURE PL
Setting out Simple bldg Plan	learners interested resource available department willing	Inadequate time resource not enough	saturated lect. large numbers	improvise group the students

CONCLUSION.

The evaluation stage brings the end of the cycle, if the success indicator is positive; the action plan is kept for future reference. But if there are failures, the weaknesses are identified corrected and re-implemented; The measurable outcome is also given by the success indicators, and in this case is the ability of the learners to set out simple building plans.

LESSON PLAN THREE

Schools Control Schools 1&2, FCE (T) Gombe, HUP Kastina
Name of Researcher: Bashir Abubakar Sabo

Reg.No: Ph.D/EDU/4525/2011-2012
Topic: - Setting Out Simple Building Plan.
Level: - NCE II Technical
Duration:- 2 hours
Date: - Week one (June/July 2015)

Instructional Resource; Measuring tape, line and pin, sketches, pegs (fig 2,3&6)

Instructional Objectives;At the end of the instruction the students should be able to: -

- Define setting out.
- State the techniques used for Setting out.
- List materials/tools used for Setting Out.

Review and focus/ Previous Experiences.

The teacher with the students reviews common building tools, basic safety precautions, and site clearance which is aimed at removing vegetable soil, and turf on site to provide a reliable bearing capacity of soil and to prevent unwanted happening

Activity I, Definition of setting out: The teachers defines and explain setting out while students listens and take notes.

Model definition, Setting out: Is simply the transfer of the drawing of a building plan, to the actual size on the ground. Considerations are given to the established building line, by the local authorities and other environmental conditions of the site.

Activity 2; Techniques for setting out:

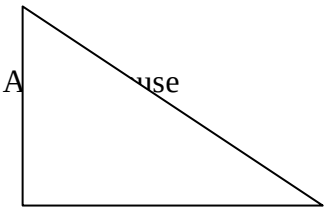
The teacher explains the techniques especially the 3:4:5 method as it relates to the Pythagoras theorem, whilestudents listen and participate in discussions.

The Pythagoras theorem stated that; In a right angled triangle the square of the hypotenuse is equal to the sum of the squares of the two opposite sides.

$a^2 = b^2 + c^2$, Where a is the hypothesis b, the adjacent & c the opposite side.

Setting out of building plan which are mostly at right angle (90^o) to established building lines are based on the basic 3:4:5: method, which simply implies that the first reference

point could be established at 90^{o} using the 3:4:5 method, and all the remaining lines could be geometrically established.



However, the dumping level could also be used to establish building lines and accurate angles.

Activity 3; Teacher list and explain Tools/equipment used for setting out, Students listens and sketch tools, they include;

Builders' square,Measuring tape.Builders' line, Pegs and Profile boards, Hammers and Nails, Shovels and diggers and Blocks

Activity 4; Evaluation, the teacher evaluates the lecture by asking simple questions like; define setting out? And the students were instructed to sketch all the tools used in setting out.

LESSON PLAN FOUR

Schools:- Control Schools 1&2, FCE (T) Gombe, HUP Kastina

Name of Researcher: Bashir Abubakar Sabo
Reg.No: Ph.D/EDU/4525/2011-2012
Topic: - Setting Out Simple Building Plan.
Level: - NCE II Technical
Duration:- 2 hours
Date: - Week two(June/July 2015)

Instructional Resource; Measuring tape, line and pin, sketches, pegs (fig. 2,3& 6) attached

Instructional objectives;At the end of the instruction the students should be able to: -

i. Demonstrate how to set out simple Building Plans
ii. Discuss simple checks in Setting Out
iii. Sought out basic safety precautions in Setting Out.

Review and focus/ Previous Experiences.

The teacher with the students reviews common building tools, basic safety precautions, and site clearance which is aimed at removing vegetable soil, and turf on site to provide a reliable bearing capacity of soil and to prevent unwanted happening, definition of setting out and techniques for setting out simple buildings, tools and equipment

used, basic safety precautions,

Activity 1: The teacher demonstrate and explain the 3:4:5 method of setting out using sketches and instructional resources available. Setting out of building plan which are mostly at right angle (90^o) to established building lines are based on the basic 3:4:5: method, which simply implies that the first reference point could be established at 90^o using the 3:4:5 method, and all the remaining lines could be geometrically established.

Activity 2: Checks on Setting out: The teacher list and explain the expected checks to be carried out after setting out and students listens take note.

i. Study the drawings and scales used properly.
ii. Then check overall measurement after setting out.

iii. Check the diagonals.

iv. Confirm angle using 3:4:5

Activity 3: Safety Precautions;

The teacher discuss general safety in building construction sites and the specific ones as it relates to setting out.

Activity 4;

Evaluation, the teacher evaluates the lecture by asking simple questions like; demonstrate setting out? And are instructed to sketch all the tools used in setting out.

LESSON PLAN FIVE

School:- Experimental Schools 1&2, FCE (T) Bichi andKanopoly
Reg.No: Ph.D/EDU/4525/2011-2012
Topic: - Foundations.
Level: - NCE II Technical
Duration:- 2 hours
Date: - Week three (June/July 2015)

Instructional Resource; Sketches and the environment (fig. 6&7) attached

Instructional objectives; At the end of the instruction the students should be able to: -

- Define foundation.
- List types of foundations..
- State the basic requirements of foundation
- List tools, materials and their functions in foundation work.
- Outline the procedures for foundation work

Review and focus/ Previous Experiences.

The teacher with the students reviews setting out of simple building plans, checks on setting out common building tools used. basic safety precautions, and site clearance. and group students into manageable size.

Activity I:the teacher instruct the Students to;

Attempt a definition of foundation and to compare the definition with members of the group.

Model definition; Foundation is simply defined as the part of a structure in direct contact with the ground, which transmits the dead and superimposed load of the building over a wide area of bearing capacity and consequently facilitating even settlement of the building.

Dead loads are loads due to the foundation, floors, roofs and all materials used in the construction while, superimposed loads are weights due to human beings, furniture and other imposed materials.

Activity 2, Types of Foundation;

The teachers encourage the Students to identify types of foundation and discuss within their group.

i. Strip foundation; this is the commonly used one in low rising structures especially in NigeriA.it consist of a continuous strip of concrete which provides a continuous ground bearing for load bearing walls mostly in firm and non-shrinkable soil.

ii. Wide strip foundations; are used in loose soils with low bearing capacity, the major difference with the strip foundation is the transverse and longitudinal reinforcement of the foundation concrete to ensure even settlement of the structure.

III. Pad foundations; are designed to support higher loading, it is mostly constructed of reinforced concrete to support steel pillars, and heavy machines in industrial buildings.

IV. The raft foundation; is used where the subsoil is very weak and is prone to failures, the entire surface of the ground is excavated to receive the raft which covers the entire area of the building and beyond. The reinforcement is made of mild steel circular bars laid in both directions.

Activity 3,

Requirements of foundations:

The Teacher instructs the student to state the requirements of foundation and to discuss in their groups.

Foundations are design and constructed with due consideration to the following features.

- Sustain the dead and superimposed load of the structure
- Transmit these loads to the area of bearing capacity
- Adequately resist attacks by sulphate and other deleterious matter in the ground.
- Deep enough to safeguard the building against damage due to swelling and shrinkage
- Withstand tensional/shearing forces and water pressures in the building

Activity 4. Tools/Equipment used in foundation work;

The teacher asks the students to; Identify and sketch some of the tools/ equipment used in foundation and state maintenance strategies of each after use.

They include; Concrete mixing machines and dumpers, Poker vibrator , Compacting factor apparatus/slump cone, Diggers, shovels and head pans,

S/N	TOOL/EQUIPMENT	MAINTENANCE AFTER USE
1	Concrete mixers	Wash drum, remove concrete deposit and grease rotating areas
2	Dumper/wheel barrows	Wash after use and oil
3	Poker vibrator	Wash and oil to avoid rust
4	Compacting factor app.	Wash after use and oil
5	Slump cone	Wash after use
6	Digger/shovels/pans	Wash after use

Activity 5, Materials used in foundation work

The major material used in foundation work is the concrete, which consist of fine aggregate (sand), coarse aggregate (gravel), cement and water properly mixed together to form a solid mass. Fine aggregates enhances the binding power by providing gritty surfaces for contact with cement, coarse aggregates increases the volume of materials and strength, cement is the matrix that binds all the materials while, water is the lubricant that initiate the chemical processes.

Concrete when hardened is known as mass concrete but when steel is introduced to improve tensional qualities and general strength is called reinforced concrete. Strength of concrete are influenced by the ratio and qualities of the constituents materials used and extent of curing. Fresh concrete ought to be workable to facilitate easy placing, compaction and removal of air bubbles. The workability of fresh concrete is therefore determined before use in foundation work, using the slump cone or the compacting factor apparatus.

Activity 6, Stages in foundation work;

The teacher and students jointly outline the procedures of constructing a simple foundation.

- Set out the propose building
- Excavate the foundation
- Cast the foundation concrete
- Build the foundation wall to the ground level
- Earth/hardcore filling and compaction
- Casting of over site concrete
- Curing using appropriate strategy.

LESSON PLAN SIX (HANDS-ON ACTIVITY)

School:- Experimental Schools 1&2, FCE (T) Bichi and Kanopoly
Name of Researcher: Bashir Abubakar Sabo
Reg.No: Ph.D/EDU/4525/2011-2012
Topic: - Foundations
Level: - NCE II Technical
Date: - Week four (June/July 2015)

Instructional Resource; Compacting factor apparatus, weighing scales, fine and coarse aggregate, cement, water, spade and trowels.

Instructional objectives;the students will be guided by the teacher to;

i. Batch concrete materials by weight using ratio 1:3:6

ii. Conduct workability test of foundation concrete using the compacting factor apparatus,

Activity 1; The teacher guide the students to develop an action plan to determine the workability of fresh concrete using the compacting factor or apparatus, in group, and it is the first stage of the PBI cycle.

Action plan to determine workability of fresh concrete

TASK	T/LEANERS	R.NEEDED	TIME/DATEE	S/ INDIC.
Determine the workability of fresh concrete	NCE 11 STDS	slump cone, compacting factor apparatus, weigh balance, rod, cement, gravels, trowel	8^{th} to 15^{th} may 2015	Obtain true slump of value between 0,75 -0.92

Activity 2, Checks Of The Action Plan;

This is done through the following questions;

- Is the action plan realistic and practicable?
- Are the required resources available for use?
- Is the time frame realistic?

Activity 3, Implementation of the Action Plan;

The students in groups are guided to carry out the experiment in the developed action plan. They will be assisted by workshop technicians and the lecturers. And will calculate the workability of fresh concrete using the formula below;

$$\text{WORKABILITY OF CONCRETE} = \frac{\text{Weight of partially compacted concrete}}{\text{Weight of fully compacted concrete}}$$

Activity 4. Evaluation of the Action Plan; after the experiment, the exercise is evaluated jointly with students for future actions. It is best done using the table below.

Evaluation of the action plan

TASK,	SUCCESS AREAS OF AC,	FAILURES OF AC, REASONS		FUTURE PLANS
Determine simple workability of fresh concrete	Successful	None	Precision	Use slump cone

CONCLUSION,

The evaluation stage brings the end of the cycle, if the success indicator is positive, that is a true slump is obtained when the slump cone apparatus is used. Another positive indicator is obtaining a value of between 0.72 to 0.92 after using the compacting factor apparatus in the experiment. The action plan is kept for future use with some other sets of students. But where there are failures.the weaknesses are identified, corrected and the action plan is re-implemented.

LESSON PLAN SEVEN

School:- Control Schools 1&2, FCE (T) Gombe and HUP Kastina
Name of Researcher: Bashir Abubakar Sabo
Reg.No: Ph.D/EDU/4525/2011-2012
Topic: - Foundation.
Level: - NCE II Technical
Duration:- 2 hours
Date: - Week three(June/July 2015)

Instructional Resource; Sketches and the environment (fig. 6 & 7) attached

Instructional Objectives;At the end of the instruction the students should be able to;

i. define foundation

ii. list type of foundations

iii. state the basic requirements for foundation work

Review and focus/ Previous Experiences;

The teacher, with the students reviews setting out of simple building plans, checks on setting out, common building tools, used basic safety precautions, and site clearance.

Activity I,: definition of foundation:

the teacher defines and explain foundation;

Model definition; Foundation is the part of a structure in direct contact with the ground, which transmits the dead and superimposed load of the building over a wide area of bearing capacity and consequently facilitating even settlement of the building.

Dead loads are loads due to the foundation, floors, roofs and all materials used in the construction while, superimposed loads are weights due to human beings, furniture and other imposed materials.

Activity 2, Types of Foundations;

The teacher list and explain the types of foundation while the students listens and take note;

i. Strip foundation; this is the commonly used one in low rising structures especially in NigeriA.it consist of a continuous strip of concrete which provides a continuous ground bearing for load bearing walls mostly in firm and non-shrinkable soil.

ii. Wide strip foundations; are used in loose soils with low bearing capacity, the major difference with the strip foundation is the transverse and longitudinal reinforcement of the foundation concrete to ensure even settlement of the structure.

ii. Pad foundations; are design to support higher loading, it is mostly constructed of reinforced concrete to support steel pillars, and heavy machines in industrial buildings.

iii. The raft foundation; is used where the subsoil is very weak and is prone to failures, the entire surface of the ground is excavated to receive the raft which covers the entire area of the building and beyond. The reinforcement is made of mild steel circular bars laid in both directions.

Activity 3, Requirementsfor foundations:

The teacher list and explain the basic requirement for foundation;

Foundations are design and constructed with due consideration to the following features.

I. Sustain the dead and superimposed load of the structure
II. Transmit these loads to the area of bearing capacity
III. Adequately resist attacks by sulphate and other deleterious matter in the ground.
IV. Deep enough to safeguard the building against damage due to swelling and shrinkage
V. Withstand tensional/shearing forces and water pressures in the building

Activity 4, The teacher evaluates the class by asking questions revolving around foundation construction, the students will also be encouraged to sketch different types of foundations.

LESSON PLAN EIGHT

School:- Control Schools 1&2, FCE (T) Gombe and HUP Kastina
Name of Researcher: Bashir Abubakar Sabo
Reg.No: Ph.D/EDU/4525/2011-2012
Topic: - Foundations
Level: - NCE II Technical
Duration:- 2 hours
Date: - Week four (June/July 2015)

Instructional Resource; Sketches and the environment (fig. 6&7) attached

Instructional objectives: At the end of the instruction, students should be able to;

i. demonstrate on the procedure for the construction of foundation

ii. Mention basic maintenance checks on tools and equipment use in foundation work

iii. Discus concrete material in foundation work and how to determine its workability

Review and focus/ Previous Experiences;

The teacher and the studentsreviews the definitions of foundation, types of foundation and some basic foundation requirements.

Activity 1, stages in foundation work;

The teacher lists, and explain the procedures of constructing a simple foundation.

i. Set out the propose building

ii. Excavate the foundation

iii. Cast the foundation concrete

iv. Build the foundation wall to the ground level

v. Earth/hardcore filling and compaction

vi. Casting of over site concrete

vii. Curing using appropriate strategy.

Activity 2,

Tools/equipment and Maintenance requirements after use,

Below are the Tools/ equipment used in foundation and the maintenance strategy of each after use. They include; Concrete mixing machines and dumpers, Poker vibrator , Compacting factor apparatus/slump cone, Diggers, shovels and head pans,

S/N	TOOL/EQUIPMENT	MAINTENANCE AFTER USE
1	Concrete mixers	Wash drum, remove concrete deposit and grease rotating areas
2	Dumper/wheel barrows	Wash after use and oil
3	Poker vibrator	Wash and oil to avoid rust
4	Compacting factor app.	Wash after use and oil
5	Slump cone	Wash after use
6	Digger/shovels/pans	Wash after use

Activity 3, Material used for foundation work,

The major material used in foundation work is the concrete, which consist of fine aggregate (sand), coarse aggregate (gravel), cement and water properly mixed together to form a solid mass. Fine aggregates enhances the binding power by providing gritty surfaces for contact with cement, coarse aggregates increases the volume of materials and strength, cement is the matrix that binds all the materials while, water is the lubricant that initiate the chemical processes.

Concrete when hardened is known as mass concrete but when steel is introduced to improve tensional qualities and general strength is called reinforced concrete. Strength of concrete are influenced by the ratio and qualities of the constituents materials used and extent of curing. Fresh concrete ought to be workable to facilitate easy placing, compaction and removal of air bubbles. The workability of fresh concrete is therefore determined before use in foundation work, using the slump cone or the compacting factor apparatus. true slump is obtained when the slump cone apparatus is used or a value of between 0.72 to

0.92 is obtained when the compacting factor apparatus is used in the experiment. The formula for determining the workability is given below.

$$\text{WORKABILITY OF CONCRETE} = \frac{\text{Weight of partially compacted concrete}}{\text{Weight of fully compacted concrete}}$$

Activity 4, Evaluation

The teacher reviewed the lesson by asking questions on stages of foundation tools and materials used and simple calculation to determine the workability of concrete.

LESSON PLAN NINE

School:- Experimental Schools 1&2, FCE (T) Bichi and, Kano poly
Name of researcher: Bashir Abubakar Sabo
Reg.no: Ph.D/EDU/4525/2011-2012
Topic: - Walls.
Level: - NCE II Technical
Duration:- 2 hours
Date: - Week five (June/July 2015)

Instructional Resource; Bricks, Blocks, Trowel, Bat, builders' square (fig.5&6) attached.

Instructional Objectives;At the end of the instruction the students should be able to: -

- Define walls/types.
- State the basic requirements of walls.
- List materials used in wall construction.
- Identify types of bonding wall construction.

Review and focus/ Previous Experiences:

The teacher and the students reviews general safety precautions on site, building tools and equipment setting out foundation work.

Activity 1, Definition of walls/types; The teacher asks students to a define walls and the types

Model definition; Walls; are simply the vertical elements of building which enclose/divide space and form the environmental envelop with the roof, they are made of different types of materials. Walls are defined as internal or external to differentiate functional requirements, and load bearing or non-load bearing to differentiate structural requirements. Load bearing walls structurally supports load from floors, roofs and its weight, while non-load bearing walls carry its own weight alone.

Activity 2. Basic requirements of walls:

The teacher asks the students to mention basic requirements for walls.

Principally walls are designed and constructed to fulfill the following functions;

- Provide the required strength and stability in the designed place of use.
- Adequately resist the weather it is exposed and other variations.
- Adequately resist fire attacks depending on the vulnerability of the materials.
- Provide thermal and sound insulation as the need arises.

Activity 3. Materials used in wall construction

The teacher and students jointly identify the basic materials for wall construction. Walls are generally named either by the materials used in the construction, the method of construction or the functions it will serve. Examples includes, stone walls (materials), masonry walls (construction), cavity walls (construction), frame walls (construction), concrete walls (materials), retaining walls (construction) and so on.

Activity 4, bonding in wall construction;

The teacher assist the students to identify types of bond used in wall construction; Bonding is the systematic arrangement of bricks/blocks in a definite pattern eventually enhancing strength and maximizing stability of the structure of the walls. The essence is to prevent both internal and external straight joints in the walls. The popular bond used in Nigeria is the stretcher bond where there is half brick lap in successive course of the walls. Other bonding types include Flemish and English bonds.

Activity 5; EvaluationThe teacher evaluates the class by asking questions on types of walls, materials used for wall construction and task the students to draw the three types of bond mentioned.

LESSON PLAN TEN (HANDS-ON ACTIVITY

School:- Experimental Schools 1&2, FCE (T) Bichi and Kano poly
Name of researcher: Bashir Abubakar Sabo
Reg.no: Ph.D/EDU/4525/2011-2012
Topic: - Walls.
Level: - NCE II Technical
Duration:- 2 hours
Date: - Week six (June/July 2015)

Instructional Resource; Bricks, Blocks, Trowel, Bat, builders' square and straight edge,

Instructional Objectives; The students will be guided to carry out the following activities

1. Set out simple brick wall.

ii. Construct a brick wall using stretcher bond

Review and focus/ Previous Experiences. The teacher with the students review common building tools used in wall construction, discuss basic safety precautions, and appraise the previous lessons on setting out, foundations and walls. The teacher then instructs the students to form flexible group that will allow the conduct of the practical at their convenience.

Activity 1. The teacher guide the students to develop an action plan in group on how to construct stretcher bond brick wall using the provision of the PBI.

Action plan for the construction of a wall.

TASK,TARGET LEARNERS	RESOURCES REQUIRED	TIME/DATE	S/INDICATOR
Construct Brick wall using Stretcher Bond	NCE II STDS trowel, hawk, square spirit level, straight edge builder square, shovel pan	Bricks, mortar, water, 21st to 28th July 2015	One week Built wall

Activity 2; Checks of The Action Plan;

This is done through responses to the following questions;

- Is the action plan realistic and practicable?
- Are the required resources available for use?
- Is the time frame realistic?

Activity 3; Implementation of The Action Plan; The students in groups are assisted to construct the wall in the developed action plan at their own convenient time, they will be assisted by workshop technicians or the lecturers. Due to the tight lecture schedule, the students could do the practical at their convenience.

Activity 4; Evaluation of The Action Plan; after the practical in the workshop it is evaluated jointly with the students. It is best done using the table below.

Evaluation of the action plan

TASK,	SUCCESS AREAS OF AC,	FAILURES OF AC, REASONS	FUTURE PLAN
Construct wall using stretcher bond	Successful	None	Flexibility of plan	English bond

CONCLUSION, The evaluation stage brings the end of the cycle, if the success indicator is positive, the action plan is kept for future use with some other sets of students. But, if there are failures, the weaknesses are identified corrected and re-implemented;The measurable outcome is also given by the success indicators which is the ability to construct the wall.

LESSON PLAN ELEVEN

School:- Control Schools 1&2, FCE (T) Gombe and HUP Kastina
Name of researcher: Bashir Abubakar Sabo
Reg.no: Ph.D/EDU/4525/2011-2012
Topic: - Walls.
Level: - NCE II Technical
Duration:- 2 hours
Date: - Week five (June/July 2015)

Instructional Resource; Sketches and the environment

Instructional Objectives;at the end of the instruction the students should be able to;

i. Define walls

ii. Identify types of wall.

iii. State the basic requirements of walls.

iv. List materials used in wall construction.

Review and focus/ Previous Experiences

The teacher and the students reviews their activities on setting out, foundation work and general safety provisions in wall construction.

Activity I; definition of walls;

The teacher defines and explains walls while the students listen and take note.

Wall; are simply the vertical elements of building which enclose/divide space and form the environmental envelop with the roof, they are made of different types of materials.

Activity 2; Types of wall,

Walls are defined as internal or external to differentiate functional requirements, and load bearing or non load bearing to differentiate structural requirements. Load bearing walls structurally supports load from floors, roofs and its weight, while non load bearing walls carry its own weight alone.

Activity3, Basic requirements of wall;

The teacher list and explain the basic requirements of wall construction.

Principally walls are designed and constructed to fulfill the following functions;

i. Provide the required strength and stability in the designed place of use.
ii. Adequately resist the weather it is exposed and other variations.
iii. Adequately resist fire attacks depending on the vulnerability of the materials.
iv. Provide thermal and sound insulation as the need arises.

Activity 4, Materials used in the construction of walls;

The teacher list and explain the materials used in the construction of walls

Walls are generally named either by the materials used in the construction, the method of construction or the functions it will serve. Examples includes, stone walls (materials), masonry walls (construction), cavity walls (construction), frame walls (construction), concrete walls (materials), retaining walls (construction) and so on.

Activity 5; Evaluation

The teacher evaluates the class by asking questions on types of walls, materials used for wall construction and task the students to draw the three types of bond mentioned.

LESSON PLAN TWELVE

School:-	Control Schools 1&2, FCE (T) Gombe and HUP Kastina
Name of researcher:	Bashir Abubakar Sabo
Reg.no:	PhDd/EDU/4525/2011-2012
Topic: -	Walls.
Level: -	NCE II Technical
Duration:-	2 hours
Date: -	week six (June/July 2015)

Instructional Resource; sketches and the environment (fig.5&6) attached

Instructional Objectives;The students should be able to;

i. Outline stages for building simple brick walls.

ii. state safety precautions in walls constructions.

iii. Define bonding in wall construction

Review and focus/ Previous Experiences

The teacher with the students review common building tools used in wall construction, discuss basic safety precautions, and appraise the previous lessons on setting out and foundations and walls.

Activity 1, Construction of simple wall using stretcher bond

The teacher outline the stages of building simple wall using bricks, starting from initial drawing of the wall pattern on the floor of the workshop to the final construction. The teacher will also discuss other types of bonding of brick wall like the English and Flemish bonds.

Activity 2, Bonding in block and brick work,

The teacher defines and explains bonding, while students listens and take note. Bonding is the systematic arrangement of bricks/blocks in a definite pattern eventually enhancing strength and maximizing stability of the structure of the walls. The essence is to prevent both internal and external straight joints in the walls. The popular bond used in

Nigeria is the stretcher bond where there is half brick lap in successive course of the walls. Other bonding types include Flemish and English bonds.

Task, draw the three types of bond mentioned.

Activity 3; Evaluation

The teacher evaluates the class by asking questions on types of wall.Materials used for wall construction, bonding and task the students to draw the three types of bond mentioned.

FIGURES

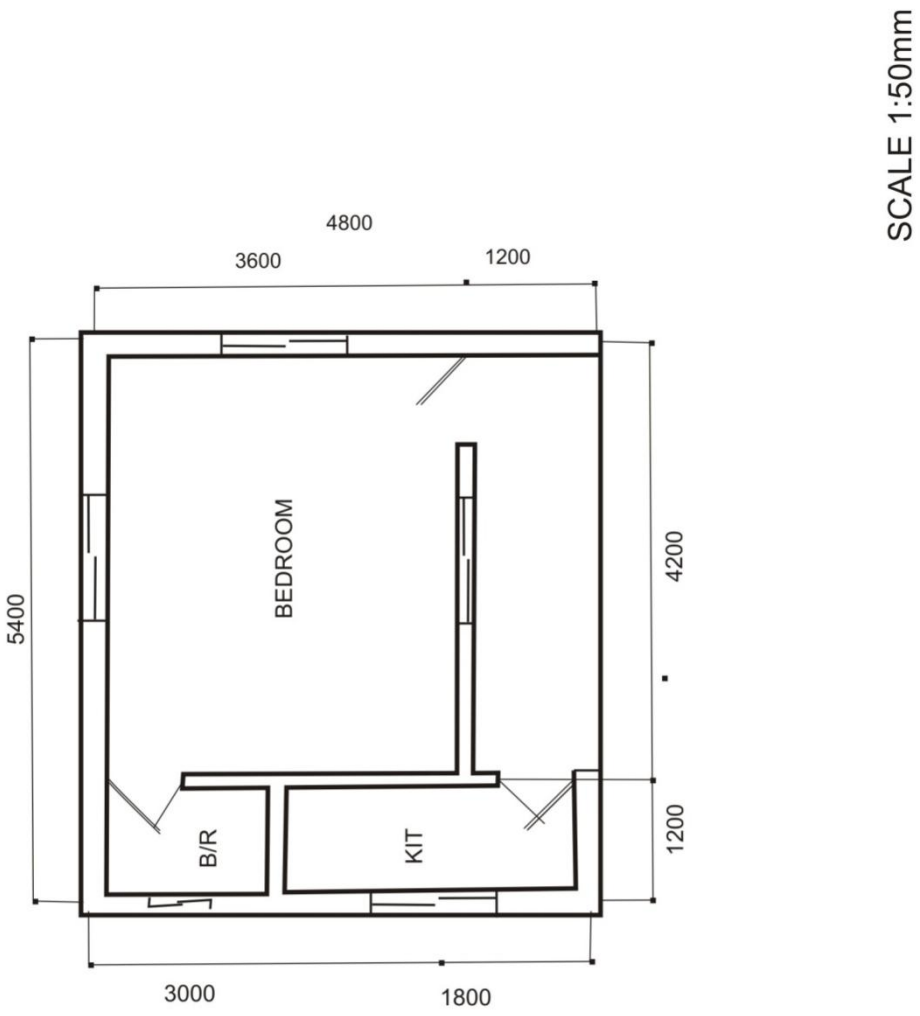


Figure 1

3.4.5 METHOD OF SETTING OUT

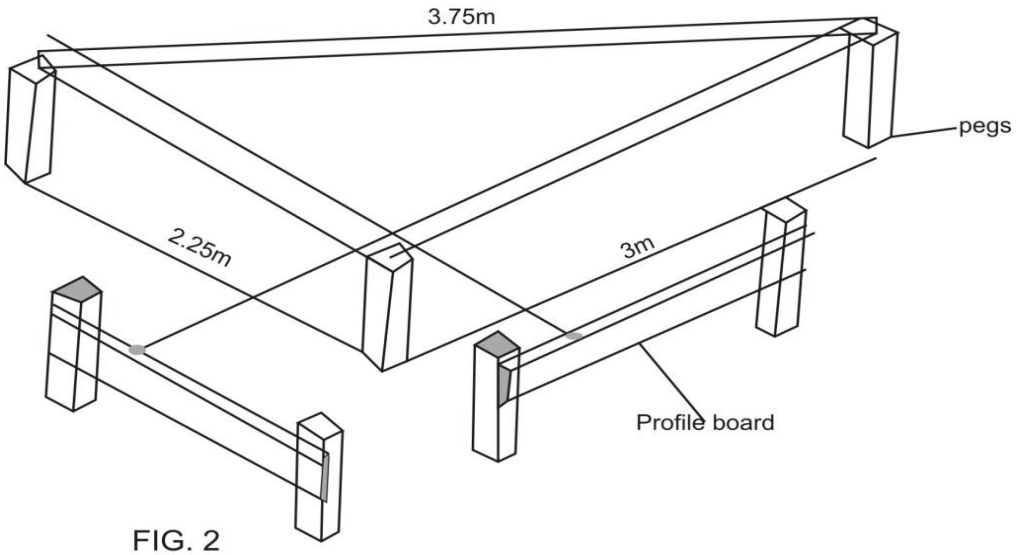
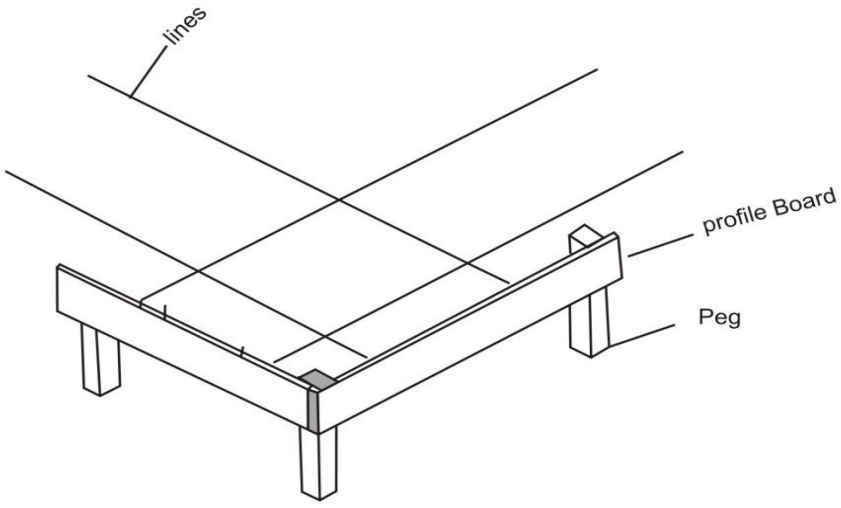


FIG. 2

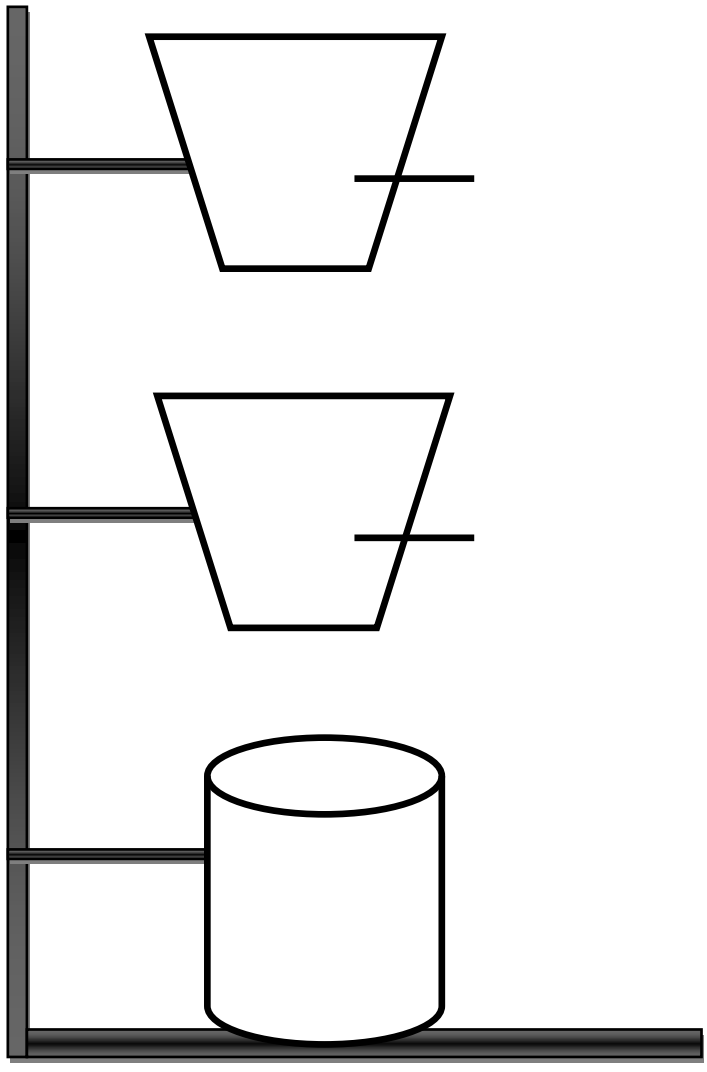


SETTING OUT USING
PROFILE BOARD

FIG. 3

TASK FOR HANDS ON ACTIVITY

WORKABILITY TEST FOR FOUNDATION CONCRETE

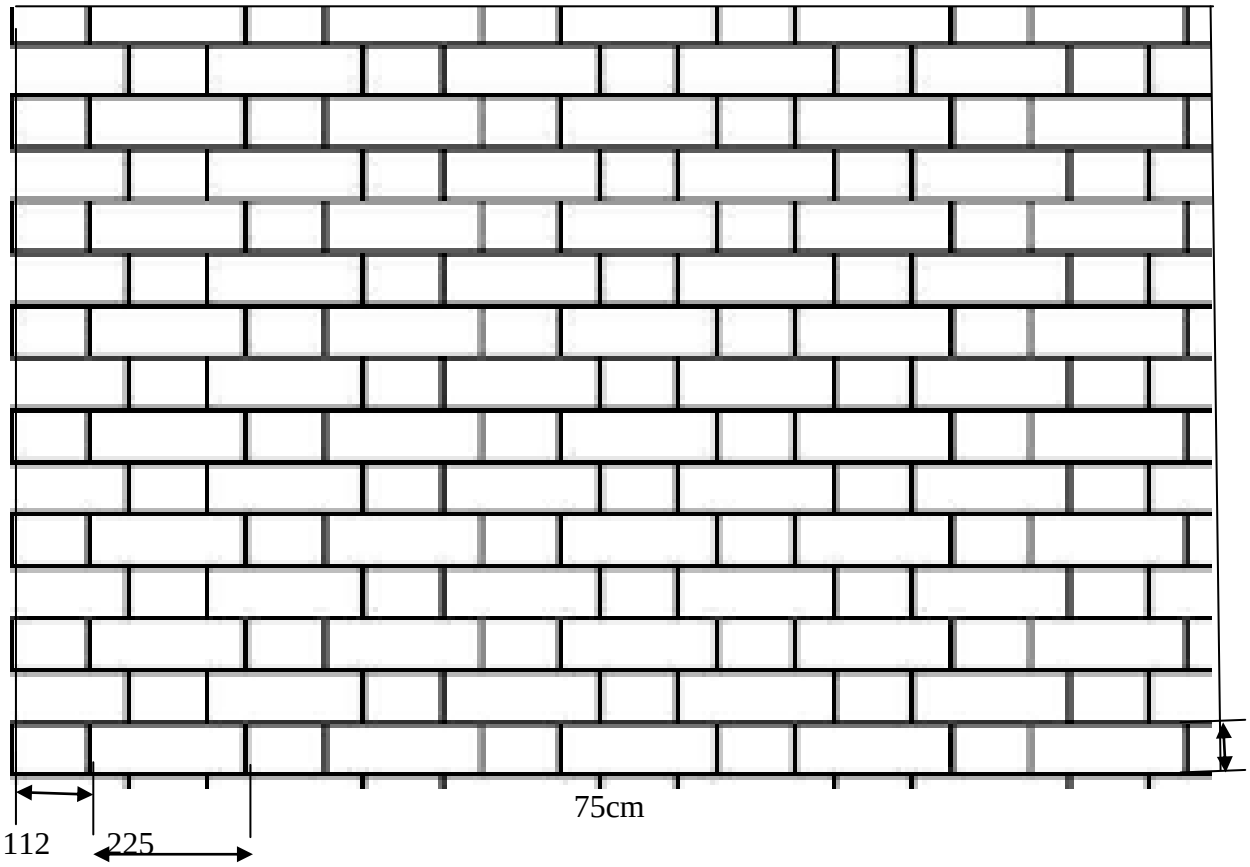


Compacting Factor Apparatus

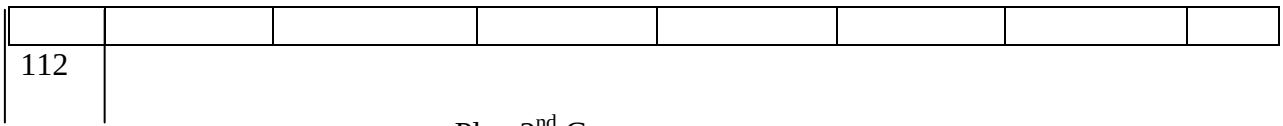
Fig.4

TASK FOR HANDS ON ACTIVITY

BRICK WORK STRETCHER BOND



Front View



Plan 2nd Course

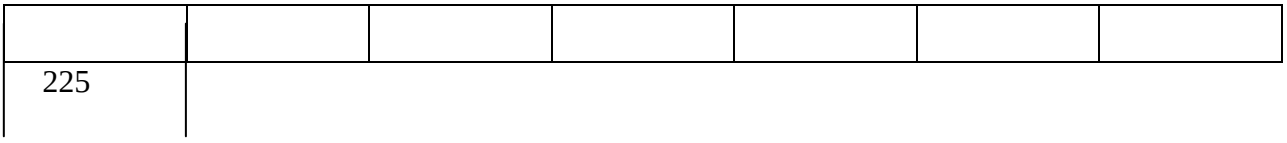
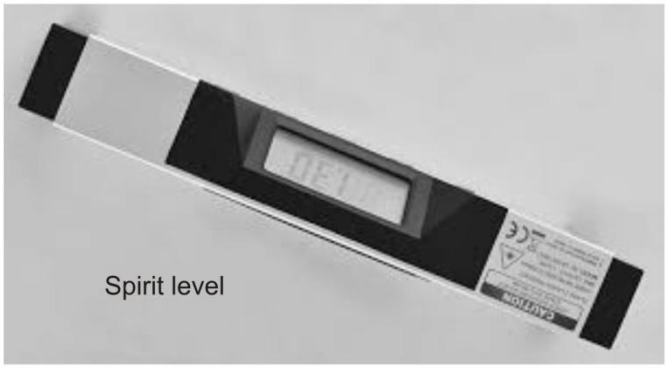


FIG. 5Plan 1st Course

BUILDING TOOLS

Measuring tool



Spirit level

Wooden flat

Trowel

Range

Shovel

Cones and Pins

FIG. 6

Excavated foundation

.

APPENDIX IV TRAINING GUIDE

Training Guide for Research Assistants in Experimental and Control Schools

Objectives of the Training include;

1. Share the purpose and focus of the Research
2. Explain how the pre-test and post-test will be conducted
3. Identify hands-on tasks in the study.
4. Develop and score checklist for resources needed vis-à-vis the hands-on tasks.

ACTIVITY ONE

INTRODUCTION

The researcher introduces himself and all present were asked to do same.

ACTIVITY TWO

The researcher explained the topic of study as "Effects of Practice-Based Inquiry Cycle on the Performance of Colleges of Education (Technical) and Polytechnics Students in Building Technology in Nigeria**"** the research further explain the focus of the work as simply a frantic search for an alternative instructional strategy that will enhance skill acquisition of pre-service teachers in the NCE (Technical) programme in NigeriA.The objectives of the study were stated as:

1. determine the effect of PBI Cycle on the general performance of Building Technology Students;
2. ascertain the effect of PBI Cycle on Performance of the students in Building Technology concepts;

3. examine the effect of PBI Cycle on Building Technology Students in affective task performance in Building Technology;
4. find out the effect of PBI Cycle on Building Technology Student in Hands-on task performance in Building Technology and
5. compare the effects of PBI Cycle on Performance of Building Technology Students between Colleges of Education and Polytechnics in Nigeria.

Comments from participants

ACTIVITY TWO

An appraisal of best practice in conduct of examinations was discussed, and the pre-tests and posts will be conducted under same examinations rules and regulations as obtained in the students hand books from the respective institutions. Additional tasks include;

1. Attendance records for the pre-tests
2. Attendance records for post-tests
3. Attendance records during treatment
4. Attendance records during lectures

Conclusion; Examination rules and regulations of each of the institution were briefly discussed with all present. More so, examination ethics' are universal there were no significantdifferences.

ACTIVITY THREE

The researcher states the hands activities contained in the treatment plan as;

1. Setting out of simple building plan
2. Workability test of foundation concrete

3. Wall construction using stretcher bond

ACTIVITY FOUR

The essence of this activity was to be certain of the resources needed for the hands-on activities vis-à-vis the targeted no of students for the treatment. The resources as outlined below were checked by the researcher and the research assistants in the experimental schools.

Check List of Resource (Tools and Materials) for Setting out, Workability test for Concrete and Construction of simple Brick wall.

TOOLS/MATERIAL	**AVAILABLE AND ADEQUATE**
1. Building plan	√
2. Line and pin	√
3. Profile boards	√
4. Square	√
5. Measuring tape	√
6. Pegs	√
7. Hammer	√
8. Nails,	√
9. Blocks	√
10. Digger	√
11. Shovels	√
12. Compacting Factor apparatus	√
13. Slump cone	√
14. Gravels	√

15. Cement √

16. Water √

17. Weighing balance √

18. Bricks √

19. Plumb level √

20. Straight edge √

CLOSING

The researcher finally sought for the support and commitment of the research assistants for the success of the study.