EFFECT OF CONSTRUCTIVIST TEACHING METHOD ON METALWORK STUDENTS' ACADEMIC ACHIEVEMENT IN TECHNICAL COLLEGES IN YOBE STATE

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By

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A THESIS PRESENTED TO THE DEPARTMENT OF TECHNOLOGY EDUCATION, SCHOOL OF TECHNOLOGY AND SCIENCE EDUCATION, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE OF MASTER OF TECHNOLOGY IN MECHANICAL (PRODUCTION) TECHNOLOGY EDUCATION OF THE MODIBBO ADAMA UNIVERSITY OF TECHNOLOGY, YOLA

AUGUST, 2019

DECLARATION

I hereby declare that this project thesis was written by me and it is a record of my own research work. It has not been presented before in any previous application for a higher degree. All references cited have been duly acknowledged.

_____ _____

DABO, UMAR YUSUF Date

DEDICATION

This thesis is dedicated to all those who have inspired my academic lives.

APPROVAL PAGE

This thesis entitled "Effect of Constructivist Teaching Method on Metalwork Students' Academic Achievement in Technical Colleges in Yobe State" meets the regulations governing the award of Masters Degree in Mechanical (Production) Technology of the Modibbo Adama University of Technology, Yola and is approved for its contribution to knowledge and literacy presentation.

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ABSTRACT

This study compared two teaching methods, namely, Constructivist and Lecture teaching methods on students' achievement in metalwork in technical colleges in Yobe State. The population for the study comprised of all the NTC II students offering Metalwork in Technical Colleges with a population of 74 students in Yobe State. Two technical colleges were selected as sample for the study comprised of 58 students. The instrument used for data collection was Metalwork Achievement Test which was validated by experts. The trial test for determining the reliability of the instrument was carried out using split-half reliability technique. Pearson Product Moment Correlation coefficient of the instrument was found to be 0.82. Students in the experimental group were taught using constructivist method while those in control group were taught using lecture method. The experiment lasted for six weeks; first week was devoted to pretest, second to fifth weeks were used for teaching the students after which a post-test was administered in the sixth week. Mean was used to answer the research questions while ANCOVA was used to test the hypotheses. The study found out that the students in the experimental group achieved higher mean score than those in control group. This implies that constructivist teaching method is better than lecture method in teaching measurement and marking out; arc and gas welding; casting process and drilling process. The study therefore recommended that Metalwork teachers should be trained in the use of constructivist teaching method and National Board for Technical Education should consider review of curriculum for National Technical Certificate in order to incorporate constructivist method as a method of teaching Metalwork.

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

It is a vision of each and every country to be technological and economically ahead, Nigeria will not be in exception. The ability of Nigeria to realize the vision of becoming one of the twenty largest economies in the world is largely dependent on the capacity to transform its youth into highly skilled and competent citizens capable of competing globally (Eneh, 2011). A major part of the responsibility for preparing such a workforce rests on the nation's education sector. Therefore, to realize this vision and in order to be competitive in the global economy, Nigeria needs to develop the appropriate knowledge and skills (Federal Ministry of Education, 2012). Technical education is the foundation of nations' wealth and development. It is a type of education that is meant to produce semi-skilled, skilled and technical manpower necessary to restore, re-vitalize, energize, operate and sustain the national economy and substantially reduce unemployment (Ogumbe, 2015). Technical Education is a form of education involving in addition to general education the study of technologies and related sciences and the acquisition of practical skills, attitudes, understanding and knowledge relating to occupations in various sectors of the economic and social life. Technical education is an aspect of education that leads to acquisition of practical and applied skills as well as basic scientific knowledge through training (FRN, 2013 p.30).

The goal of Technical Vocational Education and Training (TVET) as contained in National Policy on Education should be to:

i. Provide trained manpower in applied science, technology and business particularly at craft, advanced craft and technical level;
ii. Provide technical knowledge and vocational skill necessary for agricultural, commercial and economic development; and
iii. Give training and impart the necessary skills to individual for self-reliance economically (FRN, 2013 p.16).

The Federal Ministry of Education (2012) stated that TVET is not given the attention it deserves in Nigeria. If well attended, TVET could be an avenue for addressing a number of social and economical problems facing the country, for example the large number of out of school children, unemployed youths and adults with limited or no skills is an indicator of underdeveloped TVET in the country. In support of this Garba (2012) opined that future of any nation lies much in the number

and quality of youth of the nation. This is because youth are the leaders of tomorrow and these youth can best be empowered to move the country forward when they are given the required training in vocational technical education. In order to realize the stated objectives effectively, there is need to emphasize on Technical College being one of the institutions for the beginning of Technical Education. It is one of the levels saddled with the responsibility of training of vocational and technical education at craft level (Blessing &Oladiran, 2011).

Technical colleges are established by the Federal Government of Nigeria to prepare individuals to acquire practical skills, basic and scientific knowledge and attitude required by craftmen and technicians at sub-professional level. In an attempt to pursue the goal of technical education, the curriculum for technical college is structured in the foundation and trade modules. The components are general education, theory and related courses; workshop practice and Industrial training/production work. The length of course in technical college like in other senior secondary school shall be three years for National Business Certificate/National Technical Certificate NBC/NTC, (FRN, 2013). According to Ombugus (2013) specifically, technical college is designed to prepare individuals to acquire manipulative skills, basic scientific knowledge and attitude required of a craftsman and technician at sub professional level. Various trade such as Construction trade, engineering trade, Business trade, Miscellaneous trade and modular trade have been designed to meet the overwhelming demand and desire of students and society at large (NBTE, 2015).

In Yobe State prior to the decision of federal government in 2004 to convert all technical colleges to science and technical colleges, the state has only one technical college located in Geidam that was established in 1982 by BornoStategovernment the then (Yobe State Ministry of Home Affairs, Information and Culture, 2015).Over the years, there was shortage of technical college graduates due to inadequate technical colleges within the state. This prompted some of the small scale industries to employed secondary school drop-out instead of technical college graduates. Impressively, the state now has about eight technical colleges across the State, 2 out of the 8 are girls' technical colleges. Although the number is not up to standard (one for each local government area) but there is an improvement in the number of graduates being produces every year. However, the challenge is quality of technical college graduate produces in the state. Metalwork is one of the programmes

offered NTC certificate, and it is also offering in some of the technical colleges in the State.

Metalworkis a trade related subject offered in most of the NABTEB engineering trades such as Agricultural implements and mechanics works, Motor vehicle mechanic works, Auto electrical works, Welding and fabrication, mechanical engineering craft practice, refrigerator and air conditioning works, vehicle body building, foundry craft practice and marine engineering trade (NBTE, 2015 p.26). Malgwi and Mbah (2012) identified the followings occupational prospect associated with metalworking:

1. Roofing materials: there are opportunities for metalworker in the area of roofing, finishes and services in the building industries. A glance at the cities exposed us to the variety of roofing sheets and designs.
2. Welding: there exist great potentials in this sector of general metalworking process. The technical college graduates would excel in this area.
3. Panel beating services: the metalworker has opportunities in this service area. Although this sector operates in the formal sector, the technical college graduate would find it rewarding to engage his skills in this area.
4. Metal casting and Machining: there are great opportunities in the area using appropriate technology.
5. Metal construction: the insecurity in the country has created a potential for the metal worker to excel in the construction of burglar proof for newly constructed houses.

These prospects have provided great opportunities for metalwork graduates in Yobe State that are supported by the environment for successful entrepreneurial process. The identified occupational prospects are available in Yobe state community as such metalwork graduates from technical college have multiple opportunities after successfully graduated. That is when they opted to be employed or establish their business to become self-employed as specified among their possible options in the National Policy of Education. In most parts of the state for instance, electric arc and gas welders are in common, constructing metallic doors, window, burglar-proof, turners and so many similar product. Furthermore, if metalwork graduates opted to further their study after graduation, they still have opportunity. In the State, there are two federal tertiary institutions that runs diploma programme in mechanical engineering and Nigerian Certificate in Education (NCE) in metalwork. These

institutions are Federal Polytechnic Damaturu and Federal College of Education (Technical) Potiskum respectively.

The opportunities can be achieved through effective teaching to acquire the necessary knowledge through utilization of variety of instructional approach to meet the societal needs. George (2008) noted that the method used in delivering instruction determines the success of any instruction and choice of instruction should not be limited to particular method all the time simply because unfamiliarity with the wide variety of instructional approaches that actually exist in educational setting. This tendency can build unnecessary limitations and it can also prevent the effective use of different styles of instructions. Inflexibility of instructional approach can lead a teacher to completely fail to take into account learner differences and reception levels. But unfortunately in Nigeria schools, of which Yobe state schools could not be in exception, traditional method of teaching such as lecture method of teaching is one of the most widely practicing method (Doko& Robert, 2015). Similarly and more recently Ogbuanya, Akintonde and Bakare (2017), revealed that lecture method is widely used in technical colleges and there is no any other method frequently used that is student-centered.

During a lecture, there is no or little discussion, the only exchange that may occur between the instructor and students might be a few scattered questions from listeners (Mele, 2018). Students who are weak in note-taking skills may have trouble in summarizing or in identifying the main points they should remember from lectures. This method of teaching according to Chinwe and Okeke (2015) may not sufficiently give students the opportunity to participate in the classroom activities which in turn lead to poor performance in certificate examination which can hinder students from gaining admission in to higher technical institutions.

This situation calls for other alternative to teacher-centred approach such as constructivist instructional approach which can be used to sustain students' interest and curiosity and also to improve students' academic achievement. According to Bada, (2015) constructivist approach is an instructional approach which tends to shift the main focus from the teacher to the students. The classroom is no longer a place where the teacher being the expert pours knowledge into passive students, who wait like empty container to be filled. In the most general sense, it usually means encouraging students to actively participate in classroom activities (Sarita, 2017).

Oyenuga (2011) reported that academic achievement of the students will improve significantly if the teacher takes care of the students by adopting good instructional approach. Churcher, Asiedu, and Boniface (2016) stated that academic achievement is a function of many variables including teacher's teaching styles, the hallmark of any teaching is centred on professional methodology especially in the area of presenting the lesson. Therefore, academic achievement should be considered to be a multifaceted construct that comprises different domains of learning (Ricarda, Anja, Anne & Linda, 2017). Academic achievement of students in technical college is the measure of their achievement in both theory and practical. Students' academic performance is determined by an achievement test which should cover the three domains of learning, namely: cognitive, psychomotor and affective (Eze and Osuyi, 2018). Technical College graduates' level of academic performance is of a great concern to stake holders in education. Technical College graduates' academic performance in a particular subject is usually interpreted as low or high according to the letter grades assigned to the raw score obtained by the students. Generally as reported by Toro (2015) the academic achievement of technical college graduate in Nigeria is not favourable and some of the factors among other to be queering is method of teaching used. For technical college students to be able to perform better after graduation, the must have to satisfy the examining body in all the three domains of learning, namely: cognitive, psychomotor and affective. However in this study the focus is on cognitive domain only, that is to determine the effectiveness of constructivist teaching approach and lecture method in teaching metalwork to mechanical engineering craft students in technical college, being one of the institutions where technology education begins.

1.2 Statement of the Problem

Knowledge and skills are necessary and instrumental to the technological advancement of any nation (Amadi, Chiorlu&Obed, 2016). This connotes that any obstacle in acquisition and delivering of such knowledge and skills can hinder the technological advancement of the nation. In Nigeria, government emphasized on technological knowledge and skill acquisition by classifying the vocational and technical institutions in to post-Junior secondary school and post– Senior Secondary school institutions (Okolocha& Baba, 2016). Technical college is a post-Junior secondary school where many trades subject are offered including metalwork. Metalwork is one of the subjects offered as a trade related subject in most of the

engineering trades at the technical college whose main objective is to equip students with necessary basic knowledge and skill required to become self employed. The overall successes of technical college students may depend to a large extend, on effective implementation of its curriculum and appropriateness of teaching method. These are determinants in effective curriculum implementation.

Consequently,Faremi (2014) observed that the lecture method which is teacher-centered, is the main teaching methods employed by technical teachers for implementing the curriculum. Obviously, the adoption of only teacher-centered methods of teaching by the teacher results into ineffectiveness in teaching that leads to learning difficulties which in turn affect students' achievement negatively (Musa & Hassan, 2015). Poor students' academic achievement particularly technical college students generally had attracted the attention of educationists and researchers as a major problem to science and technological development in Nigeria. This persistent poor achievement has been partly ascribed to inadequate teaching and instructional methods adopted by technical teachers, and that is why NABTEB chief examiner in his report after May/June 2017 marking exercise suggested that technical teachers should adopt modern teaching method in teaching technical subjects, metalwork inclusive (NABTEB, 2017). This situation is not different in YobeState in terms of students' achievement particularly in metalwork. In this subject, in NABTEB examination for 2014, 65 students sat for the examination, 38 % passed and 62% failed; in 2015, 38 students sat for the examination 37% passed and 63% failed; and in year 2016, 39 students sat for the examination 30% passed and 70% failed (Field Survey, 2017). This indicates serious decline in academic achievement in the subject.

This persistence failure which had been ascribed to improper teaching method that have been used by teachers might end up producing technical college graduates that cannot further their education, be self reliant, nor be employed by any organization. Consequently, if they cannot cope with one of the three options above, they cannot contribute to the technological advancement of the State and the nation at large. So it is evident that the subject cannot thrive without appropriate instructional methods. As such, exploring the difference between constructivist teaching method and lecturemethod to teach the subject became a major concern.

1.3 Purpose of the Study

The main purpose of this study was to determine the effects of constructivist teaching approach and lecture method on the academic achievement of metalwork students in technical colleges in Yobe state. Specifically, the study intended to;

1. Determine the mean academic achievement scores of metalwork students taught measurement and marking out with constructivists' teaching approach and those taught with lecture method in technical colleges in Yobe State;
2. Determine the mean academic achievement scores of metalwork students taught arc and gas welding with constructivists' teaching approach and those taught with lecture method in technical colleges in Yobe State;
3. Determine the mean academic achievement scores of metalwork students taught casting processes with constructivists' teaching approach and those taught with lecture method in technical colleges in Yobe State; and
4. Determine the mean academic achievement scores of metalwork students taught drilling processwith constructivists' teaching approach and those taught with lecture method in technical colleges in Yobe state.

1.4 Research Questions

The following questions were used to guide the study;

1. What is the mean academic achievement scores of metalwork students taught measurement and marking out with constructivists' teaching approach and those taught with lecture method in Technical Colleges in YobeState.
2. What is the mean academic achievement scores of metalwork students taught arc and gas welding with constructivists' teaching approach and those taught with lecture method in Technical Colleges in Yobe State.
3. What is the mean academic achievement scores of metalwork students taught casting processes with constructivists' teaching approach and those taught with lecture method in Technical Colleges in YobeState.
4. What is the mean academic achievement scores of metalwork students taught drilling process with constructivists' teaching approach and those taught with lecture method in Technical Colleges in YobeState.

1.5 Hypotheses

The following hypotheses were formulated to guide the study.

$H0_1$There is no significant difference in the mean academic achievement scores of metalwork students taught measurement and marking out with constructivists'

teaching approach and those taught with lecture method in technical colleges in Yobe State.

$H0_2$There is no significant difference in the mean academic achievement scores of metalwork students taught arc and gas welding with constructivists' teaching approach and those taught with lecture method in technical colleges in Yobe State.

$H0_3$There is no significant difference in the mean academic achievement scores of metalwork students taught casting processes with constructivists' teaching approach and those taught with lecture method in technical colleges in Yobe State.

$H0_4$There is no significant difference in the mean academic achievement scores of metalwork students taught drilling process with constructivists' teaching approach and those taught with lecture method in technical colleges in Yobe State.

1.6 Significance of Study

The findings of the study will be of immense significance to students, teachers, parents, Yobe state educational administrators and curriculum planners. Students will benefit from this study in the sense that the effectiveness of alternative to frequently used method of teaching metalwork that has been revealed by this study, and this method would be used in the classroom to teach the students metalwork so as to make the students perform better academically in their internal and external examinations. The results of the study will also help the students to be imaginative, encourage positive thinking, logical reasoning and active participation in the classroom.

The findings of this study will be of great importance to practicing metalwork teachers in selecting the most effective methods of teaching metalwork in Yobe state technical colleges, thereby exposing the students to meaningful learning. It is expected that the findings will assist the metalwork teachers in stimulating and sustaining students' interest during lessons by employing the learners-centred instructional approach. Parents will also benefit from the findings of the study indirectly in the sense that the better academic achievement of their ward and children will bring joy and satisfaction, as well as assurance of better future of their children.

The findings will also provide empirical evidence which could serve as a guide to professional educational administrators and curriculum planners in their effort to help improve academic achievement of students. For administrators, the result of the study will be of immense importance for organizing conferences, workshops and seminars on new innovations in teaching and learning. The study

willhelp curriculum planners to develop curriculum that will consider and incorporate innovative instructional technique that will facilitate the training of metalwork students in technical colleges.

1.7 Scope of the Study

The study was delimited to the effect of constructivist teaching approach on technical college students' academic achievement in metalwork, this is so because constructivist instructional approach and metalwork students' achievement are the variables being emphasizes by the study. Specifically, the study was conducted using NTC II of two technical colleges in Yobe state because each of these colleges offers metalwork as a trade related subject and the NTC II students have at least stayed for one year and they don't have any external examination to take soon. The study did not cover all the themes of metalwork as contained in the syllabus, it was only delimited to measurement and marking out; arc and gas welding; casting processes; and drilling.

1.8 Operational Definition of Terms

Academic achievement: Is the performance of students which will be assessed through administering a test.

Metalwork: this is a trade related subject in engineering trade offered in technical colleges.

Technical College: is one of the technical and vocational training institutions where technicians and craftsmen are trained in various trades. The institution is now known as Science and Technical College.

Constructivist: This is an instructional approach which encourages the active participation of students in order to construct the knowledge base on their experience.

Lecture Method: It is a teaching method used in technical college involving verbal delivering of large information at a time before a large audience.

CHAPTER TWO
LITERATURE REVIEW

The literature of the study is reviewed under the following subheadings;

2.1 Theoretical Framework

2.2 Concept of Metalwork Technology

2.3 Constructivists' Teaching Methods

2.4 Lecture Method of Teaching

2.5 Technical Colleges in Nigeria

2.6 Effective Teaching Methods in Technology Education

2.7 Review of Related Empirical Studies.

2.8 Summary of Literature Review

2.1 Theoretical Framework

This study adopted constructivist teaching approach, an approach based on constructivism learning theory. The theory states that people construct their own understanding and knowledge of the world, through experiencing things and reflecting on these experiences (Bereiter, 1994).According to this theory learning should be student-centered and accomplished through active discovery learning by the student rather than attempting to receive knowledge passively from teacher (McLeod, 2015). The theory evolved from the extensive study of cognitive development by Jean Piaget in 1936 which state that people at formal operational stage of cognitive development develop the ability to think about abstract concepts, and construct an understanding of the world around them (Weeger, Pacis& Diego, 2012).

In the constructivist model, the students are urged to be actively involved in their own process of learning. The teacher functions more as a facilitator who coaches, mediates, prompts, and helps students develop and assess their understanding, and thereby their learning. In constructivist perspectives, learners directly develop knowledge by experiencing things and by reflecting on such experiences. Learners can actively learn through cognitive processes, constructing an understanding of the world around them (Har, 2013).Constructivism's central idea is that, human learning is constructed, that learners build new knowledge upon the foundation of previous learning. This view of learning sharply contrasts with one in which learning is the passive transmission of information from one individual to another, a view in which reception, not construction, is key (Sarita, 2017).

In constructivist instructional approach teacher avoids most direct instruction and attempts to lead the student through questions and activities to discover, discuss, appreciate and verbalize the new knowledge (Pegan cited in wikipedia). This study considered related to this theory in the sense that the study compared two teaching method. One of these methods is constructivist teaching method in which the teacher avoided most of the direct instruction and allowed the students actively engaged in learning activities to construct their own knowledge and understanding.

2.2 Concept of Metalwork Technology

Metalwork has evolved from the discovery of smelting various ores, producing malleable and ductile metal useful for tools and adornments. Metalworking is the process of working with metals to create individual parts, assemblies, or large-scale structures. The term covers a wide range of work from large ships and bridges to precise engine parts and delicate jewelry. It therefore includes a correspondingly wide range of skills, processes, and tools. Modern metalworking processes, though diverse and specialized, can be categorized as forming, cutting, or joining processes, furthermore today's machine shop includes a number of machine tools capable of creating a precise, useful work piece (Council of Registered Builders of Nigeria, 2017).

According Boyd (1982) metalwork cover the following aspect

1. Forging: this includes blacksmithing, spring making, drop forging and press forging.
2. Foundry: this cover areas such as bench moulding, machine moulding, smelting and casting
3. Heat treatment: this has to do with treatment of steel to acquire certain property.
4. Machining: this involves the use of various machine tools such as lathe, drilling, milling and shaping machine.
5. Sheet metalworking.

Oranu, Nwoke and Ogwo (2002) explained that metalwork involves activities in occupations that entail designing, processing and fabrication of metal products; it includes activities in foundry, forging, machine shop and welding. In addition to the fore mentioned areas of metalworking, Yakubu (2014) stated that metalwork also involves finishing which is the final treatment given to a metal in order to improve its appearance; protect it from corrosion (rusting); cover a less expensive metal with thin

coating of a more expensive one and wearing quality of surfaces. Based on the foregone, Metal work as a field of study has a wide coverage, however only some area could be facially reviewed being regarding as the most related area to this study. They are measurement and marking out; gas and arc welding; casting; and drilling operation.

2.2.1 Measuring and Marking out

Measurement and marking out are not specific discipline on their own as per as metal work is concerned, however its one of the most important aspect of metalwork. In line with this, Timings (2008) opined that measuring and marking out can be considered to be the most important process in manufacturing and without the ability to measure and mark accurately, we cannot:

i. Mark out components
ii. Set up machines correctly to produce components to the required size and shape
iii. Check components whilst we are making them to ensure that they finally end up the correct size and shape.
iv. Inspect finished components to make sure that they have been correctly manufactured. This is particularly important for large fabrications that have to be assembled on site.

However, no matter how accurately measuring equipment is made, and no matter how sensitive it is, one of the most important factors affecting the accuracy of measurement is the skill of the user. The most important procedures for the correct use of measuring equipment can be summarized as follows.

i. The measurement must be made at right angles to the surface of the component.
ii. The use of a constant measuring pressure is essential. This is provided automatically with micrometer callipers by means of their ratchet. With other instruments such as plain callipers and verniercallipers the measuring pressure depends upon the skill and feel of the user. Such skill only comes with practice and experience.
iii. The component must be supported so that it does not distort under the measuring pressure or under its own weight.
iv. Measuring instruments must be handled with care so that they are not damaged or strained. They must be cleaned and kept in their cases when

not in use. Measuring instruments must be regularly checked to ensure that they have not lost their initial accuracy (Timings, 2008).

Measurement

According to Groover (2010) Measurement is a procedure in which an unknown quantity is compared with a known standard, using an accepted and consistent system of units. Two systems of units have evolved in the world: the United State Customary System (U.S.C.S.), and the International System of Units (or SI, for SystemeInternationaled'Unites), more popularly known as the metric system. Groover further stated that measurement provides a numerical value of the quantity of interest, within certain limits of accuracy and precision. A measurement procedure is accurate when it is absent of systematic errors, which are positive or negative deviations from the true value that are consistent from one measurement to the next. In the words of Kelly (2014) measurement is the process of obtaining the magnitude of a quantity, such as length or mass, relative to a unit of measurement, such as a meter or a kilogram. The term can also be used to refer to the result obtained after performing the process. Generally measurement is carrying out to check some geometric attributes which are;

Angularity—The extent to which a part feature such as a surface or axis is at a specified angle relative to a reference surface.

Circularity—For a surface of revolution such as a cylinder, circular hole, or cone, circularity is the degree to which all points on the intersection of the surface and a plane perpendicular to the axis of revolution are equidistant from the axis. For a sphere, circularity is the degree to which all points on the intersection of the surface and a plane passing through the center are equidistant from the center.

Concentricity—The degree to which any two (or more) part features such as a cylindrical surface and a circular hole have a common axis.

Cylindricity—The degree to which all points on a surface of revolution such as a cylinder are equidistant from the axis of revolution.

Flatness—The extent to which all points on a surface lie in a single plane.

Parallelism—The degree to which all points on a part feature such as a surface, line, or axis are equidistant from a reference plane or line or axis.

Perpendicularity—The degree to which all points on a part feature such as a surface, line, or axis are 90 from a reference plane or line or axis.

Straightness—The degree to which a part feature such as a line or axis is a straight line (Groover, 2010).

Measuring Tools and their Uses

Hong Kong Industrial Centre (n.d.) classified the following as measuring tool that are commonly found in workshop;

Calipers: Calipers are the very simple tools used together with a steel rule for the measurement or comparison of linear dimensions. An experienced worker can achieve +/-0.05mm in the measurement. Calipers are classified into two types: -

i. Outside Calipers: Outside calipers are used for measuring external dimensions such as the length, diameter, or even the thickness of a solid.
ii. Inside Calipers: Inside calipers are used for measuring internal dimensions such as the diameter of a hole, or the width of a slot etc.

Vernier Calipers: Vernier Calipers are more precise tools capable for measuring external dimensions, internal dimensions, and depths. Besides the two pairs of measuring jaws and the depth gauge, its main features also include a main scale and a vernier scale.

Vernier Height Gauge: A vernier height gauge is used for measuring height of an object or for marking lines onto an object of given distance from a datum base.

Micrometer: A micrometer is a more precise measuring instrument than the vernier calipers. The accuracy is come from the fine thread on the screw spindle. The ratchet prevents excess force from being applied. Generally, the screw spindle has a pitch of 0.5mm. The thimble is divided into 50 equal divisions. Common types of micrometers used in the workshops are: -

i. Outside Micrometer: An outside micrometer is used for measuring external dimensions. The work to be measured is placed between the anvil and the tip of the spindle.
ii. Inside Micrometer: This is similar in structure to an outside micrometer and is used for measuring internal dimensions.
iii. Depth Micrometer: A depth micrometer is used for measuring the depth of a hole, slot and keyway etc. A complete set of depth micrometer is equipped with spindles of different lengths, which can be interchanged to suit different measuring ranges.

Protractor

i. **(Engineer's Protractor)** Engineer's protractor is a general purpose tool used for the measuring / checking of angles. Example angle of drill head, angle of cutting tool, and even for the marking out of angles on a component part.

ii. **Vernier Protractor:** This is a precision measuring tool that has high accuracy of measurement.

Combination Set: Combination set is a set of equipment combining the functions of protractor, engineer square, steel rule, Centre finder, level rule, and scriber.

Dial Indicator: The principle of dial indicator (dial gauge) is that the linear mechanical movement of the stylus is magnified and transferred to the rotation of pointer. The accuracy of dial indicator can be up to 0.001mm. It is usually used for calibration of machine.

Marking out Tools in Workshop

Marking out is a drawing out the shape of thepiece to show us where to cutout or file. Marking out is one of the most important skills in metalwork. It is very important to mark out as accurately as possible (Mooney, 2012). Marking out is the preliminary work of providing guidance lines and centres before cutting and machining. Usually in providing the line, pencil line would not be suitable; the hard metal surface would soon make a pencil blunt and the line would become thick and inaccurate; also a pencil line is too easily wiped off a metal surface. Therefore, the line is usually scribed using a sharp pointed metal tool, such as a scriber, which cuts into the surface of the metal and leaves a fine, permanent line (Timings, 2008).

The common tools used for marking out in metal work are as follows:

*Scriber:*A scriber is used for scratching lines onto the work piece. It is made of hardened tool steel.

Engineer's Square: Engineer's square is made of hardened tool steel. It is used for checking the straightness and the squareness of a workpiece. It can also be used for marking perpendicular lines onto a workpiece.

*Spring Dividers:*Spring dividers are made of hardened tool steel. The legs are used for scribing arcs or circles onto a workpiece.

Punch: There are two types of punch namely the Centre Punch and the Dot Punch. A dot punch has a point angle of 60^0 and it is used for making of small dots on the reference line. The centre punch has a point angle of 90^0 and it is used for making a

large indent on a workpiece for drilling. Both punches are made of hardened tool steel.

Surface Plate: Surface plate is made of malleable cast iron. It has been machined and scraped to a high degree of flatness. The flat surface is being used as a datum surface for marking out and for measuring purposes. If it can stand on the floor, it is called surface table.

*Angle Plate:*An angle plate is used for supporting or setting up work vertically, and is provided with holes and slots through which securing bolts can be located. It is made of cast iron and ground to a high degree of accuracy.

Vee Block: Veeblocks usually in a couple are made of cast iron or steel in case-hardening. They are generally used for holding circular workpiece for marking out or machining. (Mooney, 2012; Hong Kong Industrial Centre, n.d.).

2.2.2 Gas and Arc Welding

The history of welding dates all the way back to 310 AD when welding was used in the construction of the Iron Pillar of Delhi. Although, the processes have without a doubt been altered and improved, welding is still used in industry today (Gilland, 2015). Welding is a means of joining two metals permanently through localized application of suitable combination of temperature, pressure and metallurgical conditions. A wide variety of welding processes have been developed by different combinations of temperature and pressure (Devarasiddappa, 2014). Kah and Martikainen (2012) stated that Welding is one of the most common joining processes in the metal industry, applied in facilities from job shop outfits to highly-automated computer-controlled factories. They further stated that Continuing growth in welding equipment purchases shows that worldwide utilization of welding is still increasing and its use is expected to grow further due to its economic advantages. According to Timings (2008) Welding is the best option when making fluid tight joint, and the joint stresses in a welded joint are distributed uniformly. Generally welding has the following advantages over other joining processes;

1. Buildings, bridges and other structures can be built lighter and thus higher due to reduction of weight.
2. Additional joint strength can be obtained by using considerably smaller structural members. Joints are compact and do not require additional plates as in the case of riveted joints.

3. Mostly welded joint have higher resistance to corrosion compared to bolted and riveted joints.
4. Welded joints are fluid tight for tanks and vessels.
5. Many different type of joints are possible in welded joints (Jain, 2013)

Welding processes divide into two major categories namely fusion welding and non-fusion welding otherwise known as solid state welding. In a former the coalescence is accomplished by melting the two parts to be joined, in some cases adding filler metal to the joint, while in the former heat and/or pressure are used to achieve coalescence, but no melting of the base metals occurs and no filler metal is added (Groover, 2010; Jain, 2013). Sindo (2003) noted that fusion welding is a joining process that uses fusion of the base metal to make the weld. Sindo further stated that fusion welding is classified in to three major categories, namely;

i. Gas welding:
ii. Arc welding:
    a. Manual metal arc welding (MMAW)
    b. Gas–tungsten arc welding (GTAW)
    c. Plasma arc welding (PAW)
    d. Gas–metal arc welding (GMAW)
    e. Flux-cored arc welding (FCAW)
    f. Submerged arc welding (SAW)
    g. Electroslag welding (ESW)
iii. High-energy beam welding:
    a. Electron beam welding (EBW)
    b. Laser beam welding (LBW)

Gas and arc welding (particularly MMAW) are the fusion welding processes which are commonly practicing in school workshop, thus they would be reviewed.

Gas Welding

Gas welding otherwise known as Oxy-Fuel Welding (OFW) is the term used to describe the group of fusion welding operations that burn various fuels mixed with oxygen to perform welding. Gas welding processes employ several types of gases, which is the primary distinction among the members of this group (shown in Appendix I). But the most important gas welding process is oxyacetylene welding (Groover, 2010). Oxyacetylene welding which is mostly used can be manipulated to give different flames with different temperature for different purposes. Flame is the

phenomenon produced at the surface of the nozzle tip where two gases meet and undergo combustion with the evolution of heat and some light. There are three flames that are obtainable in oxyacetylene welding namely: carburizing, oxidizing and carburizing flame (Jain, 2013). Oxyacetylene welding required various components to make the complete equipment, below are the components:

i. A gas supply installation – cylinders or in bulk;
ii. A means of isolating the gas supply;
iii. A pressure regulator fitted to the outlet valve of the gas cylinder or the gas supply outlet point – used to reduce and control gas pressure;
iv. Fixed pipework and/or flexible hose to distribute the gases;
v. A burner device where the fuel gas is mixed with air or oxygen and ignited;
vi. Safety devices to limit over-pressure and prevent flashbacks and return flow;
vii. Ancillary equipment, eg flow meters (to aid process control) and flux dispensers for brazing (Health and Safety Executive, 2009).

Arc welding

Arc welding is a form of fusion welding process in which heat is liberated at the arc terminals and this heat is used to melt the metals to be welded at the points of contact, so that they will flow together and form an integral mass (Jain, 2013). The heat of arc welding is from either direct current (DC) or alternating current (AC). DC and alternating AC are used for electric arc welding, each having its particular applications. DC welding supply is usually obtained from generators driven by electric motor or if no electricity is available by internal combustion engines. For AC welding supply, transformers are predominantly used for almost all arc welding where mains electricity supply is available. They have to step down the usual supply voltage (200-400 volts) to the normal open circuit welding voltage (50-90 volts). These power sources might both be available for selection, however there are some factors that governs the selection of a the power source which includes: type of electrodes to be used and metals to be welded; required output; duty cycle; efficiency; initial costs and running costs; available floor space and versatility of equipment (Singh, 2006).

Arc welding principle of operation

The welding start with the striking an arc, to strike the arc, the electrode should be shorted by touching the work. At the moment of contact, a very heavy current starts flowing through the circuit, while voltage drops. Now, the electrode is lifted slowly so that a gap of 2–3 mm between the tip of the electrode and the work

piece is maintained. The voltage across the arc rises to about 15–20 volts and the amperage drops. Due to heat generated in the arc, the tip of the metal electrode starts melting and the gap increases. Unless the electrode is slowly moved towards the work at the same rate at which the tip of the electrode is melting maintaining the gap at 2–3 mm, the arc will extinguish. If the gap increases too much the machine voltage will not be able to maintain the arc (Gupta, Gupta, & Mittal, 2009).

2.2.3 Foundry and Casting

A factory, department or a particular unit of the industries where castings are made is called foundry (Gupta, Gupta & Mittal, 2009). Casting process is one of the earliest metal shaping techniques known to human being. It means pouring molten metal into a refractory mold cavity and allows it to solidify. The solidified object is taken out from the mold either by breaking or taking the mold apart. The solidified object is called casting and the technique followed in method is known as casting process (Singh, 2006). Casting is one of the most versatile forms of mechanical process for producing component because there is no limit to size or shape of the articles that can be produced by casting. In other words casting is the manufacture of a part by heating a metal or alloy above its melting point and pouring the liquid metal/alloy in a cavity approximately of same shape and size as the machine part (Gupta, Gupta & Mittal, 2009). After the liquid metal cools and solidifies, it acquires the shape and size of the cavity and resembles the finished product required. The manufacture of a casting requires;

i. Preparation of a pattern,
ii. Preparation of a mould with the help of the pattern,
iii. Melting of metal or alloy in a furnace,
iv. Pouring of molten metal into mould cavity,
v. Breaking the mould to retrieve the casting,
vi. Cleaning the casting and cutting off risers, runners etc., (this operation is called ‘fettling’), and Inspection of casting (Gupta, Gupta & Mittal, 2009).

There are various classification of foundry, it could be classified base on metal to be cast, some examples are steel foundries, cast iron foundries, brass foundries etc; or base on the type of work usually related to moulding process used which could be classified as;

Jobbing Foundry: This specialize in small orders for a wide variety of engineering shapes.

Repetition foundry: this foundry is for mass production of large numbers for identical castings of particular shape and composition. Repetition foundry could be further classified as green sand foundry, shell moulding foundries, investment casting foundries depending on the moulding process used (Jain, 2013). Green sand foundry is where sand casting are produces. Sand casting is the most widely used casting process, accounting for a significant majority of the total tonnage cast. Sand casting, also known as sand-mold casting, consists of pouring molten metal into a sand mold, allowing the metal to solidify, and then breaking up the mold to remove the casting. The casting must then be cleaned and inspected, and heat treatment is sometimes required to improve metallurgical properties (Groover 2010). In producing a sand casting there are basic steps involved which according to Madsen (1999), are;

i. Patternmaking. Patterns are required to make molds. The mold is made by packing molding sand around the pattern. The mold is usually made in two parts known as cope and drag so that the pattern can be withdrawn after molding.
ii. Core boxes making: If the casting is to be hollow, additional patterns, referred to as core boxes, are needed to shape the sand forms, or cores, that are placed in the mold cavity to form the interior surfaces of castings. Thus the void between the mold and core eventually becomes the casting.
iii. Molding is the operation necessary to prepare a mold for receiving the metal. It consists of ramming sand around the pattern placed in a support, or flask, removing the pattern, setting cores in place, cutting the feeding system to direct the metal if this feeding system is not a part of the pattern, removing the pattern, and closing the mold.
iv. Melting and pouring are the processes of preparing molten metal of the proper composition and temperature and pouring this into the mold from transfer ladles.
v. Cleaning is all the operations required to remove the gates and risers that constitute the feeding system and to remove the adhering sand, scale, and other foreign material that must be removed before the casting is ready for shipment or other processing. Inspection follows, to check for defects in the casting as well as to ensure that the casting has the dimensions specified on the drawing and/or specifications.

Sand casting process had being used in production of various metal products because of its advantages compare to other means of manufacturing. Olsen (2017) highlighted the following as its advantages;

Nearly any alloy: Sand castings can be readily produced in nearly any ferrous or non-ferrous alloy. Some materials cannot be worked, and must be produced as a casting.

Low tooling cost: The relatively low cost of tooling makes sand casting a process of choice for lower volume needs. Patterns do wear, though, so the material selected for the pattern (typically wood, plastic, or metal) will depend on the expected usage quantity of the part being produced.

Versatile – Size, Weight, Shape: Sand castings can be produced in weights from ounces to 200+ tons. Through the use of cores, internal structures can be cast in place. Shaped parts rely only on the imagination of the designer. Most sand castings, however, will need at least some machined surfaces, either because of innate tolerance limits of the process, or the need to mate with other components.

Any Quantity: Because the tooling cost can be minimal, sand casting may be appropriate for a single piece run. Alternatively, there are automotive components that are produced using this process, so it may also be used in high volume applications.

Timing: The casting process itself may be quicker than some others, like investment casting, but it is important to consider the post-casting processes like machining that may be required when computing total lead times.

2.2.4 Drilling

Gupta, Gupta and Mittal (2009) defined drilling as the process of making a hole in a solid metal piece by using a rotating tool called drill. Drilling is the process of cutting holes in metals by using a drilling machine. Drills are the tools used to cut away fine shavings of material as the drill advances in a rotational motion through the material. The twist drill is made from High Speed Steel, tempered to give maximum hardness throughout the parallel cutting portion. Flutes are incorporated to carry away the chips of metal and the outside surface is relieved to produce a cutting edge along the leading side of each flute (Hong Kong Industrial Centre, n.d). Groover (2010) stated that several operations are related to drilling most of the operations follow drilling, that is a hole must be made first by drilling, and then the hole is modified by one of the other operations. Centering and spot facing are exceptions to this rule. All of the operations use rotating tools, these operations are;

i. Reaming. Reaming is used to slightly enlarge a hole, to provide a better tolerance on its diameter, and to improve its surface finish. The tool is called a reamer, and it usually has straight flutes.
ii. Tapping. This operation is performed by a tap and is used to provide internal screw threads on an existing hole.
iii. Counterboring. Counterboring provides a stepped hole, in which a larger diameter follows a smaller diameter partially into the hole.
iv. Countersinking. This is similar to counterboring, except that the step in the hole is cone-shaped for flat head screws and bolts.
v. Centering. Also called center drilling, this operation drills a starting hole to accurately establish its location for subsequent drilling. The tool is called a center drill.
vi. Spot facing. Spot facing is similar to milling. It is used to provide a flat machined surface on the work part in a localized area.

Procedures for drilling operation

i. Centre punch where the hole is to be drilled
ii. Secure the piece into the drilling machine vice
iii. Place a piece of wood under it if needed
iv. Select the correct size drill bit
v. Make sure the drill bit is secure in the chuck
vi. Select the correct drilling speed
vii. Use cutting fluid if needed
viii. Drill through the piece
ix. Turn off the drill
x. Wait for the chuck to stop spinning
xi. and removed the piece
xii. De-burr the hole (Mooney, 2012).

Drilling operation is carries out on a machine called drill press or drilling machine. Drilling machines are classified on the basis of their constructional features, or the type of work they can handle. The various types of drilling machines are:

i. Portable drilling machine
ii. Sensitive drilling machine
    a. Bench mounting
    b. Floor mounting

c. Upright drilling machine
d. Round column section
e. Box column section machine

iii. Radial drilling machine
a. Plain
b. Semiuniversal
c. Universal
d. Gang drilling machine

iv. Multiple spindle drilling machine

v. Automatic drilling machine

vi. Deep hole drilling machine (Singh, 2006).

Regardless of type or the function performed, drilling machine has the following features;

i. The head containing electric motor, V-pulleys and V-belt which transmit rotary motion to the drill spindle at a number of speeds.

ii. Spindle is made up of alloy steel. It rotates as well as moves up and down in a sleeve. A pinion engages a rack fixed onto the sleeve to provide vertical up and down motion of the spindle and hence the drill so that the same can be fed into the workpiece or withdrawn from it while drilling.

iii. Drill chuck is held at the end of the drill spindle and in turn it holds the drill bit.

iv. Adjustable work piece table is supported on the column of the drilling machine. It can be moved both vertically and horizontally.

v. Column is a vertical round or box section which rests on the base and supports the head and the table (Singh, 2006).

In the forgone mentioned concept of metalworking, most of the contents have being integrated and incorporated for long to be offers as a subject in Nigerian technical colleges.

The offering of metalwork as a subject in Nigeria dates back to early nineteen century, before that time there was no programme for vocational skills training in the formal education curriculum in the country until 1909 when some form of vocational education programmes were opened in the country. The Hope Waddell Training Institute which was founded in1895 developed technical programme in tailoring, carpentry and some commercial subjects. In the same year that is 1909 Nassarawa

School was opened in the North. The institution had technical courses which includes leatherwork, carpentry, metalwork, weaving and book binding (Akpan, Usoro, &Ibiritamn.d.; Idriss&Garba, 2006).

In 1987, the National Council on Education (NCE) approved NBTE. This board designed a new syllabus in 1992 to be examined by NABTEB which took effect in 1995 (Okolocha& Baba, 2016). This current syllabus incorporated metalwork as a trade related subject in 14 engineering trades (Agricultural Equipment and Implements Mechanics Work; Motor Vehicle Mechanics Work; Automobile Electrical Work; Fabrication and Welding; Mechanical Engineering Craft Practice; Refrigeration and Air-conditioning work; Vehicle Body Building; Light Vehicle Body Repair Work; Instrument Mechanics Work; Appliance Maintenance and repairs; Foundry craft practice; Marine engineering craft; and Ship building craft practice) and in 3 construction trades which are Furniture making; Plumbing and Pipe Fitting; and Draughtmanship craft practice (NABTEB, 2018).

According to United Nation Education Scientific and Cultural Organisation, UNESCO (2001) on completion of metalwork module in technical college, the students should be able to;

1. Understand workshop safety rules and their application in handling and using hand tools, portable power tools and machine tools.
2. Know the physical properties, manufacturing process and application of ferrous and nonferrous metals in common use.
3. Select and use common measuring, marking out, cutting and striking tools.
4. Understand the basic working principles of drilling machine and be able to use it for various types of screws treads rivets, and be able to rivet and cut screws by hand. Understand the application of various types of screw threads and rivets, and be able to rivet and cut screws by hand.
5. Understand the ISO system of tolerances and fits, and their application in engineering production.
6. Produce simple engineering components using casting process.
7. Understand the essential features and working principles of the center lathe and carry out basic operations such as turning, stepped turning facing, taper turning, knurling, chamfering and undercutting.

While on practical competence, the students should be able to;

1. Use all tools correctly ensuring the machinery guards and protective eye shields are used at all times.
2. Comply with the general rules for safe practice in the work environment at all this.
3. Use and select hand tools for carrying out various bench fitting and assembly tasks.
4. Use tools such as hacksaws, taps, reamers, drills, dividers, surface gauge.
5. Produce threads using taps and dies.
6. Correctly grind drill point angles: Drills: Twist and flat drills
7. Select and set drilling machine speeds to carry out a range of operations using the appropriate coolants. Drilling, reaming, counter sinking, counterboring
8. Perform metal joining by a range of processes. Cut through the joints and investigate the depth of penetration of the metals at the interface. Processes: Soldering, brazing, and fusion welding.
9. Mark out on metals and other materials, datum lines, angles, radii/circles and hole positions using a range of tools.

After the students have been taught the above listed themes, there is an external examination to be taken by the students. This examination consist both written and practical examination. The question in written examination consist of two section, the first section is 40 objectives questions students are expected to answer it in 40 minutes. The second section is 6 essay questions from which students are expected to answer four (4). In practical examination, it comprises two practical questions usually called test A and test B, test A is a fitting work while test B is machining. There usually used to be a compulsory questions one from each test (A and B). The questions paper is releases to candidates one week to the examination date (NBTE, 2011).

2.3 Constructivists Teaching Approach

Constructivist views learning as a constructive process in which the learner is building an internal illustration of knowledge, a personal interpretation of experience. This representation is flexible always open to modification and not rigid, its structure and linkages forming the ground to which other knowledge structures are attached to. Learning is then an active process in which experience has an important role to play in understanding and grasping the meaning of a particular concept (Amineh&Hanier, 2015). They further stated that this view of knowledge does not necessarily reject the

existence of the real world, instead it agrees that reality places constrains on the existing concepts, and contends that all individuals' knowledge of the world is the interpretations of their experiences. According to Khalid and Azeem (2012) the constructivist teacher help the students through problem-solving and inquiry-based learning activities with which students formulate and test their ideas, draw conclusions and inferences, and pool and convey their knowledge in a collaborative learning environment. Constructivism transforms the student from a passive recipient of information to an active participant in the learning process. Always guided by the teacher, students construct their knowledge actively rather than just mechanically ingesting knowledge from the teacher or the textbook. The task of the instructor is to translate information to be learned into a format appropriate to the learner's current state of understanding.

Peter and William (1999) stated that constructivist instructional approach is applicable to teaching of technical education, where students are expected to acquire reliable knowledge and skills. The approach according them emphasize the ability of individuals to construct similar, if not identical, mental models based on similar or identical experiences, this conformed to the requirement of technology education. Olufemi (2008) opined that the constructivist pedagogy could be a better choice if some or all of the following conditions prevailed;

1. The roles of the teacher will not be that of transferring knowledge or 'pouring' in some facts to the learner but in acting as a facilitator who encourages learner by giving tasking activities, organize and set probing questions and experiments while the learner is left to interact with available resources to find meaning of the 'real' world.
2. When course contents are arranged and structured to encourage learner to be left most times alone to have deep understanding of concepts with little and intermittent input from the tutor as demanded of the course goals.
3. In the case where the centre focus of learning emphasizes the roles of the learner in evaluation and assessment; undertaking tasks, searching knowledge in the sea of information on the net and when sieving information and ideas in order to come up with fresh insight remains the focus of learning activities(p.59).

Looking at the above conditions specifically number 2 above, it can be concluded that constructivist instructional approach could be an appropriate to teach technical college

students since the syllabus is arranged and structure from the simplest to complex, For instance in metalwork syllabus from measurement to marking out and to cutting (NABTEB, 2015).

Theera (2010) maintained that constructivist instruction is being characterize by learning personalization, reflective thinking, problem-solving and investigation, relevance to daily-life, collaborative learning, discussion, and teacher scaffolding. Jayeeta (2015) stated that learning is a search for meaning. Therefore, learning must start with the issues around which Students are actively trying to construct meaning, meaning requires understanding wholes as well as parts. Parts must be understood in the context of wholes. Therefore, the learning process focuses on primary concepts, not isolated facts. Jayeeta further stated that the purpose of learning is for an individual to construct his or her own meaning, not just memorize the right answers.

Constructivist instructional model has four stages as noted by Abbas and Karema (2014) which are;

1. *Phase of the call:* where students are invited to learn through a variety of ways. In this stage teacher ask them some questions related to their previous knowledge.
2. *The stage of exploration and innovation:* This stage challenges the capabilities of the students in searching answers to specific questions generated through observation, measurement and experimentation and group work.
3. *The stage of proposal explanations and solutions:* in this stage all the groups are to provide their findings and interpretations of solutions and proposals and discussed.
4. *The decision point:* This is a stage where practical applications of the findings, solutions and conclusions are made.

Similarly Aydisheh and Gharibi (2015) maintained that the target procedures in constructivist teaching includes exploration, explanation, expansion, and evaluation.

Exploration: In constructivist method, exploration means that there are some ways to construct knowledge. Employing all their senses, the learners attempt to construct a part of the knowledge during their exploration.

Explanation: In this stage, the teachers interact with the students so that they can understand the presented views and materials. In order to interact effectively, the teachers need to ask questions relevant and appropriate to previous ones. Teacher should help the learners in sharing their discoveries.

Expansion: In this phase, teachers assist students expand their mental and motor activities or skills. Here, the students are assisted to revise their views and correct their skills.

Evaluation: It is necessary to evaluate students' methodological discoveries, acquired skills, and qualification in order to know changes happened in thoughts and mastery over skills and to provide the learners with related feedback.

In order to employ constructivist teaching approach effectively, Brooks and Brooks, 1995 cited in Abbas, Leong, and Ismail (2013) suggested the following strategies for teachers to exercise in order to move towards a more constructivist approach;

i. encourage and accept student autonomy and initiative;
ii. use cognitive terminology such as classify, analyze, predict and create;
iii. allow student responses to drive lessons, shift instructional strategies, and alter content;
iv. inquire about students' understanding of concepts before sharing their own understandings of those concepts;
v. encourage students to engage in dialogue, both with the teacher and with one another;
vi. encourage student inquiry by asking thoughtful, open-ended questions and encouraging students to ask questions of each other;
vii. allow wait time after posing questions;
viii. provide time for students to construct relationships and create metaphor;

Teacher's roles in constructivist instructional approach

According to Nura and Zubairu (2015) constructivist approach teachers do not dominates the entire session of the class, instead, teachers act as a guide by providing students with opportunities to test the adequacy of their current understandings. Based on Constructivists, the following tips are arranged for teachers:

1. The teacher should consider the knowledge and experiences students bring to class.
2. Learners construct their knowledge through a process of active enquiry (discovery) is facilitated by providing the necessary resources.
3. Knowledge is actively constructed and learning is presented as a process of active discovery.
4. Provide assistance with assimilation of new and old knowledge.

5. Learning program should be sufficiently flexible to permit development along lines of student enquiry.
6. Due to its interpretive nature, each student will interpret information in differently.
7. Create situations where the students feel safe questioning and reflecting on their own.
8. Present authentic tasks to contextualize learning through real-world, case-based learning environments.
9. Support collaboration in constructing knowledge, not competition.
10. Encourage development through inter-subjectivity.
11. Providing Scaffolding at the right time and the right level.
12. Provide opportunities for more expert and less expert participants to learn from each other (Nura&Zubairu, 2015 p.76).

Students' roles in constructivist instructional approach

The expectation within a constructivist learning environment is that the students play a more active role in, and accepts more responsibility for their own learning. The theory also brings out some activities expected of a student as an active participant in the learning process as follows:

1. The role of the students is to actively participate in their own learning.
2. Students have to accommodate and assimilate new information with their current understanding.
3. One important aspect of controlling learning process is through reflecting on their experiences.
4. Students begin their study with pre-conceived notions.
5. Students are very reluctant to give up their established schema/idea & may reject new information that challenges prior knowledge.
6. Students may not be aware of the reasons they hold such strong ideas/schemata.
7. Learners need to use and test ideas, skills, and information through relevant activities.
8. Students need to know how to learn or change their thinking/learning style.
9. Because knowledge is so communally-based, learners deserve access to knowledge of different communities.

10. For students to learn they need to receive different 'lenses' to see things in new ways.
11. Learners need guidance through the Zone of Proximal Development (ZPD).
12. In social constructivism tutors and peers play a vital role in learning (Nura and Zubairu, 2015 p.78).

2.3.1 Advantages of Constructivist Approach over Traditional Approach

Constructivism promotes social and communication skills by creating a classroom environment that emphasizes collaboration and exchange of ideas. Students must learn how to articulate their ideas clearly as well as to collaborate on tasks effectively by sharing in group projects. Students must therefore exchange ideas and so must learn to negotiate with others and to evaluate their contributions in a socially acceptable manner. This is essential to success in the real world, since they will always be exposed to a variety of experiences in which they will have to cooperate and navigate among the ideas of others (McKinley, 2015 in wikipedia). Abbas and Karema (2014) opined that this approach has some advantages compare to traditional approach to the sense that it:

i. Makes the learner focus of the educational process by activating the role of learner discovers and looking and performs activities.
ii. Allows the learner the opportunity to debate and dialogue with fellow learners or with the teacher in order to assist the growth of the language of dialogue and make him active.
iii. Links between science and technology, which gives learners the opportunity to see the importance of science for society and the role of science in solving the problems of society.
iv. Makes learners think in a scientific way.
v. Encourages constructivist learning model to develop a spirit of cooperation and work as a team

Constructivist model promotes students' active learning, unlike in behaviorist learning environments, where students were positioned as merely passive recipients of information. It also emphasized on collaboration to construct, share, and challenge ideas and knowledge with peers and teachers (Thompson, 2014). Jack (2017) noted that the shift from the teacher-centered method of teaching to student-centered activity based method encourages and develops in the child the spirit of inquiry.

Har (2013) noted the differences between Constructivist and Traditional instructional approach base on the following dimensions;

Nature of learner

Constructivist sees learners as unique individuals; the unique nature of learners is an integral part of the learning process, while traditional sees learners as homogenous mass defined by chronological age upon which learning targets and materials are designed in the curriculum; learners are expected to meet the nominal standard.

Responsibility for learning

Constructivist resides with the learner; emphasizes the active role of learners in the learning process in looking for meaning. Unlike in constructivist, traditional approach rests with the teacher; learner is passive and receptive; learners present what they learn from teachers.

Learning motivation

In constructivist, learners' motivation is develops through authentic experiences in handling problems; by gaining success, learners gain confidence and motivation to embark on more complex challenges; intrinsic. But in traditional Learners' behaviors are reinforced by praises and rewards; learners increase motivation by conforming to standards and expected achievements; extrinsic.

Role of Teacher

Constructivist role of teacher are usually asks, supports, provides guidelines, and creates environment for learners to arrive at their own conclusions; continuous dialogue with learners; teacher should challenge learners. While in traditional teacher often gives instructions from the front; gives answers and expects learners to be disciplined in receiving the content of the curriculum with the least distraction and disturbances; learners are under control in the learning process.

Interaction

From the perspective of interaction, in constructivist teachers and learners learn from each other; learners compare their version of truth with that of teachers and peers to arrive at a socially tested/socially negotiated version of truth; learning task is the interface between teachers and learners, both should develop awareness of each other's viewpoints and should look at their own standards and values. In traditional learning experience is objective; learners receive truth and knowledge from teachers

through given tasks; the teacher is an expert who gives expert advice and instruction to get learners gain knowledge efficiently.

Collaboration

Learners in constructivist approach collaborate to arrive at a shared understanding of truth in a specific field; through "scaffolding," learners can extend beyond the limitation of physical maturation to the extent that the development process lags behind the learning process. While in traditional approach Learners are expected to be attentive and disciplined to achieve the content set in the curriculum; they should try hard to fulfill expectations from teachers; students seek advice from teachers in their study.

Context

Constructivist sees the context in which learning occurs as central to learning; learning is directly relevant to application; it acculturates students into authentic and complex practices through activities and social interaction. Knowledge in traditional approach is de-contextualized; it may not give learners skills to understand authentic tasks; learning occurs when outcomes are measured.

Assessment

In constructivist a two-way process involving interaction between teachers and learners; inextricably linked with the learning process to find out learning achievements and quality of learning experiences; courseware; share possible ways in which learner's performance may be improved. While in traditional a process carried out by the teacher; a separate process of measuring how much learners have gained and how far learners have reached at the end of the learning process.

2.3.2 Different Between Constructivist Approach and Traditional Approach

There is a distinction different between the two methods. Owusu (2015) identified the differences between the two, stated that traditional approach mostly begins with parts of the whole by emphasizing basic skills, Strict adherence to fixed curriculum, Textbooks and workbooks-oriented, Teacher is a provider and learners are passive recipients, Teacher assumes a directive and authoritative role, Assessment is via testing and emphasis on correct answers, Knowledge is inert, and lastly learners in traditional approach work individually and independently. While in constructivist approach lesson begins with the whole and expand to parts, the focus is on pursuit of

learner questions and interests, the use of primary sources and manipulative materials, learning is interactive and builds on what learners already know, teacher interacts and negotiates with learners, assessment is via learner works observations, points of view and tests, knowledge is dynamic and changes with experiences and lastly learners work in groups to facilitate self-construction of knowledge.

Ukpongson and Ezekoye (2015) maintained that for developing country like Nigeria to meet the needs of today's workforce TVET programme must move away from teacher-centered learning environment to one where students have the primary responsibility and play an active role in their learning. Considering this information, it can be concluded that the constructivist learning approach which use a different view in learning activities, have an important contribution on the academic achievement of students and on the durability of the information learned (Ayaz&Sekerci, 2015).

2.4 Lecture Method of Teaching

The word *lecture* comes from the latin word *lectus*, from the 14th century, which translates roughly into "to read." It wasn't until the 16th century that the word was used to describe oral instruction given by a teacher in front of an audience of learners (Paris, 2014). Lecture method according to Mele (2018) is the art of telling or giving large volumes or quantities of factual information, principles and theories to a large audience without minding whether the audience understands the information being delivered or not, and that learners are expected to go and develop or put flesh on the principles and theories on their own through personal research. Lecture method of teaching is the one in which the teacher, or some other knowledgeable person supplies information to students. There is very little students' participation, students are merely required to listen and understand the information being given (Oroko, 1993). In other words it is an instructional method where an instructor who possesses the knowledge on a given topic delivers all relevant information to students verbally. During a typical lecture, an instructor stands before a class and present information for the students to learnt (Kelley, 2018).

This method of teaching according to Center for Instructional Development and Distance Education (2014) provides an economical and efficient method for delivering substantial amounts of information to large numbers of student; it offers current information (more up to date than most texts) from many sources; and provides a summary or synthesis of information from different sources as well as creating interest in a subject as lecturers transmit enthusiasm about their discipline. In

term of effectiveness, lecture method being the most widely practicing method of teaching had been found to be less effective in students academic achievement compare to other method of instruction (Oviawe, 2010; Ameh& Dantani, 2012; Musa & Hassan, 2015). Lecture is one of the most frequently used method of teaching. In a study conducted by Sakala (2013) revealed that class size, wide syllabi, learning/teaching materials, caliber and background of the learner, the need to drill learners for the purpose of examination and supervision of teaching are the factors responsible for frequent use of lecture method.

Center for Instructional Development and Distance Education (2014) proposed the following hints to be observed for a successful delivering of lecture;

i. Present an outline of the lecture (use the blackboard, overhead transparency or handout) and refer to it as you move from point to point.
ii. Repeat points in several different ways. Include examples and concrete ideas.
iii. Use short sentences.
iv. Stress important points (through your tone or explicit comments).
v. Pause to give listeners time to think and write.
vi. Use lectures to complement, not simply repeat, the text.
vii. Learn students' names and make contact with them during the lecture.
viii. Avoid racing through the last part of the lecture. This is a common error made by instructors wishing to cram too much information into the allotted time.
ix. Schedule time for discussion in the same or separate class periods as the lecture.
x. Prepare because preparation reduces stress, frustration, insecurity and consequent ineffectiveness (p.7).

Sandhu, Afifi, and Amara (2012) proposed the following steps in carrying out lecture, these are;

Step One: Opening

An effective lecture efficiently transfers knowledge to students by enhancing their conceptual understanding and retention of knowledge this needs their attention at first instance. To arose their interest at the opening the teacher should;

i. State the purpose of the lecture to prompt the learners to be engaged and to seek their immediate attention.

ii. Review the lecture objectives that challenge the learners to a set of expectations. This also builds up curiosity and clearly outlines their role in meeting those expectations.

iii. Pose a question at the beginning of the lecture for the students to think about. This creates a challenge for the learners and alerts them to focus during the lecture, with the anticipation of seeking answers to that question.

iv. Create a positive and safe learning environment by acknowledging students' responses.

An excellent opening summary is critical to the success of a lecture. It encourages the students to focus with anticipation and mental alertness. The opening summary should be brief and captivating because students' first impression of the lecture is important, and their awareness and receptiveness level are their highest level during the first 5 minutes (McLeish, 1976 cited in Sandhu, Afifi, & Amara 2012).

Step Two: Presentation

The second step in delivering an effective lecture is presentation of the content, or body of the lecture. The core content is organized and analyzed into constituent components and key concepts for easy delivering to the students.

the content is organizes according to the objectives, relating it to prior knowledge and creating situations for students to think about extending their knowledge to new and hypothetical situations.

Step Three: Instructor-Learner Interaction

The teacher and students interaction builds in the component of a two-way communication in an effective lecture, which is meant to engage students in active learning. However, for teacher and students interaction to be engaging, meaningful, and effective, it should take into consideration characteristics of instructors and learners. Instructor characteristics such as verbal and non-verbal skills are very essential in ensuring effective lecture.

Step Four: Formative Quiz

In the delivery of an effective lecture there should be a formativequiz at the end of the lecture. Regular formative assessments, in theform of quizzes, with immediate feedback are a vital part of effectivelectures, helping to promote better learning.

Step Five: Conclusions

This is final step in which a summary of important concepts in key points is provided at the end of a lecture. It is as important as the opening summary used to introduce that lecture. It helps to draw attention towards the most important concepts, facts, or ideas. By focusing the student's attention in the last minutes of class, an instructor establishes the most important facts and tries to make a link between what was taught and what they will be able to use in practice.

2.4.1 Advantages of the Lecture Method

Lecture is one the common method of teaching. Farooq (2012) stated that Lecture method of teaching is the oldest teaching method applied in educational institution, a one way channel of communication of information. It has the following advantages;

1. In this teaching method a large amount the topics can be covered in a single class period.
2. Using of this method exclude the using of any equipment or Lab.
3. Learning material is not required.
4. Student listening skills developed.
5. Logical arrangement of the material in order to present it orally
6. Help to learn languages

According to Paris (2014) the lecture method has a few advantages that has kept it as the standard approach to teaching for so long which includes;

Teacher control: Because the lecture is delivered by one authoritative figure – a teacher, professor, or instructor of some other kind – that person has full reign of the direction of the lesson and the tone of the classroom. They alone are able to shape the course, and so lectures remain highly consistent when it comes to what kind of information is delivered, and how it's delivered.

New material: Lectures are literally just long-winded explanations of information, deemed important by the lecturer. As such, students can absorb large quantities of new material.

Effortless: The lecture method makes the learning process mostly effortless on the part of the students, who need only pay attention during the lecture and take notes where they see fit. Because so little input is required from students, it's the most clear, straightforward, and uncomplicated way to expose students to large quantities of information.

2.4.2 Disadvantages of the Lecture Method

1. Psychologically this method is not acceptable because individuals are not alike. Teacher delivers the same lecture to both students without recognizing the individual differences.
2. Language using in the lecture in most cases is above the standard of the students. They are not able get full advantage of the lecture.
3. Lecture are often forgotten by the students soon after while learning is retained if activities are experienced.
4. Attention level is not the same while student listening the lecture (Faruq, 2012). Other disadvantages as noted by Paris (2014) are;

One-way: People who are against the lecture method see it as a one-way street. Teacher dictates information to students, who have little to or opportunity to provide their own personal input, or protest the information being delivered.

Passive: Not only do people see the lecture method as a biased, one-way road, but they also see it as a wholly passive experience for students. Not being actively engaged in a discussion over certain material can make the material itself seem worthless to a student, they might even be bored by the material because they will have no opportunity to learn.*Strong speaker expectations:* The lecture method can be disadvantageous to the teacher, as well. Not all academics can be expected to have the same level of public speaking skill. A teacher might be a genius in his or her field, knows the material from every angle, and is conversant, but might have trouble speaking in front of large groups.

2.5 Technical Colleges in Nigeria

Technical colleges which according to Okoro (2003) are sometimes called trade centres are different from technical schools. Technical college admits graduates of junior secondary school and provides them with a full vocational course of three years duration. Technical colleges sometimes admit students who have the first school leaving certificate and give them a full six years vocational training. This later case occurs in situations where the technical college is experiencing low enrollment that is difficulties in attracting enough junior secondary school leavers into its vocational programmes. At the end of the approved period of study, technical college students take various examinations, particularly, the National Technical Certificate examination, the senior school certificate examination and the then City and Guilds of London intermediate certificate examination. Technical colleges are regarded as the principal vocational institutions in Nigeria. They give full vocational training intended

to prepare students for entry into various occupations (Okoro, 1993). Technical colleges train craftsmen in auto-mechanic, plumbing, carpentry and joinery, cabinet making, painting and decorating, fabrication and welding, electrical installation, radio and TV repair, building construction and a few other areas. On the completion of the course of training students obtained work in industries or establish business on their own (NBTE, 2011). The institution is being monitored by National Board for Technical Education.

The National Board for Technical Education (NTBE) established in 1985, gives recognition to three broad classifications of technical institutions and their different missions in meeting the needs of immediate society, this includes technical colleges (FME, 2014). The board introduced a new curriculum for all vocational and technical courses offered in technical colleges. The new curriculum presented in modules and students are certified as having successfully completed the NTC course or the ANTC course when all the relevant modules have been passed. It is hope that this new curriculum will produce well trained technical manpower at various levels (operatives, craftsmen and master craftsmen) and in various technical and vocational fields when implemented in technical colleges (Okoro, 1993).

The first technical institute established in Nigeria was the Hope Waddell Institute in Calabar in 1885 with the aim of proving education in the rudiments training in the technical trades and teacher's education, (Mamman, Chadi, Jirgi, & Mubarak, as cited in Okolocha& Baba, 2016). Yaba Higher College was officially opened in 1934, at the beginning the first students were medical students but the college soon developed courses in engineering, agriculture and teacher education in 1948 with the motive to train Artisans, crafts men and Technicians, together with teachers of technical education to teach in technical colleges, the then trade centres (Idriss&Garba, 2006). Thereafter, technical colleges were established by various regional governments various locations in the country, namely: Enugu in 1950, Ilorin in 1951, Kano in 1953, Bukuru in 1953, Sapele in 1955, Ijebu-Ode in 1959, Osogbo, Oyo in 1961, Owo in 1963, Aba in 1964 and Abakaliki in 1966 and were examined by external examination body (Okolocha and Baba, 2016).

In Nigeria, the Regulatory examination body for technical college (the then craft centre) before the NABTEB was Royal Society of Arts (RSA) and the City and Guilds of London Institute (CGLI), all these bodies are based in United Kindom (Aikhionbare, 2016). These bodies continued to regulate the study of technical

subjects, even after the establishment of WAEC (West African Examinations Council) in 1952. In 1960 WAEC started acting as an agent for these bodies. In December 1972, WAEC took over the conduct of examinations in some technical and commercial subjects from RSA and CGLI. Within this structure, the federal government approved that the CGLI be supplemented with a qualification known as the Federal Craft Certificate (FCC) issued by the technical colleges. The Federal Craft Certificate incorporated practical aspects of the trades examined by CGLI. After the take-over by WAEC in 1978, it introduced practical sessions into its examinations. Even so, WAEC did not introduce more general education into the curriculum of these trades offered in the technical colleges. Thus, the graduates of these colleges were unable to secure admission in tertiary institutions. For this reason, the image of technical education remained tarnished as a programme for academically weak students (Oranu, n.d).

Ashby report in 1962 had considerable influence in Nigeria vocational technical education system. Ashby commission wrote to have already drawn attention what they consider to be major defect in Nigerian education namely the strong bias towards the traditional literacy and academic subjects. This is reflected in a lack of respect on the part of the public for manual skills and technical achievement, thus the commission strongly believed that the most effective ways of correcting this would be to introduce a manual subject as obligatory ingredients of all primary and secondary schooling not as a vocational training (Idriss&Garba, 2006). The Commission report also recommended the introduction of technical streams in the secondary schools and three levels of technical education in the country namely:

1. Pre-vocational and Pre–technical levels of training for secondary schools;
2. Craftsman training for technical colleges, trade centres and vocational schools;
3. Technical training for Polytechnics and Colleges of Technology (Fanfunwa, 1995)

The implementation of the 6-3-3-4 education system in Nigeria which began in 1982 have also brought many reforms into the educational system in Nigeria. Among the innovations is the vocationalization of the secondary school curriculum in Nigeria that was the time Nigeria adjusted her secondary educational system to encompass diversified curriculum that integrates academic with technical and vocational subjects, intended to empower the individual for self employment (Dorothy, 2011). In 1985 National Council on Education approved another reform to

take care with technical colleges examination but it was eventually replaced by NABTEB in 1995 which is the current reform to date. The reform took effect in 1995 following the establishment of NABTEB in 1992. NABTEB was charged with the conduct of technical and business examinations hitherto conducted in Nigeria by the RSA, CGLI and WAEC (Oranu, n.d). The Board offers examinations in four trade areas namely;

1. Engineering trades: under this trade, there are 19 various trades which are related to engineering discipline and lead to the award of NTC, the includes;
    a. Agricultural Equipment and Implements Mechanics Work.
    b. Motor Vehicle Mechanics Work.
    c. Automobile Electrical Work.
    d. Electrical Installation and Maintenance Practice.
    e. Fabrication and Welding.
    f. Mechanical Engineering Craft Practice.
    g. Electronic Work.
    h. Refrigeration and Air-conditioning work.
    i. Vehicle Body Building.
    j. Light Vehicle Body Repair Work.
    k. Instrument Mechanics Work.
    l. Appliance Maintenance and repairs.
    m. Foundry craft practice
    n. Marine engineering craft
    o. Ship building craft practice
    p. Computer craft practice
    q. Animal Husbandry
    r. Fisheries
    s. Photographic practice.
2. Construction trades: under this trade there are only7 trades which are;
    a. Bricklaying, Blocklaying and Concrete Work.
    b. Carpentry and Joinery.
    c. Furniture making.
    d. Machine Woodworking.
    e. Painting and Decorating.
    f. Plumbing and Pipe Fitting.

g. Draughtmanship craft practice

3. Miscellaneous trades: under this trade there are 10 various trades, they include;
    a. Cosmetology.
    b. Men's Garment Making.
    c. Ladies Garment Making.
    d. Catering Craft Practice.
    e. Leather Trade.
    f. Printing Craft Practice.
    g. Textile Trade.
    h. Graphic Arts.
    i. Ceramics
    j. Tourism
4. Business studies
    a. Secretarial studies
    b. Book-keeping
    c. Salesmanship (NABTEB, 2018).

In addition to trade group subject and trade related subject, there are general education subjects which are English language, mathematics, chemistry and physics. These subjects are made compulsory to all candidates and trade related subjects are chosen according to trades. Also there is provision of electives subjects among which candidate must select one or two to have a minimum of 7 subjects and maximum of 9 subjects. The electives subjects are;

i. Economics
ii. Biology
iii. Literature-in-English
iv. Information & Communication technology (ICT)
v. Civic Education
vi. Agricultural science
vii. Geography
viii. Christian Religious Studies
ix. Islamic Religious Studies (NABTEB, 2018).

In order to sustain the reform, the Joint Admission and Matriculations Board (JAMB) accepted the NTC and NBC certificates as being adequate for admission into

institutions of higher learning. Furthermore, all technical colleges were required to affiliate with NABTEB for their examinations. NABTEB also embarks on accreditation exercises before a technical college is approved as an examination centre. The teaching language remained English, which has also been made a core aspect of the curriculum. The sciences were also made a core aspect of the curriculum (Oranu, n.d). To boost enrolment in technical colleges, government in 2004 converted all Federal Government Technical Vocational Schools to Science Technical Colleges. This successfully increased the demand for placement into the colleges (FME, 2014). Despite this effort there is still a skilled labour deficit in Nigeria due to the number of technical colleges in the country. Based on the nation policy on education, the country supposes to have 774 technical colleges across the country, but the country has 110 only. Out of these 774, 17 federal colleges, 90 state colleges and three owned by private. This means that Nigeria still have deficit of 664 technical colleges that needs to be established. There is a need to establish more technical and technological institutions to improve access to technical education and boost our technical, innovative and inventive skills that will meet our industrial needs (Kazaure, 2017). The more technological institutions we have, the more skilled citizens we can get.

2.6 Effective Teaching Methods in Technology Education

Teaching is an attempt to bring about desirable changes in human learning, abilities and behaviour in order to contribute to better living. Teaching method is a strategy by which a teacher delivers his/her subject matter to the learners based on some predetermined instructional objectives in order to promote learning in the students (Dorgu 2015). A variety of the use of teaching methods is a must for teachers if learning is to be effective and efficient, and hence there is need for a good teacher to be multi-talented in other to be conversant with the use of various teaching methods in the teaching and learning process (Dorgu, 2015). Apagu and John (2001) classified teaching method in to two which are Teacher-Centered (Authoritarian or Autocratic styles) and students-centered (democratic or permission styles). In the first category, the teacher dominates the teaching processes and the students are passive mostly listening and taking notes. Under this category, there are various methods such as lecture, demonstration, discussion, textbook presentation, oral dictation, visual presentation, television instruction, and slide presentation. The second category is where students participate actively in the teaching learning situation, there is complete involvement and extensive students activity. Typical methods in this category include:

drill or practice method; recitation; problem solving; simulation and skill simulators; direct research and direct study; case study, printed instruction sheet; and oral report.

Under the two categories there are many teaching method. Okoro (1993) stated that many teaching methods can be used in vocational and technical education (technical college included), but the most widely used methods are: lecture; discussion; questioning; demonstration; project; experiment; assignment; and field trips method. Also Ajila (2010) noted that many researchers have been written on various teaching methods used in vocational and technical education courses/subjects especially in Metalwork Technology they includes; guided discovery method, lecture method, project method, field trip, demonstration method, exhibition method, programmed instructional method, systematic reporting, questioning method, independent study method, meta learning, cognitive apprenticeship instructional method, modeling method, collaborative method, constructivist method, role play method, and explanatory method. In technical college specifically Oranu (n.d) stated the lecture and project methods are the main teaching/ learning strategies employed for implementing the technical college curriculum. In this approach, the strategies are content driven and certainly not child-centred. The teachers have to cover the content in order to ensure that students are able to pass the NABTEB examinations. Students are not given ample opportunities to participate in the classroom instruction. The traditional method in which teaching reflects each discipline is still in use since the teacher has to concentrate on particular trades or modules. Similarly Ali, Rajuddin, Abdullatib, Udin, Sukri&Yahya (2012) revealed that the teaching methods applied for the development of skills and training of the students of technical colleges were basically done using 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. They further stated that Students also have no option than to be listeners from the teachers who spend all the time in explaining and demonstrating the concepts with the locally sourced scraps and sometimes in abstract without engaging the students into the real practical work.

Conclusively based on the foregoing, the following are teaching methods and styles that are commonly used in vocational technical education institutions of which technical colleges is included;

i. Discussion method

ii. Questioning method
iii. Demonstration method
iv. Project method
v. Experiment method
vi. Assignment method
vii. Field trips method
viii. Programmed instructional method.
ix. Collaborative method
x. Lecture method (Okoro, 1993; Ajila, 2010).

2.6.1 Discussion method

Discussion is a student centered teaching method which requires careful planning by the teacher to guide discussion. Successful discussions are guided by specific teaching goals. It involves a process of free guided discussion and expression of views and ideas on a given topic, question or problem by the teacher. In the students attempt to solve the problem or answer the question, students pair up in smaller groups for about 5 minutes or more,, discuss the issue on ground and then they are brought back for a full group discussion (Dorgu, 2015).In order to have an effective discussion class, the teacher should consider the following:

i. Decide on the goals of the class discussion. That is what a teacher want the students to get from each class session.
ii. Explain to the students how discussions will be structured. Will the discussion involve the whole class or will students work in smaller groups?. The teacher should also make clear what he expect the students to do before coming to each class session.
iii. If a teacher want students to discuss questions and concepts in small groups, explain to students how the groups will form.
iv. Teacher should not allow a few students to dominate the discussion. Some students will naturally respond more quickly, but they must be encouraged to let others have a chance. Ensure that all students participate at an acceptable level.
v. Teacher should look for opportunities for himself or for students to bring to class mini demonstrations illustrating important points of the day's topic. This is a very effective way to stimulate discussion.

vi. Teacher should be willing to adjust to the needs of his/her students through watch for signs that the students need more or less guidance (National Academy of Sciences, 2018).

This method of teaching was compared with lecture method and found that, it has significant effects on students' academic performance in some of the technical based subjects in technical colleges (Onweh&Akpan, 2014). Discussion method of teaching is mostly used when teaching theory aspect of particular subject and this makes it defective in teaching practical aspect.

2.6.2 Questioning Method

According to Dorgu (2015)questioning method is credited to Socrates, a Greek Philosopher. The questioning methods may be used when teacher want to determine how well the group understand the material; arouse the interest and curiosity of the students; and when channeling the students' thinking. According to Okoro (1993) question method can be used;

i. At the beginning of the lesson to determine whether students have fully comprehended the previous lesson. If the previous lesson had not been fully understood some amount of re-teaching may have to be done.
ii. In the process of presenting a new lesson to increase students participation.
iii. When introducing new topic, seek a solution to a problem.
iv. To draw students attention to some important point

In using questioning method Dorgu (2014) noted that there are five (5) basic types of questions which are likely to ask by the teacher namely;

a. Factual: These require straight forward answers based on obvious facts or awareness. Answers are either right or wrong-yes or no.
b. Convergent – Answers to questions of this nature are usually within a finite range of acceptable accuracy. They allow for only one right response; they are questions about concrete facts.
c. Divergent: These questions allow for many right responses. These questions give students the room to explore various avenues, creates alternative answers. Correct answers here could be based on logical projections or imagination. Questions here deal with opinions, hypotheses & evaluation and they predict different outcomes.
d. Evaluative: Evaluative questions are open-ended & more difficult to answer, because some criteria must be established for making any judgment. Basically,

evaluative questions require students to make judgments on something. Responses to these questions are limited to a number of choices.

e. Combination: These are questions that blend and can be combined as a question example.

Kathleen (n.d) proposed the following guidelines for using questioning method:

i. Incorporate questioning into classroom teaching/learning practices.
ii. Ask questions which focus on the salient elements in the lesson; avoid questioning students about extraneous matters.
iii. When teaching students factual material, keep up a brisk instructional pace, frequently posing lower cognitive questions.
iv. With older and higher ability students, ask questions before (as well as after) material is read and studied.
v. Question younger and lower ability students only after material has been read and studied.
vi. Ask a majority of lower cognitive questions when instructing younger and lower ability students. Structure these questions so that most of them will elicit correct responses.
vii. Ask a majority of higher cognitive questions when instructing older and higher ability students.
viii. In settings where higher cognitive questions are appropriate, teach students strategies for drawing inferences.
ix. Keeps wait-time to about three seconds when conducting recitations involving a majority of lower cognitive questions.
x. Increase wait-time beyond three seconds when asking higher cognitive questions.
xi. Be particularly careful to allow generous amounts of wait-time to students perceived as lower ability.
xii. Use redirection and probing as part of classroom questioning and keep these focused on salient elements of students' responses.
xiii. Avoid vague or critical responses to student answers during recitations.
xiv. During recitations, use praise sparingly and make certain it is sincere, credible, and directly connected to the students' responses.

Instruction which includes posing questions during lessons is more effective in producing achievement gains than instruction carried out without questioning

students. Students perform better on test items previously asked as recitation questions than on items they have not been exposed to before. Furthermore questions which focus student attention on salient elements in the lesson result in better comprehension than questions which do not (Kathleen, n.d).

2.6.3 Demonstration Method

Demonstration teaching method is based predominantly on the modeling of knowledge and skills. It is a form of teaching whereby the teacher or learners show how something works or operates, or how something is done. For example, a teacher could demonstrate how to use a hammer, how to operate a power drill, or how to bend a sheet metal. Following that, students practice under teacher supervision and finally independent practice is done to the point of proficiency (Cruikshank, Bainer and Metcalf cited in Petrina, in press).

Teacher's Roles in Demonstration Method of Teaching.

i. Demonstrate work to be learned slowly commentary paying special attention to the key points and more difficult parts.
ii. Demonstrate difficult or important operation.
iii. Allow learner to imitate, practice difficult Elements and movement as soon as possible.
iv. Demonstrate the whole process once more or Twice more at normal speed.
v. Ask one or two learners to repeat the demonstration carry out a critical estimation (Enemali, 2006).

Students' Roles in Demonstration Method of Teaching.

i. Make a survey operation and running their interconnection observe and repeat in their head.
ii. Observe and repeat in their heads once again in isolation.
iii. Repeat in their heads and practice (Enemali, 2006).

According to Enemali (2006) explanation is necessary during the demonstration and plays an important role in the success of demonstration. The teacher should speak in a simple language to suit the background of his students, should avoid using unfamiliar terms, which may tend to hinder progress in learning. The demonstration is the greatest mean of aiding student's fundamental skills and practices. Hence, its procedure should be carefully analyzed and organized for its success. Demonstration is the most widely used instructional method for the acquisition of practical skills as it involves verbal and practical illustrations of a given procedure. This method of

teaching as revealed by Onweh and Akpan (2014) it is found to be effective in practical lesson in technical colleges.

2.6.4 Project Method

Project method of teaching has evolved from the philosophy of programatists. It is experience-centered strategy related to life-situation. This teaching method focus on socializing a child and help him to achieve cognitive, affective and psychomotor objectives (Farooq, 2013). Farooq further stated that project method provides invaluable opportunities for correlation of various elements of the subject matter and for transfer of training or learning. According to Frank (2007) the project method of teaching has the following steps;

i. The method begins with finding and receiving an obvious set problem concerning the participants.
ii. In a second step the problem is located and stated more precisely. A general instruction goal in form of a problem is given.
iii. The third phase is characterised by drawing up action and solution bases by making a plan to solve the problems the aim is stated more precisely
iv. The simulation phase is to help to test the worked out solution possibilities intellectually and to check them for the implementation of the plan.
v. In the end, the experimental check is the implementation of the worked out project plan. Carrying out the plan as a problem solution or implementing the product, if required balanced realisation under the principle of job-sharing.

This method of teaching has positive effect on technology students' academic achievement. It was revealed in one of the study conducted to determine the effect of the method on Basic Technology students' academic achievement on car battery system, it was found that students taught with group project method performed better than those taught with the conventional lecture method (Okwelle&Emeli, 2016). The method is more suitable in teaching skills rather than theory aspects.

2.6.5 Experiment Method

Experiment teaching method according to Duru (2010) have being used in science education since the middle of 19th century. Experimental teaching method helps to improve students' hand skills, makes them more productive and increases their active involvement in learning. Students can create a relationship between theory

and practice by using experimental teaching method and by applying what they learn into their real life problems through experiments.

Frank (2007) proposed the following steps for experiment method of teaching;

i. Observing a phenomenon
ii. Formulating a question respectively a hypothesis.
iii. Planning of an experiment, i.e. creating an artificial, technical reality complying with certain marginal conditions.
iv. Carrying out an experiment.
v. Formulating a statement (a result) respectively supporting or falsifying the initial hypothesis in consideration of the marginal conditions and the accuracy of measurement.
vi. Categorising the sub statements in a full theory. Reflecting the consequences of the statements and of the application possibilities.

2.6.6 Assignment Method

According to Dewit (n.d.) assignment is a teaching method in which teacher give assignments to the students during class. The objective of these assignments is to stimulate the students to work actively on the learning content. This method of teaching is suitable for teaching basic knowledge and skills, but can also be used for learning more complex skills. Assignment can be given with the aim of reproducing information previously obtained or for solving complex problems. Steps that are involves in assignment teaching method are;

i. The teacher creates the assignment
ii. The teacher gives the students the necessary instructions
iii. The students complete the assignment
iv. The teacher and students discuss and evaluate the assignment (Dewit, n.d.).

In order to achieve the effective learning experience among the students through the assignment method teacher has his / her own important role and functions in this method. The following role and functions are considered mandatory for every teacher when executing the assignment method as stated by Modhavan (n.d.);

i. The teacher should divide the lesson into easier and appropriate parts that should be able to pursue as assignment topics.
ii. The assignments must be interrelated and develop from one to another gives good learning experiences.

iii. Teacher must have some targets in the learning experiences that to be acquired by the students from the assignments.

iv. Before giving the assignment works to the students' progress sheet should have been prepared by the teacher.

v. Teacher should have the complete bibliography and references for the subject he assigned for the assignments to the students.

vi. The reference and required information must be given with guidelines to the students when they opt for assistance in their assignment as well as in other academic works.

vii. The teacher must have the list of the assignments and its feed back with the problem solving guidelines to reduce the gaps in learning process among the students.

viii. Active sheets must be prepared and kept under his custody for the experiments and laboratory work.

Research indicates that, along with classroom instruction and students' responses to class lessons, assignment is an important method that increases students' academic achievement (Cooper, Robinson, &Patall, cited in Nicole, 2013). Assignment can be use in conjunction with other method to teach either theory or practical aspects.

2.6.7 Field Trips Method

This method has to do with Observations made or work carried on in a natural setting. Students visit the local museum of natural history to see displays about dinosaurs, or they begin and operate a small business to learn about production and marketing (Cruikshank, Bainer& Metcalf cited in Petrina, in press). This method of teaching was introduced in 1827 by George Shillibeer for a Quaker school at Abney Park in Stoke Newington, London, United Kingdom. Among other, the method has the following advantages;

i. Real-world experience. It allows students to have a real-world experience. For example, a textbook lesson on casting can be enhanced by trip to a local foundry where the students can clearly see the processes.

ii. Increase in quality of education.

iii. Improvement of the social relations. It is a way to bring the students closer together. Many field trips combine educational content with team-building activities, such as working together to clean a stream that has been

polluted. In fact, it is often a good idea to go on a field trip to help create a bond between the students (Limbu, 2012).

The steps involved in conducting field trip are as follows;

Trip Selection.

This is the first step where objectives will be identify, site to be visited will be selected as well as arrangement of date and time. In this also, pre-visit conducted to familiarize with the major features of the field and obtain address, directions, contact person and mobile numbers.

Logistics Planning

Apply for administrative approval and file requisition for transportation, making arrangement for meals and develop schedule for the day. Furthermore in this step, special equipments like cameras are arranged for historical purpose. Parents are informs about the trips and create a list of student names and home phone number for emergency.

Field Trip Preparation/Pre-trip discussion

Here, purpose of the field trip is being discuss to the participant, photographs or posters of the site should be shown to them as well as the standard conduct, dress code and other necessary things have be explain before the trip.

The Field Trip

In this step students sketch if it is necessary, ask questions and note the answers.

Post-field Trip

Student share their observations and reactions to field trip experiences; create classroom bulletin board displaying materials collected while on field trip; and compose thank-you letter to those who helped during the field trip.

Evaluating Field trip

In this step mostly involves asking questions like; what was the unique educational value in this trip?, Did students meet the objectives?, Was there adequate time?; Was there adequate staff and adult supervision?; What might be done differently to be better? (Limbu, 2012).

There is empirical evidence that proved field trips method very effective in technology education. The study was conducted to determine the different between

the academic achievement of students that taught Basic Technology with field trip and those taught with conventional lecture method. It was found that those taught with field trip performed better in achievement test administered to them (Amosa, Ogunlade&Atobatele, 2014).

2.6.8 Programmed Instructional Method.

Programmed instructional is a form of individualized instruction whereby information is learned in small, separate units either by way of reading programmed texts or using computer-based programs (Cruikshank, Bainer& Metcalf cited in Petrina, in press). According to Umar (2013) the focus of this method of teaching is to bring desirable change in the cognitive domain of the learner's behavior. The structure of teaching method is that the selected content is analyzed and broken into smaller elements each element is independent and complete in itself. The programmer develops frames based on each element. Responses are also provided to the learner in the program on some different leaflets. Umar further stated that the correct response of the learner is the new knowledge or new behavior. Immediate confirmation of correct response provides reinforcement to the learner and he proceeds to the next frame. Wrong responses required feedback. Physical presence of the teacher is not necessary. He may come to give instructions regarding the program. Students are left for learning at their own pace.

Advantages of programmed instruction

i. The main emphasis is on individual differences and students' involvement.
ii. There is no fixed time interval for learning. Students may learn at their own paces.
iii. Learning by doing maxim of teaching is followed to involve learners in the learning process.
iv. Students are exposed only to correct responses, therefore, possibility to commit errors in reduced.
v. Immediate confirmation of the results provides reinforcement to the learners and encourages the learners to proceed further. Feedback is provided to wrong answers, so that learner is able to develop mastery over the content (Umar, 2013)

Programmed instructional had been proved to be effective positively in a study conducted by Doko and Robert (2015) on metal work technology students' academic achievement.

2.6.9 Collaborative Method

In this method learners are placed in groups of four to six. Sometimes the groups are as diverse or heterogeneous as possible. In such cases, group members are often rewarded for the group's overall success. Student groups might be given a teacher presentation on division of fractions. They would then be given worksheets to complete. Team members would first help and then quiz one another (Cruikshank, Bainer& Metcalf cited in Petrina, in press). Collaboration method is an educational approach to teaching and learning that involves groups of learners working together to solve a problem, complete a task, or create a product. In this method the learners are challenged both socially and emotionally as they listen to different perspectives, and are required to articulate and defend their ideas. In so doing, the learners begin to create their own unique conceptual frameworks and not rely solely on an expert's or a text's framework (Marjan&Mozhgan 2012).

The role that the Teacher takes is critical to the success of collaborative method of teaching. Teacher is likely to become group creator, monitor, mediator, organiser, coach, mentor and adviser in resolving internal group problems. The Teacher is also responsible for dealing with issues of inequity, allocating and moderating grades and providing constructive and useful feedback to individuals and groups (Centre for Academic Development, 2013). It further stated that the teacher must ensure that the objectives and assessment of the lesson are clear and link to learning outcomes. Initially, the Teacher should allocate adequate class time to be devoted to the group formation, negotiation of expectations, explanation of roles, and setting times and frequencies of meetings. This method of instruction had been confirmed to be effective in teaching building technology which is one of trades in technical colleges (Oviawe, 2010). The method encourages group work in teaching and learning processes.

2.7 Review of Related Empirical Studies

Peter, Abiodun and Oke (2010) carried out a study on effect of constructivism instructional approach on teaching practical skills to mechanical related trade students in western Nigeria technical colleges. Three (3) research questions and two hypotheses were formulated in guiding the study. The specific purpose of the study

were to: determine the mean score and standard deviation of experimental and control group on concept mapping in the general metal work practical skill test; determine the mean score and standard deviation of experimental and control group on cooperative work skills items in the general metal work achievement test; and to determine the mean score and standard deviation of experimental and control group on cognitive apprenticeship in the general metal work achievement test. The population of the study consisted of all year two students in all the thirty four technical colleges in six of the south western state in Nigeria. A multi stage random sampling was employed in which four technical colleges were selected consisting of one hundred and six (106) year two students. Two of the four technical colleges were assigned to experimental group while the other two were assigned to control group. The research design adopted for the study was quasi experiment pre-test, post-test non equivalent group.

The instruments used for the study were the constructivism lesson plans, conventional lesson plans, consumables and equipment for the practical exercise and thirty objective questions for the pre testpost test tagged general metal work achievement test (GMWAT). The constructivist lesson plans, the conventional lesson plans and the general metal work achievement test were face and content validated by three test and measurement experts in the Department of Curriculum Studies, University of Ado Ekiti, Nigeria. The data collected were analyzed using t-test analysis to test the significance difference between male and female students exposed to the experimental method and analysis of covariance (ANCOVA) was used to test for significant difference between the teaching methods at 0. 05 level of significance. The findings of the study revealed that Students taught with constructivism instructional approach scored higher in the post-test than those taught with conventional method which signifies that the components of constructivism instructional approach such as concept mapping, cooperative work skills and cognitive apprenticeship lead to higher academic achievement in general metal work than the conventional method. The researchers offered recommendations among others that Metal work teachers should always adopt the components of constructivism. This will enable them to cater for diverse learning styles of students in their classrooms and hence, improve their academic achievement and development of practical skills. This study is related to the present study because constructivist instructional approach was used for the study and it was concerned about comparing different teaching approaches.

Akanwa and Ovute (2014) carried out a study on the Effect of constructivist teaching model on SSS physics students' achievement and interest. The study was guided by two research questions and two hypotheses. The population of the study was all the senior secondary two (SS2) physics students in all the public schools in Oboll-Afor Education Zone. Four secondary schools that have physics students in the SS2 class were sampled for the study. From each school, forty (40) SS physics students were drawn from the intact classes. A total of 160 physics students who were in the four sampled class formed the sample of the study. The four (4) classes were categorized into the experimental and control groups of two (2) classes each. The experimental and control groups consisted of 80 students respectively. The study employed a quasi-experimental design. Two instruments, the achievement test and interest scale instruments were developed and used for the study. The physics achievement test that covered the waves and sound contents contained in the SS2 physics curriculum was developed. The reliabilities of the instruments were also determined, using cronbach-alpha for interest and kuder- Richardson 20 for achievement test. The reliability values were 0.76 and 0.74 respectively for the achievement test and interest scales. Mean, standard deviation and z-test was used for data analysis. Finding of the study revealed that constructivist group had a higher mean that their conventional counterparts. Also, a z-test analysis of the mean scores shoe that the difference observed was significant at 0.05 level of probability. By implication, constructivist teaching has a positive effect on physics students' achievement. They made recommendations among others that Physics teachers at secondary schools should use the constructivist instructional model for effective and higher achievement as well as their interest. This study is related to the present study because two methods of teaching were involved and the concern is on students' academic performance. The study employed a quasi-experimental design and samedesign was used for this study.

In a study conducted by Duyilemi and Bolajoko (2014) titled effects of constructivists' learning strategies on senior secondary schools students' achievement and retention in biology in which two research questions and two hypotheses was used. The study specific purpose of the was to find out whether the constructivists' strategies are more effective than conventional method of teaching arthropods, and also to find out whether males can perform better than females when taught arthropods using constructivists' strategies. The population of the study consisted of

all Senior Secondary School Class Two (SS2) biology students in Ondo State which are co-educational schools. In the study Two schools were randomly selected from the list of seventeen secondary schools in Owo Local Government Area of Ondo State purposively. A total number of one hundred and sixty biology students were selected for the study. The sample consisted of male and female students. Eighty students were assigned to the constructivists' method of instruction in the first school while another eighty students were assigned to the control group. Each school has two intact classes of 40 students each totaling one hundred and sixty students.

The instrument designed and used by the study includes: Biology Achievement Test, teacher's instructional guide on constructivist strategies, and teacher's instructional guide on conventional method. The instruments were examined by experts in Biology and research supervisor that gave it a face and content validity. The instrument was trial tested by Kuder Richardson Formula KR 21 and a reliability coefficient of 0.6 was obtained. Descriptive Analysis was used to analyze the data collected for both experimental and retention tests while ANCOVA and Multiple Classification Analysis (MCA) statistics were used to test the hypothesis at 0.05 level of significance. It was found that constructivists' strategies is more effective than the conventional methods with regard to achievement and retention in biology in the area of arthropods; and male students performed better than female students taught using the constructivists' strategy though the difference was not significant as reported by the researchers. They made a recommendation that Science teachers should be ready to adopt modern strategies of teaching in Nigerian secondary schools. This study is related to the present study because two methods of teaching was employed in study and is what was equally employed in the present study. Also the study employed quasi-experimental design with emphasis on improvement of students' academic performance, this is what the present study intend to investigate.

A study conducted by Musa and Hassan (2015) on effect of using constructivist instructional approach on students' academic achievement in Auto mechanics in Yobe state technical colleges. Two research questions and two hypotheses were used in guiding the study, and specifically the purpose of the study was to determine the pre-test mean achievement scores of the experimental group and control group; and to determine the effect of constructivist approach on students taught fuel system and those taught using traditional teaching method. The population of the study consisted of 48 NTC 1 students of Government Science and Technical

College Potiskum for the 2012/2013 academic session. They used quasi experiment pre-test, post-test non equivalent group design for the study. The instrument used for the study was two lesson plans (traditional and constructivist), and twenty (20) objectives test questions for the pre-test and another twenty (20) objective test questions for the post-test tagged General Automobile Work Achievement Test (GAWAT). The GAWAT was validated by two experts in school of technical education, Federal College of Education (Technical) Potiskum. The data generated was analyzed using mean, standard deviation and t-test statistical tool. The finding revealed that during the pre-test, both groups were found to posses equivalent entry behavior, and in post-test experimental group performed better than the control group in compression ignition fuel system. They proffered some recommendations among other, that the automobile technology teachers should adopt the components of constructivism instructional approach. This study considered relevant to the present study because the study determined the effect of constructivist instructional approach by comparing it with conventional lecture method; quasi-experimental design was used; and concerned was about technical students' academic performance. So also the present study employed quasi-experimental design in comparing two methods of teaching on achievement of technical college students.

Oguguo (2015) carried out a similar study on effects of constructivist method of teaching on students' achievement in financial accounting. The study was guided by two research questions and two hypotheses. Specifically the study determined the effects of constructivist instructional approach on achievement of student in financial accounting; and mean achievement scores of male and female students in financial accounting. The study adopted quasi-experimental research design in which pre-test, post-test, non-equivalent control group design was used. The population of this study consisted of 964 SS3 financial accounting students in Owerri education zone of Imo state. Purposive and random sampling techniques were used for the study in drawing the sample which consisted of two hundred (200) senior secondary accounting students, randomly drawn from 9 out of 111senior secondary schools in Owerri Education zone in Imo State. The instrument used for data collection was the financial accounting achievement test (FAAT). The FAAT was 50 items multiple test developed by the researcher based on the contents of SS3 financial accounting scheme of work. The reliability coefficient of the instrument was determined using Kuder-

Richardson formula 20 and the result of the reliability coefficient testing of 0.89 was obtained.

The scores obtained from the pre-test and post-test were analyzed using mean and standard deviation while ANCOVA was used in testing the null hypotheses at 0.05 level of significance. The finding of the study revealed that experimental group that those that taught financial accounting using constructivist instructional approach perform better than the control group in achievement test. Moreover, the study revealed that constructivist instructional approach is not gender sensitive. The researcher proffered a recommendation that Constructivist teaching method should be adopted by financial accounting teachers in order to produce functional students who could effectively exploit their environment by adequately acquiring the necessary vocational skills that will enable them fit into the society. He also recommended that comprehensive research should be carried out locally and nationally on constructivist method of teaching in other subject areas in secondary education in Nigeria. This study is related to the present study because the study adopted quasi-experimental research design in which pre-test, post-test, non-equivalent control group design was used; the focus was on improvement of students' academic achievement. This is what wasusedfor the present study that is, it employed quasi-experimental research design in which pre-test, post-test, non-equivalent control group design was used.

Ndubuisi (2016) carried out a study on effects of constructivist instructional model on junior secondary school students' achievement and interest in social studies. Six (6) research questions and six (6) hypotheses were used in guiding the study. Among others, the specific purpose of the study is to ascertain the differential effects of constructivist instructional model and conventional teaching method on junior secondary school students mean achievement scores in Social Studies and determine the effect of constructivist instructional model on the mean achievement scores of male and female students in JSS Social Studies. The population of the study comprised all the junior secondary school two (JSS II) students in all the 45 public secondary schools in Agbani education zone of Enugu state which made up of 14,987 students made up of 5,600 males and 9,387 females. While the The sample of the study comprised two hundred and ninety (290) junior secondary school two (JSS II) students that were drawn from six (6) secondary schools out of the existing 45 public secondary schools in Agbani education zone of Enugu State. The six (6) secondary schools were drawn through simple random sampling technique. The design of this

study was pretest, post-test, non-randomized and non-equivalent control group quasi experimental design.

The instruments used was Social Studies Achievement Test (SSAT) and Social Studies Interest Inventory (SSII) which was validated by three experts, consisting of two subject specialists from Social Studies unit of the Department of Social Science Education, University of Nigeria, Nsukka, and one measurement and evaluation expert from the Department of Science Education, University of Nigeria, Nsukka. The research questions were answered using mean and standard deviation while the hypotheses were tested using the ANCOVA at an alpha level of 0.05. The findings of the study among others revealed that JSS students taught Social Studies using constructivist instructional model performed better than their counterparts who were taught using conventional teaching method. The researcher proffered recommendations among other that Social Studies teachers should be encouraged to use constructivist instructional model during classroom instruction in order to enhance students' achievement and interest in Social Studies. This study is related to the present study because the study used pretest, post-test, non-randomized and non-equivalent control group quasi experimental design. The study also compared two different teaching approaches on students' academic achievement and ANCOVA was used in data analysis. The present study similarly employed pretest, post-test, non-equivalent control group quasi experimental design and ANCOVA was used for the analysis in comparing the two teaching methods.

2.8 Summary of Literature Review

The literature review contained the theoretical and conceptual frame works which reviewed the necessary theories and other concepts related to the study such as: Constructivists' Teaching Methods, Lecture Method of Teaching, Concept of Metalwork, Technical Colleges in Nigeria, Teaching Methods and Academic Achievement in Technical Education and Review of Related Empirical Studies.The theoretical framework has shown that constructivist instructional approach is based upon constructivist theory of learning. The major pioneer that constituted the theory is Jean Piaget who promoted the idea of cognitive constructivist learning by contributing the idea of transformation in learning and development.

The traditional instructional method of teaching and learning particularly lecture method was reviewed. The traditional (lecture) method of teaching cannot be effectively used to deliver the cognitive information. Poor teaching method may be

therefore, blamed for the poor performance of students in metalwork. This prompted the call for alternative methods of teaching. The concept of metalwork was reviewed and it was revealed that the subject comprises different areas in metalworking such as foundry, forging, welding and machining. However, only concept that are much related to the study were partially reviewed which are measurement and marking out; casting; gas and arc welding; and drilling operation. The concept of metalwork as a subject has also been reviewed. It was revealed that the subject has long being offers in Nigeria technical and vocational institutions at secondary level, the then called craft centre. Now a day the subject is being offers as trade related subject in engineering trades at technical college curriculum which was designed by NBTE. This curriculum is being examined by NABTEB. Teaching methods that are commonly practicing in technical education others than lecture method have been reviewed which among others includes; discussion, questioning, demonstration, project, experiment, assignment, and field trips method of teaching.

Finally the reviewed of related empirical study was conducted on the effectiveness of constructivist instructional approach on difference subjects with different students under different conditions. In all the studies that were reviewed which includes; Peter, Abiodun and Oke (2010); Akanwa and Ovute (2014); Duyilemi and Bolajoko (2014); Musa and Hassan (2015); Oguguo (2015); and Ndubuisi (2016), little or no study have been carried out to compare constructivist teaching method with lecture method particularly on metalwork students' academic performance in technical college in Yobe state. From the review, it has been seen that constructivist method improves students' achievement in so many subjects. Therefore, there is need to see if the method will enhance students' achievement in metalwork in Yobe State technical colleges where the frequently used teaching method (lecture) had found to be defective based on the students' performance in the subject.Hence, this study intends to fill the gap that was left by these researchers.

CHAPTER THREE
METHODOLOGY

This chapter describes the procedures which will be employed in this study under the following headings: Research Design, Area of the Study, Population of the Study, Sample and Sampling Technique, Experimental Procedure, Instrument for Data Collection, Validation of the Instrument, Reliability of the Instrument, Method of Data Collection, Method of Data Analysis and control of extraneous variables.

3.1 Research Design

The design for the study was quasi-experimental pretest, post-test non-equivalent control group. Sambo (2005) defined quasi-experiments as a design which involved assignment, but not random assignment of participants to groups, in other words, entire classrooms, not individual students, are assigned to treatments. In education, many experimental situations occur in which researchers must have to use intact groups, they cannot artificially create groups for the experiment because the setting prohibits forming artificial groups which might disrupt classroom learning (Creswell, 2012). The design was chosen and considered appropriate for the study because school authorities will hardly allow a researcher to disrupt their normal school setting for the purpose of creating a true experimental group hence the school intact class was used.

The two groups (made up of two technical colleges) experimental and control groups, were randomly assigned to the methods of teaching. Intact classes were also randomly assigned to different treatment conditions. The experimental group was treated using constructivist instructional approach while lecture method of teaching was used for control group. The pre-test, post-test with control groups design organized as shown below Gay, Geoffrey, and Peter (2012);

G_1 O_{A1} X O_{B1}

G_2 O_{A2} O_{B2}

Where:

G_1 = Experimental Group (constructivist method)

G_2 = Control Group, (Lecture Method)

O_{A1} = Pretest Mean Performance Result for Experimental Group

O_{A2} = Pretest Mean Performance Result for Control Group

X = Treatment for Experimental Group (constructivist method)

O_{B1} = Post-test Mean Performance Result for Experimental Group

O_{B2} = Post-test Mean Performance Result for Control Group

3.2 Area of the Study

The geographical area of the study is Yobe State, which is situated in Northeastern Nigeria. The State was created out of Borno State on 27th August 1991. It is located at Latitude 12.1871^0 N and Longitude 11.7068^o E of the Greenwich Meridian. The state occupies a total land area of about 31,000km^2 (Jatawa, 2013). The state was curved out of old Borno state, it shares international boundary with Niger Republic to the north, it shares borders with Jigawa and Bauchi states to the west, Borno state to the east as well as Gombe and Borno states again to the south. The state has 17 local government areas that covers 47,153 sq km with population of 2.5 million people as per the national head count conducted in March 2006 (Yobe State Ministry of Home Affairs, Information and Culture, 2015).

3.3 Population of the Study

The target population for the study consisted of NTC II in all Government Science and Technical Colleges that are offering metalwork. This covered students from three Government Science and Technical College located in Potiskum, Damagum and Geidam. The number of students drawn from each school is shown in Appendix II.

3.4 Sample and Sampling Technique

Purposive sampling technique was used in the selection of the schools and students for the experiment. Two out of three technical colleges that are offering metalwork was selected namely; Government Science and Technical College Potiskum with 26 metalwork students and Government Science and Technical College Damagum with 32 metalwork students. The two schools are selected because of some of the characteristics they have in common such as location and nature of schools facilities. The total was 58 NTC II students. NTC II students was used for this study because they have spent at least one full year in their colleges and have no

external examination immediately in view that can interfered with their normal concentration in the class.

3.5 Experimental Procedures

The researcher observed the following procedures in carrying out the treatment;

1. Visited the experimental schools to obtain permission from the Principals of the schools and in order for the researcher to acquaint himself with the schools environment
2. Second visit was to brief a regular metalwork teacher on how to teach students metalwork using constructivist instructional approach in experimental group. Both of the groups were taught by their respective regular metalwork teachers.
3. Conduct of the Pretest: the students in experimental group and control group were given pre- test to check their entry equivalence.
4. Conduct of the actual experiment – The research assistance with the supervision of researcher conducted the lesson for four weeks of teaching session involving the two different methods (constructivist and lecture). This teaching was guided by two different lesson plans.
5. The experiment lasted for six weeks. The first week was devoted to the administration of pre-test and general teacher orientation.A group leader was appointed in each group.Second to fifth weeks wereused for teaching of the content areas of the study where students were taught measuring and marking out in the second week, gas and arc welding in third week, casting processes was taught in fourth week, drilling process in week 5, and week sixth was devoted to the administration of the post-test.
6. At the end of the treatment given to the students in the fourth week, a post – test was administered to the students in experimental group and control group. The post– test duration lasted for 2 ½ hours and the scores obtained was recorded.

3.6 Instrument for Data Collection

The instrument for the study is multiple choice objective test items tagged "Metal Work Achievement Test (MWAT)" as in appendix IV. It consisted of four sections, A, B, C and D. each section has 20 questions making a total of eighty (80) researcher-made objective questions. Section A, B, C and D- asked questions on measuring and marking out; gas and arc welding; casting; and drilling process

respectively as in Appendix IV. The study also utilized constructivism lesson plan (appendix VI) and lecture lesson plan (appendix VII) in teaching the students on measuring and marking out; gas and arc welding; casting; and drilling. The above mentioned themes are drawn out from the NABTEB metal work syllabus.

3.7 Validation of the Instruments

The constructivist lesson plans, the lecture lesson plans and the MWAT was given to three experts for face and content validation, two from Modibbo Adama University of Technology Yola to check the adequacy of content, logical sequence and suitability of the technical terms used, and one from Government Science and Technical College Damagum to check the content of the instrument against NABTEB syllabus on Measurement and marking out; gas and arc welding; casting process and drilling process. Their comments and suggestions (appendix ix) were used to restructure the final instruments.

3.8 Reliability of Instrument

Split-half procedure was employed in determining the reliability of the instrument. The instrument was administered to 25 students in Government Day Technical College TafawaBalewa, Bauchi state which is close to study's area of coverage and therefore can have some characteristics in common.After a week interval, the other half was administered to the same group of students and their scores was collected, recorded and measured using Pearson product moment correlation coefficient. Uzoagulu (2011) stated that the correlation between the two scores of two administrations of the same test is a measure of the reliability of the instrument. A reliability coefficient of 0.82 was obtained, which is within the acceptable range of reliability of the instrument.

3.9 Method of Data Collection

The pre- test was administered on both experimental group and control group to obtain the scores. At the end of the treatment, post – test was administered on both experimental group and control group again with the instrument but differently arranged to obtain the score as well with the help of the one research assistant from each school on different occasions under the supervision of the researcher.

3.10 Method of Data Analysis

The scores obtained from the pre-test and post-test was analyzed using mean and standard deviation to answer the research questions, while Analysis of covariance

(ANCOVA) was used for testing the null hypotheses at 0.05 level of significance. Any group with higher mean in the achievement test irrespective of the closeness in the mean value was taken to have performed better and the method used in teaching them was equally considered better. While for the hypotheses if the p-value is less than 0.05, the null hypothesis was rejected. Alternatively if the p-value is greater than or equal to 0.05, the null hypothesis was accepted. ANCOVA is considered appropriate for the study as Gay, Geoffrey and Peter (2012) stated that if the groups are not essentially the same on the pre-test, post-test scores, it should be analyzed using analysis of covariance, which adjusts post-test scores for initial differences on any variable, including pretest scores. The analysis was made using statistical package for social science (SPSS) version 21.

3.11 Control of Extraneous Variables

Extraneous variables as described by Oviawe (2010) are those variables that are not included in the study but whose significant influence may invalidate results. They are not variables of primary interest in the study but must have to be controlled. Therefore the control of the extraneous variables in this study was achieved through the following procedures:

Teacher variability

In order to reduce the effect of teacher variable on the students' performance, the researcher visited the schools, selected teachersthat have qualification and teaching experience in common and briefed them on constructivism teaching method. The researcher also ensured that the students involved are taught by the regular selected teachers throughout the period of experiment.

Instructional Situation Variability

For uniformity of instructional situation, the different tutors were provided with the relevant instructional materials such as detailed lesson plans prepared by the researcher and validated by experts. There were four different lesson plans for each of the method as the teaching lasted for four weeks.

Hawthorne Effect:

Hawthorne effect as defined by Owodunyi (2011)is a situation where the performance of research subject is affected due to the fact that the students are conscious of the fact that they are involved in an experiment. In order to reduce this problem, the researcher used the normal classroom teachers in both control and

experimental groups. Also he assigned each school to a single treatment (control or experimental).

Effect of Pre-test – Post-test

There was four weeks interval between the pre-test and the post-test and the items in pre-test and post-test were arranged in different order, it was reshuffled to take care of the possibility of the students becoming test-wise.

CHAPTER FOUR

RESULTS AND DISCUSSION

This Chapter presents the results and discussions of the data analyses for the study. The presentations were organized according to the research questions and null hypotheses that guided the study.

4.1 Results

Research Question 1

What is the mean academic achievement score of metalwork students taught measurement and marking out with constructivists' teaching approach (experimental) and those taught with lecture method (Control) in technical colleges in Yobe State.

Table 1: ***MeansAchievement Score and Standard Deviations of Pretest and Posttest of Experimental and Control Groups on Measurement and Marking Out***

Group	N	Pre-test		Post-test		Mean Diff.
		$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$
Experimental Group (Constructivists Method)	33	5.06	1.52	13.82	2.11	8.76
Control Group (Lecture Method)	25	4.96	1.37	9.92	2.59	4.96

N = Number of Subjects; $\bar{X}$ = Mean and SD = Standard Deviation

Table 1 shows that prior to the use of constructivist method in the teaching of measurement and marking out to metalwork students in the experimental group, the mean score was 5.06 while the standard deviation was 1.52. The control group has a pretest mean score of 4.96 and the standard deviation of 1.37. The standard deviation of 1.52 for the experimental group and 1.37 for the control group indicates that there is slight variation in test scores of experimental group than in control group. But after the treatment which was teaching the students, the posttest mean scores for the

experimental students is 13.82 while for the control group is 9.92 with the standard deviation of 2.11 and 2.59 respectively. The standard deviation indicates variation in the scores. The table also shows that the mean difference was 8.76 for experimental group and 4.96 in lecture method. This implies that the students taught measurement and marking out with constructivist teaching method performed better in the achievement test than those taught with lecture method. The result shows that constructivist teaching method is the better method in teaching measurement and marking out compared to lecture method.

Research Question 2

What is the mean academic achievement score of metalwork students taught arc and gas welding with constructivists' teaching method (experimental) and those taught with lecture method (Control) in technical colleges in Yobe State.

Table 2: ***Means Achievement Score and Standard Deviations of Pretest and Posttest of Experimental and Control Groups on Arc and Gas Welding***

Group	**N**	**Pre-test**		**Post-test**		**Mean Diff.**
		$\bar{X}$	**SD**	**$\bar{X}$**	**SD**	**$\bar{X}$**
Experimental Group (Constructivists Method)	33	4.85	1.52	13.94	1.60	9.09
Control Group (Lecture Method)	25	5.12	1.51	9.16	2.06	4.04

N = Number of Subjects; $\bar{X}$ = Mean and SD = Standard Deviation

The data presented in Table 2 shows that in arc and gas welding section of MWAT, experimental group has a pre-test mean score of 4.85 with a standard deviation of 1.52, while the control group has a pretest mean score of 5.12 and the standard deviation of 1.51. There is slight spread out in both the tests scores based on standard deviation of 1.52 for the experimental group as against 1.51 for the control group. In the post-test, the mean scores for the experimental students increased from 4.85 to 13.94 while for the control group the mean score increased from a mean score of 5.12 to 9.16. But when compared with the experimental group, it was low. The table also shows that the mean gain difference was 9.09 for experimental group and 4.04 in lecture method. This implies that the students taught arc and gas welding with

constructivist teaching method performed better in the achievement test than those taught with lecture method. The finding here shows that constructivist teaching method is the better method in teaching arc and gas welding compared to lecture method.

Research Question 3

What is the mean academic achievement score of metalwork students taught casting process with constructivists' teaching approach (experimental) and those taught with lecture method (Control) in technical colleges in Yobe State.

Table 3: ***Means Achievement Score and Standard Deviations of Pretest and Posttest of Experimental and Control Groups on Casting Process***

Group	**N**	**Pre-test**		**Post-test**		**Mean Diff.**
		$\bar{X}$	**SD**	**$\bar{X}$**	**SD**	**$\bar{X}$**
Experimental Group (Constructivists Method)	33	4.62	1.18	12.64	1.97	8.02
Control Group (Lecture Method)	25	4.84	1.46	10.68	2.75	5.84

N = Number of Subjects; $\bar{X}$ = Mean and SD = Standard Deviation

Table 3 shows that prior to the use of constructivist method in teaching casting process to metalwork students in the experimental group, the mean score was 4.62 while the standard deviation was 1.18. The control group has a pretest mean score of 4.84 and the standard deviation of 1.46. The standard deviation indicates that there is slight closeness in the test scores. In posttest, the mean scores for experimental group is 12.64 while for the control group the mean score was 10.68. The table also shows that the mean gain difference was 8.02 for experimental group and 5.84 for control group. This implies that the students taught casting process with constructivist teaching method performed better in the achievement test than those taught with lecture method. The result shows that constructivist teaching method is the better method in teaching casting process compared to lecture method.

Research Question 4

What is the mean academic achievement score of metalwork students taught drilling process with constructivists' teaching approach (experimental) and those taught with lecture method (Control) in technical colleges in Yobe State.

Table 4: ***Means Achievement Score and Standard Deviations of Pretest and Posttest of Experimental and Control Groups on Drilling Process***

Group	**N**	**Pre-test**		**Post-test**		**Mean Diff.**
		$\bar{X}$	**SD**	**$\bar{X}$**	**SD**	**$\bar{X}$**
Experimental Group (Constructivists Method)	33	4.21	0.96	11.79	1.95	7.58
Control Group (Lecture Method)	25	3.96	1.43	8.88	2.15	4.92

N = Number of Subjects; $\bar{X}$ = Mean and SD = Standard Deviation

The data presented in Table 4 shows that, in drilling process section of MWAT, experimental group has a pre-test mean score of 4.21 with a standard deviation of 0.96, while the control group has a pretest mean score of 3.96 and a standard deviation of 1.43. There is closeness in the test scores in experimental group than in control group based on standard deviation of 0.96 for the experimental group as against 1.43 for the control group. In post-test, the mean scores for the experimental group was 11.79, while for the control group it was an increased to 8.88. But despite the increased it was low when compared with the mean of experimental group. The table also shows that the mean gain difference was 7.58 for experimental group and 4.92 in control group. This implies that the students taught drilling process with constructivist teaching method performed better in the achievement test than

those taught with lecture method. The finding proves that constructivist teaching method is the better method in teaching drilling process compared to lecture method.

Hypothesis 1

There will be no significant difference in the mean academic achievement scores of metalwork students taught measurement and marking out with constructivists' teaching approach and those taught with lecture method in technical colleges in Yobe State.

Table 5: ***Analysis of Covariance of the Mean Achievement Scores of Students Taught Measurement and Marking Out with Two Different Teaching Methods***

Source of Variance	Sum of Squares	DF	Mean Square	F	Sig. of F (p-value)
Corrected Model	216.15[a]	2	108.08	19.51	.00
Intercept	618.82	1	618.82	111.69	.00
Pretest (Covariate)	.004	1	.004	.001	.98
Group (Teaching Methods)	215.95	1	215.95	38.98	.00
Error	304.75	55	5.54		
Total	9066.00	58			
Corrected Total	520.90	57			

Table 5 reveals that the F value of pretest is 0.001 with p-value of 0.98 which is greater than 0.05 indicating that there is no significant different in the covariate. The F-calculated value for teaching methods (1, 55) is 38.98 with p-value of 0.00. Since the p value of 0.00 is less than 0.05, the null hypothesis is therefore rejected. Hence, there is significant difference between the mean achievement scores of students taught measurement and marking out with constructivist teaching method and those taught with lecture method. It means that there is a significant difference in effectiveness of constructivist and lecture teaching method in teaching measurement and marking out.

Hypothesis 2

There will be no significant difference in the mean academic achievement scores of metalwork students taught arc and gas welding with constructivists' teaching approach and those taught with lecture method in technical colleges in Yobe State.

Table 6: ***Analysis of Covariance of the Mean Achievement Scores of Students Taught Arc and Gas Welding with Two Different Teaching Methods***

Source of Variance	Sum of Squares	DF	Mean Square	F	Sig. of F (p-value)
Corrected Model	325.05[a]	2	162.53	48.82	.00
Intercept	616.44	1	616.44	185.17	.00
Pre Test (Covariate)	.138	1	.138	.041	.84
Group (Teaching Methods)	323.49	1	323.49	97.17	.00
Error	183.10	55	3.33		
Total	8693.00	58			
Corrected Total	508.16	57			

Table 6 reveals that the F value of pretest is 0.041 with p-value of0.84 which is greater than 0.05. It implies that there is no significant different in the covariate. Also in the table the F-calculated value for teaching methods (1, 55) is 97.17 with p-value of 0.00. Since the p value of 0.00 is less than 0.05, the null hypothesis is therefore rejected. Meaning there is significant difference between the mean achievement scores of students taught arc and gas welding with constructivist method and those taught with lecture method. The result here proved that there is a significant difference in effectiveness of constructivist and lecture teaching method in teaching arc and gas welding.

Hypothesis 3

There will be no significant difference in the mean academic achievement scores of metalwork students taught casting processes with constructivists' teaching approach and those taught with lecture method in technical colleges in Yobe State.

Table 7: ***Analysis of Covariance of the Mean Achievement Scores of Students Taught Casting Process with two different teaching methods***

Source of Variance	**Sum of Squares**	**DF**	**Mean Square**	**F**	**Sig. of F (p-value)**
Corrected Model	184.28[a]	2	92.14	17.53	.00
Intercept	453.26	1	453.26	86.23	.00
Pretest (Covariate)	15.84	1	15.84	3.01	.09
Group (Teaching Methods)	180.17	1	180.17	34.28	.00
Error	289.12	55	5.26		
Total	9737.00	58			
Corrected Total	473.40	57			

Table 7 reveals that the F-calculated value of covariate is 3.01with p-value of0.09 which is greater than 0.05 indicating that there is no significant different in the pretest. The F-calculated value for teaching methods (1, 55) is 34.28 with p-value of 0.00. Since the p value of 0.00 is less than 0.05, the null hypothesis is therefore rejected. Hence, there is significant difference between the mean achievement scores of students taught casting process with constructivist teaching method and those taught with lecture method. It implies that there is a significant difference in effectiveness of constructivist and lecture teaching method in teaching casting process.

Hypothesis 4

There will be no significant difference in the mean academic achievement scores of metalwork students taught drilling process with constructivists' teaching approach and those taught with lecture method in technical colleges in Yobe State.

Table 8: ***Analysis of Covariance of the Mean Achievement Scores of Students Taught Drilling Process with Two Different Teaching Methods***

Source of Variance	Sum of Squares	DF	Mean Square	F	Sig. of F (p-value)
Corrected Model	124.12[a]	2	62.06	14.95	.00
Intercept	386.06	1	386.06	93.00	.00
Pretest (Covariate)	3.84	1	3.84	.93	.34
Group (Teaching Methods)	114.39	1	114.39	27.56	.00
Error	228.31	55	4.15		
Total	6789.00	58			
Corrected Total	352.43	57			

Table 8 reveals that the F-calculated value of pretest (that the covariate) is 0.93 with p-value of0.34 which is greater than 0.05.This shows that there is no significant difference in the pretest. The table also reveals that F-calculated value for teaching methods (1, 55) is 27.56 with p-value of 0.00. Since the p value of 0.00 is less than 0.05, the null hypothesis is therefore rejected. Meaning there is significant difference between the mean achievement scores of students taught drilling process with constructivist method and those taught with lecture method. This shows that there is a significant difference in effectiveness of constructivist and lecture teaching method in teaching drilling process.

4.2Findings of the Study

The following were the findings from the study based on the data collected and analyzed and hypotheses tested.

1. Constructivist teaching method yieldedbetter result than lecture method in teaching measurement and marking in technical colleges in Yobe State.
2. Constructivist teaching method yielded better result than lecture method in teaching arc and gas welding in technical colleges in Yobe State.
3. Constructivist teaching method yielded better result than lecture method in teaching casting process in technical colleges in Yobe State.
4. Constructivist teaching method yielded better result than lecture method in teaching drilling process in technical colleges in Yobe State.
5. There is a significant effectbetween constructivist and lecture teaching method in teaching measurement and marking out.
6. There is a significant effect between constructivist and lecture teaching method in teaching arc and gas welding.
7. There is a significant effect between constructivist and lecture teaching method in teaching casting process.
8. There is a significant effect between constructivist and lecture teaching method in teaching drilling process.

4.3 Discussion of Findings

The discussion of the findings is presented in line with the research questions and the hypotheses tested.

In answering research question one, the finding revealed that the main effect of constructivist teaching method on students' achievement on measurement and marking out is higher than the main effect of lecture method. It means that constructivist method is the better teaching method. Also, Analysis of covariance was used to test the first hypothesis. F-value is 38.96, Significance of F is 0.00 and confidence level of .05 which implies that there is a statistically significant difference between the main effect of constructivist teaching method and lecture method on students achievement confirming that the difference in the effectiveness of the two methods is statistically significant. The implication of this finding is that constructivist teaching method, in which students are actively engaged in teaching and learning process is more effective than lecture method in enhancing students' achievement on measurement and marking out of metalwork concepts. The findings that constructivist teaching method has positive effect on students achievement is

similar to the finding of Peter, Abiodun and Oke (2010) that carried out a study on effects of constructivism instructional approach in teaching mechanical related trade subject in western Nigerian technical colleges and found that students taught with constructivism instructional approach scored higher in the post-test than those taught with conventional method which signifies that the components of constructivism instructional approach such as concept cooperative work lead to higher academic achievement in General Metalwork than the conventional method. It is also in agreement with the findings of Akanwa and Ovute (2014) who revealed that students that were taught physics with constructivist method performed better than their counter partswho were taught using conventional method of teaching. A possible explanation for the effectiveness of the constructivist method is the students' active involvement in learning process.

For research question 2, the mean gain difference was 9.09 for group taught with constructivist method and 4.04 for group taught with lecture method. This implies that the students taught arc and gas welding with constructivist method performed better in the achievement test than those taught with lecture method. Meaning that, constructivist method is the better method of teaching arc and gas welding to metalwork students. While for the hypothesis 2, calculated F-value is 97.17, F. significant (p-value) is 0.00 which is less than .05, this implies that the different between the performance of the two group is statistically significance, which equally means that there is a significant effect of constructivist method in teaching arc and gas welding. This is in line with the findings of Musa and Hassan (2015) conducted a study on effect of using constructivist instructional approach on students' academic achievement in Auto mechanics in Yobe state technical colleges. They found that during the pre-test, both groups were found to posses equivalent entry behavior, and in post-test experimental group (those that were taught using constructivist method) performed better than the control group (those that were taught using lecture method of teaching. A possible explanation for the effectiveness of the constructivist method is the shift from teacher centered to student-centered in learning process. Ukpongson and Ezekoye (2015) maintained that for developing country like Nigeria to meet the needs of today's workforce TVET programme must move away from teacher-centered learning environment to one where students have the primary responsibility and play an active role in their learning. It is also in line with Jack (2017) found that the shift from the teacher-centered method of teaching to student-

centered activity based method encourages and develops in the students the spirit of inquiry and thereby improves their performance. The hypothesis tested which found that there is significant difference in the effectiveness of the two teaching methods in teaching arc and gas welding, agrees with the finding of Duyilemi and bolajoko (2014) statistically confirmed that there is statistically significant difference in performance of biology students that were taught with constructivist teaching method and those taught with lecture method.

In answering research question three, the findings revealed that mean gain (8.02) of constructivist teaching method on metalwork students' academic achievement on casting process in MWAT is higher than the mean gain (5.84) of lecture teaching method. This establishes that students that were taught casting process with constructivist teaching method performed better due the effectiveness of the method. Analysis of covariance presented for the hypothesis 3 confirmed that the difference between the main effects of (constructivist teaching method and lecture teaching method) on metalwork students' achievement on casting process is significant. Meaning the null hypothesis has been rejected. This affirmed the finding of Oguguo (2015) that carried out a study on effects of constructivist method of teaching on students' achievement in financial accounting. Specifically to determine the mean achievement scores of SS2 students taught with constructivist and lecture teaching method. Oguguoused ANCOVA statistical tool at arrived at; those that taught financial accounting using constructivist instructional approach perform better than the control group in achievement test. This finding is similar to what had been arrived in this study. The significant difference is attributed to the treatment given to the treatment group assigned to constructivist teaching method in which students worked together as a group. This agrees with the statement of Har (2013) that one of the advantage of constructivist teaching method which can make it to be effective and better compare to other conventional methods, is collaborative nature of the methods. Learners in constructivist teaching collaborate to arrive at a shared understanding of truth in a specific field through scaffolding.

The findingwith regard to research question four revealed that students taught drilling process with constructivist method performed better than those taught with lecture method. This shows that the use of constructivist method in teaching drilling process improved students' academic achievement than teaching with lecture method. Low achievement of the students taught using lecture method can be attributed to the

method. Faruq (2012) stated that lectures are often forgotten by the students soon unlike other students-centered methods and the attention level of students is not the same while listening the lecture. Once there was no proper attention during teaching, students can hardly retained what they have been taught and retrieve it during evaluation. In addition, analysis of covariance was used for testing the fourth hypothesis. The F-value is27.56while Significance of F is 0.00 which is less than .05. It means there isa significant difference between the mean score of students taught drilling process with constructivist teaching method and those taught with lecture method in the achievement test confirming that the difference between the effectiveness of constructivist teaching method and lecture method is statistically significant. This is in agreement with the finding of Ndubuisi (2016) who through statistical tools ANCOVA as used in this study, confirmed that students taught social studies with constructivist teaching performed better than those taught with lecture method, and that the different is statistically significant.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The main purpose of this study was to investigate the effects of constructivism method of teaching on technical college students' academic achievement in metalwork in Yobe State. Specific objectives of the study were to determine the mean academic achievement scores of metalwork students taught some conceptsin metalwork with constructivists' teaching approach and those taught with lecture method in technical colleges in Yobe State. These concepts are; Measurement and marking out; Arc and gas welding; Casting processes and Drilling process. To fulfill these objectives, four research questions and four were formulated in line with the purposes.

The study reviewed constructivist theory of learning as the study itself is related to the theory. The concepts of metalwork technology as well as the nature of technical colleges in Nigeria were partially revived. It also reviewed the meaning, importance, advantages and disadvantages of the instructional methods being addressed by this study. The review of related literature also gave broad spectrum of various methods of teaching in technology education. A number of relevant and related literature by different authors were reviewed on the research problem. The population for the study comprised all the technical colleges in Yobe State. The target population comprised all the Year two metalwork students of the technical colleges. The sample consisted of 58 metalwork students. Purposive sampling technique was used to select two out of eight technical colleges. The Year two intact classes were used for the research exercise. The students in each of the intact class constituted the sample used for the study. Therefore, the intact class selected in each of the technical college chosen for the study served as either experimental or the control group.

The instrument for data collection was Metal Work Achievement Test (MWAT). The data collected were used to answer the four research questions using the mean and standard deviation. Similarly, the four null hypotheses were statistically

tested at a significant level of 0.05, using the Analysis of Covariance. This study established that, constructivist teaching method is more effective than lecture teaching method on metalwork students' academic achievement on measurement and marking out; Arc and gas welding; Casting process; and Drilling process in MWAT. Furthermore the study found that there is statistically significant difference in the academic achievement of metalwork students taught metalwork concept with constructivists' teaching method and those taught with lecture method.

The findings of this study have implications for education particularly in teaching metalwork in technical college. The implications of this study border on development of more virile instructional approach for teaching metalwork. The study revealed that constructivist teaching method was superior to lecture method. These results imply that the current instructional approach used in teaching metalwork might have been partly responsible for student's poor performance.

5.2 Conclusion

The study found out that the use of constructivist teaching method is more effective compared to lecture method in improving the academic achievement of metalwork students in the technical colleges. Drawing from the findings of this study, it can be concluded that for metalwork students to do well, constructivist method should be employed in teaching metalwork.This will motivate and promote the interest of the students in terms of achieving good results.It will also encourage parents, and teachers would be proud of using the method as an effective means of teaching Metalwork. Moreover, based on this study, there is a dare need for metalwork teachers in the technical colleges to develop interest in using constructivist teaching method to teach metalwork subjects in the classroom.

5.3 Recommendations

In line with the findings of this study, the researcher proffered the following recommendations:

1. Since this study revealed that constructivist teaching method significantly affected students' academic performance positively than lecture method in this study, it is therefore recommended that Metalwork teachers should be trained in the use of constructivist instructional method in the classroom so as to improve the academic performance of technical colleges students in Yobe State.

2. In training the teachers, workshops, seminars and conferences should be organized by educational administrators of Technical Colleges to enlighten technical teachers and improve their knowledge and skills on the use of constructivist method.
3. National Board for Technical Education (NBTE) should consider review of curriculum for National Technical Certificate in order to incorporate constructivist instructional technique as a method of teaching Metalwork.
4. Yobe State policy makers in the area of technical education should make it compulsory for school authorities/management to adopt constructivist method in teaching Metalwork so that Metalwork teachers can employ the method in the classroom.

5.4 Suggestions for Further Study

Based on the findings of this research study, the researcher made the following suggestions for further studies:

1. Replication of this study in other geo-political zones in Nigeria, particularly with female metalwork students should be sample in the population where available.The title should read as "effects of constructivist teaching method on metalwork students' gender and academic performance in technical colleges".
2. Similar research should be carried out to include other aspects of metal work such as sheet metal working, nonconventional machining, forging etc. In this regard the title of the study should be "effects of constructivist teaching method on metalwork students' academic performance on nonconventional machining processes in technical colleges".
3. Further study should be carry out in other areas of technical subjects such as woodwork, electrical installation, building etc. The study title should be "effects of constructivist teaching method on woodwork students' academic performance in technical colleges".
4. Study should be conducted to sample private technical colleges in the population so as to compare their mean and standard deviation using the constructivist teaching method. The study title should read as "effects of constructivist teaching method on metalwork students'academic achievement in public and private technical college".

5.5 Limitation of the Study

This study, like any other experimental study had its limitations. One of these limitations was students' punctually which can affect the result in the sense that a student can fail in particular question because he was absent when it was taught. Therefore, the research assistants had to call the students to order by enlightening the students on the importance of coming to school early and also the importance of attending lesson regularly. Another limitation was problem of unavailability of teaching and learning materials which the researcher had to provide and also improvise some teaching materials. This can affect the result because improvised material can hardly look like the real object.

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APPENDICES

APPENDIX I
THE GASES USED IN OXYFUEL WELDING AND/OR CUTTING, WITH FLAME TEMPERATURES AND HEATS OF COMBUSTION.

Fuel	**Temperature**		**Heat of Combustion**	
	^{0}C	**^{0}F**	**MJ/m3**	**Btu/ft3**
Acetylene (C_2H_2)	3087	5589	54.8	1470
MAPP[b] (C_3H_4)	2927	5301	91.7	2460
Hydrogen (H_2)	2660	4820	12.1	325
Propylene[c] (C_3H_6)	2900	5250	89.4	2400
Propane (C_3H_8)	2526	4579	93.1	2498
Natural gas[d]	2538	4600	37.3	1000

Source: Groover, (2010)

APPENDIX II
POPULATION DISTRIBUTION IN THE STUDY AREA

S/N	Name of School	Population
1	Government Science and Technical College Potiskum	33
2	Government Science and Technical College Damagum	25
3	Government Science and Technical College Geidam	16
	TOTAL	74

Source: Field survey (2018).

APPENDIX III
LETTER TO PRINCIPAL

Department of Technology Education,

School of Science and Technology Education,

Modibbo Adama University of Technology,

Yola.

6th November, 2018

The Principal,

……

……,

…….

Dear Sir,

PERMISSION TO USE YOUR SCHOOL FOR ACADEMICRESEARCH

I am a post-graduate student in above mentioned school carrying-out a research titled **Effect of Constructivist Teaching Method on Metalwork Students' Academic Achievement in Technical Colleges in Yobe State.** Your school is one of those sampled for the study which will involve only NTC II metalwork students and their teachers.

I therefore request for your permission to carry out this study in your school to get your cooperation and also cooperation of your teachers during the conduct of the research. It will not in any way disrupt your normal school activities and all information obtained will be treated with utmost confidence solely for academic purpose.

Thanks for your anticipated approval and cooperation.

Yours Faithfully,

Dabo Umar Yusuf

(M.TECH/TED/17/1149)

APPENDIX IV
METALWORK ACHIEVEMENT TEST (MWAT)

Instructions: The test consists of four sections, Section A, B, C and D. You are to answer all the questions in each section. All questions carry equal marks.
Time Allowed: 2 ½ hours

Section A (Measurement and Marking out)

1. A measurement between two surfaces is called…….. measurement
   a. Quick
   b. Line
   c. End
   d. Edge
2. …… of length is the comparison of the size of a component or a feature of a component and a known standard of length.
   a. Measurement
   b. Tracing
   c. Reducing
   d. Increasing
3. Line measurement is measurement between
   a. Eight lines
   b. Two lines
   c. Two ends
   d. Eight ends
4. In a workshop when measuring a distance which is greater than 1 metre in length then
   a. flexible steel tapes are used
   b. steel rules are used
   c. try squares are used
   d. combination sets are used
5. The diameter of an object with a ball or cylindrical shape can be measured by
   a. line measurement
   b. end measurement
   c. all of the above
   d. none of the above
6. Steel rules are used when measuring a distance which is ……. in length
   a. more than 1 metre
   b. more than 1000mm
   c. less than 1 metre

d. more than 1000cm

7. Measurement and dimensional accuracy is what permits ……..of parts and components
   a. Distraction
   b. Dressing
   c. Interchangeability
   d. Inter-continuity
8. Steel rule that is mostly used in workshop is engraved with……. units of measurement
   a. Inch and millimeter
   b. Meter and kilometer
   c. Meter
   d. Kilometer
9. Depth of a hole could be measured using
   a. Steel rule
   b. Flexible steel rule
   c. Vernier caliper
   d. None of the above
10. Measurement precedes ……
    a. Marking out
    b. Placing out
    c. Cleaning out
    d. All of the above
11. Micro meter consists of the following parts except
    a. Spindle
    b. blade
    c. Saddle
    d. Adjusting nut
12. Vernier caliper consists of the following parts except
    a. Fixed jaw
    b. Sliding jaw
    c. Vanier scale
    d. Jaw cover
13. Internal diameter can be measured using
    a. Inside measuring faces of vernier caliper
    b. Outside measuring faces of vernier caliper
    c. All of the above
    d. None of the above
14. One of the advantages of vernier caliper over micrometer is …….
    a. It cannot be used for internal and external measurements
    b. It is very expensive
    c. It can be used to measure diameter of up to 4 meters
    d. It can be used for both internal and external measurements

15. A drawing on metal so as to provide guide lines for cutting or folding is called….
    a. Measurement out
    b. Tracing out
    c. Marking out
    d. Cutting out
16. A mark or point which serves as a reference or base for the measurement of other quantities is called ……
    a. Datum
    b. Data
    c. Line
    d. Circle
17. A line which serves as a reference or base for the measurement of other quantities
    a. Point datum
    b. Angle datum
    c. Line datum
    d. Face datum
18. A punch is a marking tool used for……
    a. Drawing lines parallel to the work piece
    b. Making large indent on a work piece for drilling
    c. Drilling a hole on a work piece
    d. None of the above
19. Scriber and punches are mostly made from……
    a. Cast steel
    b. Cast iron
    c. Wrought iron
    d. Tool steel
20. Scriber is used in conjunction with …….. to draw line on metal work piece
    a. Flexible ring
    b. Steel rule
    c. Micrometer
    d. Vernier caliper

Section B (Gas and arc Welding)

21. Gas welding is a…….
    a. Fusion welding operations that burn various fuels mixed with oxygen to give the flame for welding.
    b. Forging welding operations that burn various elements mixed with oxygen to perform welding.
    c. Non fusion welding process that burn various sticks mixed with oxygen to perform welding.
    d. Process that burn various metal mixed with alloy to perform welding.

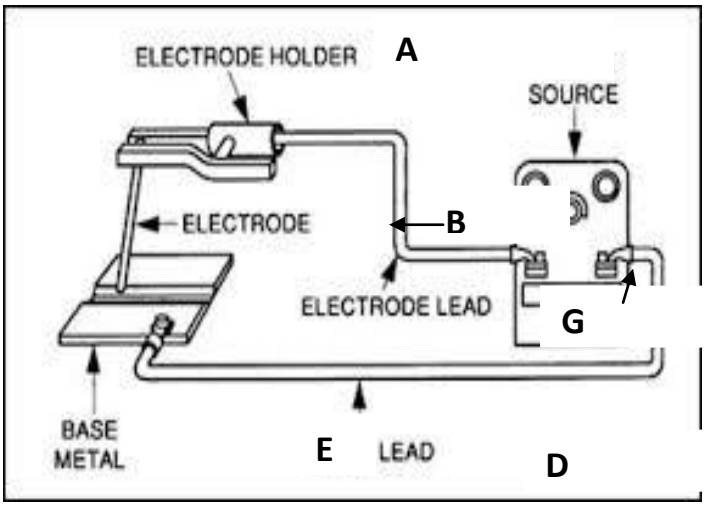
22. Fusion welding process that uses the heat generated by an electric arc to fuse metal in the joint area, this process is called
    a. gas welding
    b. arc welding
    c. forge welding
    d. spot welding
23. Component that takes gases from cylinders to the blow pipe is called…..
    a. Electrode holder
    b. blowpipe
    c. Hoses
    d. Cylinders
24. The following diagram is a …….

    a. Welding torch
    b. Electrode holder
    c. Cutting torch
    d. Spray gun
25. Which of the following term is applied to arc welding process
    a. Filler rod
    b. Electrode
    c. Pressure valves
    d. Regulators
26. ……is a device in arc welding set into which the electrode is placed or fixed
    a. Electrode covering
    b. Electrode holes
    c. Electrode holder
    d. Electrode cable
27. ……. are terms applicable to gas welding process
    a. Slag
    b. Chipping hammer
    c. Pressure valves
    d. Electric cables
28. The cylinder of oxygen is usually painted
    a. Black
    b. Brown
    c. Blue
    d. Maroon
29. For a material to be welded using an arc welding process, the material needs to be

a. Good conductor of electricity
b. Good insulator of electricity
c. Poor conductor of electricity
d. None of the above

30. The cylinder of acetylene in gas welding set is mostly painted
    a. Blue
    b. Maroon
    c. Black
    d. Green
31. Which of the following is not a component of arc welding set
    a. Electrode
    b. Ground cable
    c. Electrode holder
    d. None of the above
32. A hose that is blue in colour in a gas welding set is an ……
    a. Acetylene hose
    b. Oxygen hose
    c. All of the above
    d. None of the above
33. …….. is a device where the fuel gas is mixed with air or oxygen and ignited
    a. Black pipe
    b. Electrode holder
    c. Blow pipe
    d. Blue pipe
34. The following are gas welding equipment except
    a. Hoses
    b. Cylinders
    c. Regulators
    d. Tong

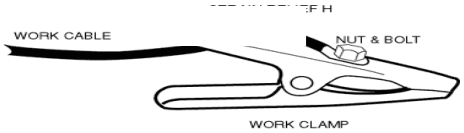
Use the following diagram to answer questions 35 – 38



35. The part labeled ‘A’ is called……..

a. Ground cable
b. Metal plate
c. Source of power
d. Electrode holder

36. The part labeled ‘E’ is a
    a. Source of power
    b. Electrode holder
    c. Metal plate
    d. Electrode
37. The part labeled ‘B’ is a/an
    a. Metal plate
    b. Electrode
    c. Electrode holder
    d. Power source
38. The part labeled with ‘C’ is a/an
    a. Electrode
    b. Electrode holder
    c. Source of electrode
    d. Source of power
39. The following is a sketch of a/an…….



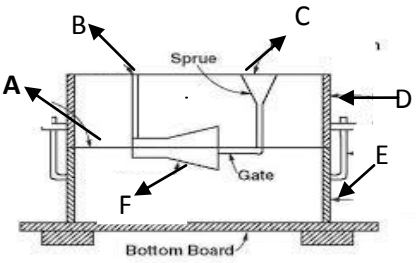
    a. Electrode holder
    b. Work-clamp
    c. Electrode
    d. Cable
40. Gas and arc welding are all examples of
    a. Temporary joint
    b. Permanent joint
    c. Contract joint
    d. All of the above

Section C (Casting Process)

41. In sand casting gases do escape through the
    a. natural porosity of the sand mold
    b. gating system
    c. sprue pin
    d. metal pattern
42. Flow of molten metal by gravity or other force into a mold is referred to as
    a. casting
    b. casting process
    c. cast iron
    d. cast steel

43. A part that is made through casting process is called…..
    a. A machine
    b. An article
    c. A caste
    d. A forging
44. Which of the following statement is not correct about casting process
    a. Casting can be used to produce very large parts.
    b. The casting process can be performed on any metal that can be heated to the liquid state.
    c. Some casting methods are quite suited to mass production.
    d. Casting process does not involve heat
45. One of the advantages of casting as a manufacturing process is that
    a. Complex part geometries, including both external and internal shapes can be created
    b. Complex part geometries, including both external and internal shapes cannot be formed
    c. Welding of large components together in a furnace
    d. None of the above
46. The workers who perform the casting operations in these factories are called
    a. Machinists
    b. Castanists
    c. Foundrymen
    d. Blacksmith
47. A factory equipped for making molds, melting and handling metal in molten form, performing the casting process, and cleaning the finished casting is called
    a. furniture
    b. foundry
    c. casting
    d. casting process
48. Which of the following is not a foundry tool
    a. Sprue pin
    b. Rammer
    c. Shovel
    d. Eraser

Use the following diagram to answer questions 49 - 53



49. The part labeled D is called

a. Riser
b. Sprue
c. Cope
d. Gate

50. The part labeled A is called
    a. Parting line
    b. Riser
    c. Sprue
    d. Drag
51. The part labeled C is called
    a. Pattern
    b. Cope
    c. Pouring basin
    d. Sand
52. The part labeled B is called
    a. Pin
    b. Riser
    c. Drag
    d. Course
53. The part labeled F is the…….
    a. Pattern
    b. Gate
    c. Cope and drag
    d. Parting line
54. In a casting process a tool which is used to remove the excess sand from the top of a molding box is called
    a. Mallet
    b. Rammer
    c. Strike off bar
    d. Sprue pin
55. …… are basically employed in moulding for smoothing or slicking thesurfaces of molds
    a. Rammers
    b. Trowels
    c. Gate cutters
    d. Spirit level
56. The foundry tool below is called

    a. Strike off bar
    b. Trowel
    c. Gate cutter
    d. Spirit level

57. In sand casting the mold cavity is formed by means of a
    a. Pattern
    b. Clearance
    c. Tolerance
    d. Shifting
58. In sand casting process, the cavity in the mold provides the …….. of the mold
    a. Internal surfaces
    b. External surfaces
    c. Internal and external surfaces
    d. None of the above
59. In sand casting process, core in the mold provides the …….. of the mold
    a. External surface
    b. Internal surface
    c. Internal and external
    d. None of the above
60. In a casting mold, the channel or network of channels, by which molten metal flows into the cavity is called
    a. Funnel
    b. Gating system
    c. Riser
    d. Sprue

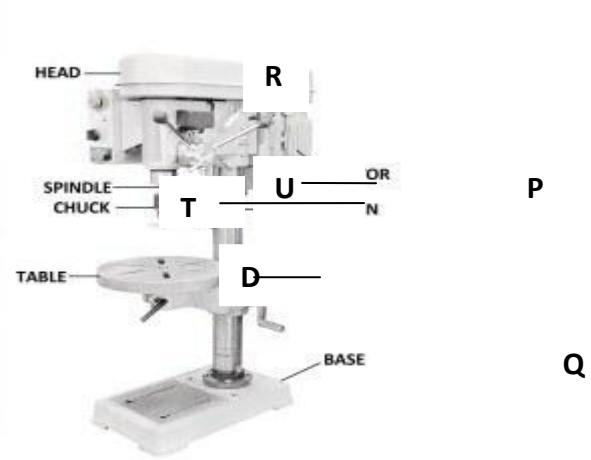
Section D (Drilling Operation)

61. Drilling is a ……
    a. Machining operation used to weld a hole on a work piece
    b. Machining operation used to create a round hole in a work part
    c. Forging operation used to create joint close to a hole
    d. Creation of multiple holes between a joint
62. The tool that is used in drilling operation is called…….
    a. Drill hole
    b. Drillings
    c. Drill bit
    d. Drill operation
63. A part of drilling machine that houses and is responsible for movement of spindle is called……...
    a. Housing
    b. Head
    c. Column
    d. Movable case
64. …….. is responsible for holding and rotating cutting tool
    a. Machine vice
    b. Spindle
    c. Table

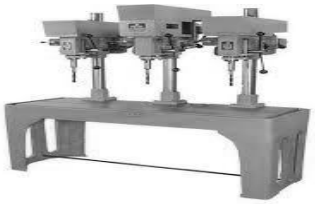
d. Head

65. Which of the following is not part of drill bit
    a. Shank
    b. Flute
    c. Land
    d. Base
66. In drill bit,…… is what permit the passage of chips and cutting fluid
    a. Flute
    b. Shank
    c. Cutting edges
    d. Land
67. A type of drilling machine which is mounted on a table or bench rather than the floor is called …….
    a. Sensitive drill press
    b. Pillar drill press
    c. Upright drill press
    d. Dwarf drill press
68. Which of the following is not a type of drilling machine
    a. Radial drilling machine
    b. Drill press
    c. Gang drilling machine
    d. Readily drilling machine
69. A type of drilling machine that has arm along which the drilling head can be moved and clamped to cut hole on large part is called
    a. Multi-spindle drilling machine
    b. Radial drilling machine
    c. Gang drilling machine
    d. Drill press
70. A type of drilling machine on which a series of drilling and related operations can be accomplished in sequence such as centering, drilling, reaming, and tapping is called
    a. Multi-spindle drilling machine
    b. Drill press
    c. Radial drilling machine
    d. Gang drilling machine

Use the following sketch to answer questions 71 – 73



71. The part labeled with letter ‘P’ is called a
    a. Table
    b. Base
    c. Column
    d. Spindle
72. Base is the part labeled with alphabet
    a. R
    b. D
    c. Q
    d. T
73. The part labeled with alphabet ‘T’ is called
    a. Spindle
    b. Chuck
    c. Base
    d. Drill
74. Which of the following is not a type of drill bit
    a. Twist drill
    b. Low-helix twist drill
    c. High-helix twist drill
    d. Medium-helix twist drill
75. The following diagram is a typical



    a. Radial drilling machine
    b. Gang drilling machine
    c. Sensitive drilling machine
    d. Multi-spindle drilling machine
76. …….. is a process used to slightly enlarge a hole, to provide a better tolerance on its diameter, and to improve its surface finish.

a. Counter bouring
b. Counter sinking
c. Reaming
d. Enlarging

77. Creation of a stepped hole, in which a larger diameter follows a smaller diameter partially into the hole is known as
    a. Counter attack
    b. Counter boring
    c. Counter sinking
    d. Counter drilling
78. Part of drill bit that is directly mounted or fixed to the spindle chuck is called a
    a. Fixed edge
    b. Land
    c. Flute
    d. Shank
79. …….. is an operation which is performed to provide internal screw threads on an existing hole.
    a. Tapping
    b. Topping
    c. Blind hole
    d. Blind drilling
80. The major part of drill press in which transmission of power is carried out is called
    a. Base
    b. Head
    c. Electric motor
    d. Table

APPENDIX V

METALWORK ACHIEVEMENT TEST(MWAT) MARKING SCHEME

The following are correct answers to each question.One (1) mark for each correct answer.

Section A (Measurement and marking out)

1. C
2. A
3. B
4. A
5. C
6. B
7. C
8. A
9. C
10. A
11. C
12. D
13. B
14. D
15. C
16. A
17. C
18. B
19. D
20. B

Section B (Gas and Arc Welding)

21. A
22. B
23. B
24. C
25. B
26. C

27. A
28. A
29. A
30. B
31. D
32. B
33. C
34. D
35. D
36. C
37. B
38. C
39. B
40. B

Section C (Casting Process)

41. A
42. B
43. C
44. D
45. A
46. C
47. B
48. D
49. C
50. A
51. C
52. B
53. A
54. C
55. B
56. C
57. A
58. B
59. B
60. B

Section D (Drilling)

61. B
62. C
63. B
64. B
65. D
66. A
67. A
68. D

69. B
70. D
71. C
72. C
73. B
74. D
75. B
76. C
77. B
78. D
79. A
80. B

APPENDIX VI
LESSON PLAN ONE (1)
TEACHING METHOD:CONSTRUCTIVIST

<table>
<tr><td colspan="2">School: Gov. Sci. & Tech. Coll. Potiskum</td><td>Date: 12th November, 2018</td></tr>
<tr><td colspan="2">Class: NTC II</td><td>Age bracket of students: 15 – 18 years</td></tr>
<tr><td colspan="2">Subject: Metalwork</td><td rowspan="2">Duration of lesson: 70 minutes (double period of 35 minutes)</td></tr>
<tr><td colspan="2">Topic: Measuring and marking out</td></tr>
<tr><td colspan="3">Units:
i. line and end measurement
ii. Uses of measuring tape, steel rule,micrometer, vernier caliper and combination set.
iii. Use of scriber and centre punch
iv. Use of datum line, datum point and datum face</td></tr>
<tr><td colspan="3">Instructional objectives:At the end of the lesson;
i. the students should be able to differentiate between line and end measurement
ii. the students should be able to state the uses of measuring tape, steel rule, micrometer, vernier caliper and combination set.
iii. the students should be able to state the use of datum line, datum point and datum face</td></tr>
<tr><td colspan="3">Previous knowledge: Students have been taught about dimension and units of measurement</td></tr>
<tr><td></td><td>Teacher Activities</td><td>Students' Activities</td></tr>
<tr><td>Time: 10 minutes

Engagement</td><td>Ask students who are already divided into groups of 4-5 to observe the width and length of their note books and the difference between the two. Which one is the shorter and the larger.
Ask students to draw a circle and locate the centre</td><td>Students are expected to do the activity and differentiate them

Draw the circle as ordered by the teacher
They became curious while reporting their experience</td></tr>
</table>

	by making a dot. (Determine students' current understanding, prior knowledge of concept or idea)	and try to find answer of question.
Time: 20 minutes **Exploration**	Give each group a steel rule to measure the length of their note book. They should further measure the distance between two end of the note book Ask the students to mark out the distance they have measured on a separate sheet Present the sketches of micrometer, vernier caliper in used to the students	Start the activity Mark out the distance they have measured on a separate sheet. Observed the shape of object being measured by the micrometer and the vernier caliper. They should also observe the leveled parts of the instrument.
Time: 15 minutes **Explanation**	Interact with the students so that they can understand the presented views and materials. Teacher should help the learners in sharing and relating their observations and explanation to the topic.	Are expected to give explanation of what they have measured and observed on the sketches through interaction with the teacher.
Time: 15 minutes **Expansion**	Teachers assist students expand their mental and motor activities or skills. Assist the students in translating the idea of using pencil to mark the dot and draw the line into using scriber and punch in marking on metal	The students are assisted to revise their views and correct and expand their understanding. They are expected to identify more measurable object beyond the example given to them. Translate the idea of using pencil in to scriber and punch
Time: 10 minutes **Evaluation**	Ask the student evaluative questions on measurement and marking out as follows; i. What is the different between end and line measurement? ii. What is the use of steel rule? iii. When do we use micrometer? iv. State the use of datum line	Respond to the asked questions.

The lesson Plan is developed based on the suggestions and guidelines given by Aydisheh and Gharibi (2015); Singh and Yaduvanshi (2015) on constructivist teaching approach.

LESSON PLAN TWO (2)
TEACHING METHOD: CONSTRUCTIVIST

<table>
<tr><td colspan="2">School: Gov. Sci. & Tech. Coll. Potiskum</td><td>Date: 19th November, 2018</td></tr>
<tr><td colspan="2">Class: NTC II</td><td>Age bracket of students: 15 – 18 years</td></tr>
<tr><td colspan="2">Subject: Metalwork</td><td rowspan="2">Duration of lesson: 70 minutes (double period of 35 minutes each)</td></tr>
<tr><td colspan="2">Topic: Gas and Arc Welding</td></tr>
<tr><td colspan="3">Units:
i. Gas welding equipment and procedures
ii. Arc welding equipment and procedures</td></tr>
<tr><td colspan="3">Instructional objectives:At the end of the lesson;
i. the students should be able to explain gas welding and state its equipment
ii. the students should be able to define arc welding and state its equipment</td></tr>
<tr><td colspan="3">Previous knowledge: Students have been taught about measurement and marking out</td></tr>
<tr><td></td><td>Teacher Activities</td><td>Students Activities</td></tr>
<tr><td>Time: 10 minutes

Engagement</td><td>Ask students who are already divided into groups of 4-5 to identify any breakable objects each group should identify one

Ask students to locate and observe any joint in any of the class metallic furniture.

(Determine students' current understanding, prior knowledge of concept or idea)</td><td>Students will identify the objects and state how these objects can be joined when needed.

Are expected to locate and observed the joint

They became curious while reporting their experience and try to find answer of question.</td></tr>
<tr><td>Time: 20 minutes</td><td>Give a time to students to itemize various means of joining objects they know and the procedure as well as equipment involved</td><td>Start the activity

Study the material and make a group analysis</td></tr>
</table>

Exploration	Present the material containing the equipment and procedures of gas and arc welding to the students	
Time: 15 minutes **Explanation**	Teacher will interact with the students and asked each group to explain what they come up with during the analysis Teacher asked probing questions for the justification of real and virtual images.	Are expected to give explanation of what they have study and analysis in the study.
Time: 15 minutes **Expansion**	Teachers assist students expand their mental and motor activities or skills. Assist the students in relating what they have itemized early and what was presented to them on gas and arc welding.	The students are assisted to revise their views and correct and expand their understanding. The students should relates their previous knowledge with the presented material and construct their understanding
Time: 10 minutes **Evaluation**	Ask the student evaluative questions on gas and arc welding such as; i. what type of welding use electricity as source of heat. ii. List any 3 gas welding equipment iii. What is arc welding	Respond to the asked questions.

LESSON PLAN THREE (3)
TEACHING METHOD: CONSTRUCTIVIST

<table>
<tr><td colspan="2">School: Gov. Sci. & Tech. Coll. Potiskum</td><td>Date: 26th November, 2018</td></tr>
<tr><td colspan="2">Class: NTC II</td><td>Age bracket of students: 15 – 18 years</td></tr>
<tr><td colspan="2">Subject: Metalwork</td><td rowspan="2">Duration of lesson: 70 minutes (double period of 35 minutes each)</td></tr>
<tr><td colspan="2">Topic: Casting process</td></tr>
<tr><td colspan="3">Units:
i. Casting and Sand moulding process
ii. Foundry tools and equipment</td></tr>
<tr><td colspan="3">Instructional objectives: At the end of the lesson;
i. the students should be able to define casting process
ii. the students should be able to list and explain the uses of common foundry tools.</td></tr>
<tr><td colspan="3">Previous knowledge: Students have been taught about arc and gas welding</td></tr>
<tr><td></td><td>Teacher Activities</td><td>Students Activities</td></tr>
<tr><td>Time: 10 minutes
Engagement</td><td>Will present various castings (casted objects) to students who are already divided into groups of 4-5 and ask them to observe it and identify the manufacturing process that were used in producing the object

(Determine students' current understanding, prior knowledge of concept or idea)</td><td>Students are expected to do the activity and identify the process that were used in producing the objects

They became curious while reporting their experience and try to find answer of question.</td></tr>
<tr><td>Time: 20 minutes
Exploration</td><td>Give each group a text material incorporated with sketches.

Ask the students to observe</td><td>Collect the material and observed it.

Mark out the distance they have measured on a</td></tr>
</table>

	and study the text material presented to them.	separate sheet.
Time: 15 minutes **Explanation**	Interact with the students so that they can understand the presented text materials. Teacher should help the learners in sharing and relating their observations and explanation to the topic.	Are expected to give explanation of what they have study and observed on the sketches through interaction with the teacher.
Time: 15 minutes **Expansion**	Teachers assist students expand their mental and motor activities or skills. Assist the students in translating and relating their idea of other manufacturing process with casting	The students are assisted to revise their views and correct and expand their understanding. They are expected to identify more measurable object beyond the example given to them. Integrate casting process knowledge in to their previous idea of manufacturing process
Time: 10 minutes **Evaluation**	Ask the students the following evaluative questions on casting; i. What is casting? ii. List any 4 foundry tools? iii. What is the use of get cutter?	Respond to the questions asked by the teacher

LESSON PLAN FOUR (4)
TEACHING METHOD: CONSTRUCTIVIST

<table>
<tr><td colspan="2">School: Gov. Sci. & Tech. Coll. Potiskum</td><td>Date: 3rd December, 2018</td></tr>
<tr><td colspan="2">Class: NTC II</td><td>Age bracket of students: 15 – 18 years</td></tr>
<tr><td colspan="2">Subject: Metalwork</td><td rowspan="2">Duration of lesson: 70 minutes (double period of 35 minutes)</td></tr>
<tr><td colspan="2">Topic: Drilling Process</td></tr>
<tr><td colspan="3">Units:
i. Drilling machines
ii. Drilling related operations</td></tr>
<tr><td colspan="3">Instructional objectives:At the end of the lesson;
i. the students should be able to state various drilling machines
ii. the students should state drilling related operations</td></tr>
<tr><td colspan="3">Previous knowledge: Students have been taught about casting process</td></tr>
<tr><td></td><td>Teacher Activities</td><td>Students Activities</td></tr>
<tr><td>Time: 10 minutes
Engagement</td><td>Present metal plate incorporated with holes to students who are already divided into groups of 4-5 and ask them to observe it and state the process that was used in creating the holes.

(Determines students' current understanding, prior knowledge of concept or idea)</td><td>Students are expected to observe and identify the process that were used in producing the holes

They became curious while reporting their experience and try to find answer of question.</td></tr>
<tr><td>Time: 20 minutes
Exploration</td><td>Give a time to students to itemize various objects they know which contained a hole.

Present a text material containing the explanation</td><td>Start the activity

Study the material through interaction with each other within the group and make a collective analysis on</td></tr>
</table>

	and sketches of various drilling machines; and drills.	material.
Time: 15 minutes **Explanation**	The teacher will interact with the students and asked each group to explain what they come up with during the observation Teacher will ask probing questions for the justification of students' understanding	Are expected to give explanation of what they have study and analyses in the study.
Time: 15 minutes **Expansion**	Teachers should assist students expand their understanding and activities. Assist the students in relating what they have identified early and what was presented to them on gas and arc welding.	The students are assisted to revise their views and correct and expand their understanding. The students should relates their previous knowledge with the presented material and construct their understanding
Time: 10 minutes **Evaluation**	Ask the students evaluation questions on drilling operation such as; i. What is drilling operation ii. what is the difference between pillar and sensitive drilling machine; iii. list any four parts of drilling machine	Respond to the questions asked by the teacher.

APPENDIX VII
LESSON PLAN ONE (1)
TEACHING METHOD: LECTURE

School: Gov. Sci. & Tech. Coll. Damagum
Class: NTC II
Subject: Metalwork
Topic: Measurement and marking out
Time allowed: 70 minutes (double periods of 35 minutes)
Age bracket of students: 15 – 18 years
Date: 13th November, 2018

Entry Behaviour: The students have been taught about dimension and units of measurement

Behavioural Objectives: At the end of the lesson the students should be able to:

i. Differentiate between line and end measurement
ii. State the uses of measuring tape, steel rule, micrometer, vernier caliper and combination set.
iii. State the uses of datum line, datum point and datum face

Teaching aids: Writing board, chalk/marker and steel rule

Introduction: The teacher introduces the lesson by asking the students the following questions based on their previous knowledge while students are expected to listen and respond to the questions;

i. What is dimension
ii. List any two units of measurement

Lesson Presentation: The teacher will present the lesson through the following steps;

	Teacher activity	**Students activity**
Step One:	The teacher will define measurement and explain the different between line and end measurement. The teacher will	Students are expected to listen and ask questions when necessary

	pause and allow students to ask questions	
Step Two:	The teacher will explain and describe to the students the parts and uses of measuring tape, steel rule, micrometer, vernier caliper and combination set. The teacher will pause and allow students to ask questions	Students are expected to listen and ask questions when necessary
Step Three:	The teacher will explain to the students the use of datum line, datum point and datum face. The teacher will pause and allow students to ask questions.	Students are expected to listen and ask questions when necessary
Evaluation	The teacher will evaluate the lesson by asking the students the following questions based on the lesson taught to them; i. What is line measurement ii. List two main parts of micrometer iii. What is the use of verniercalliper	Students are expected to listen and respond to questions ask by the teacher.
Summary and conclusion:	The teacher will give highlights of the whole lesson through emphasizing on the important areas.	

The lesson Plan is developed based on the suggestions and guidelines given by Mele (2018) on drafting of lesson plan.

LESSON PLAN TWO (2)
TEACHING METHOD: LECTURE

School: Gov. Sci. & Tech. Coll. Damagum
Class: NTC II
Subject: Metalwork
Topic Gas and Arc Welding
Time allowed: 70 minutes (double periods of 35 minutes)
Age bracket of students: 15 – 18 years
Date: 20th November, 2018

Entry Behaviour: The students have been taught about temporary and permanent joints in metalwork

Behavioural Objectives: At the end of the lesson the students should be able to:

i. The students should be able to explain gas welding and state its equipment
ii. The students should be able to explain arc welding and state its equipment

Teaching aids: Writing board, chalk/marker, a piece of metal contain weld

Introduction: The teacher will introduce the lesson by asking the students the following questions based on their previous knowledge while students are expected to listen and respond to the questions;

i. What are the example of permanent joint
ii. List any material that could be joined permanently.

Lesson Presentation: The teacher will present the lesson through the following steps;

	Teacher activity	**Students activity**
Step One:	The teacher will define gas welding and explain its principles of operation. Gases that are used in gas welding and their application will also be explained	Students are expected to listen and ask questions when

	by the teacher. The teacher will pause and allow students to ask questions	necessary
Step Two:	The teacher will list and explain all the component and equipment that are used in gas welding set. Examples cylinders, regulators, blow pipe, etc. The teacher will pause and allow students to ask questions.	Students are expected to listen and ask questions when necessary
Step Three:	The teacher will define arc welding and explain its principles of operation. The teacher will also explain the constituents of arc welding set such as electrode holder, electrodes, chipping hammer etc. The teacher will pause and allow students to ask questions	Students are expected to listen and ask questions when necessary
Evaluation	The teacher will evaluate the lesson by asking the students the following questions based on the lesson taught to them; i. What is gas welding ii. State components that made up a gas welding set iii. What is the source of heat in arc welding iv. Mention any material that can be arc welded	Students are expected to listen and respond to questions asked by the teacher.
Summary and conclusion:	The teacher will give highlights of the whole lesson through emphasizing on the important areas.	

The lesson Plan is developed based on the suggestions and guidelines given by Mele (2018) on drafting of lesson plan.

LESSON PLAN THREE (3)
TEACHING METHOD: LECTURE

School: Gov. Sci. & Tech. Coll. Damagum
Class: NTC II
Subject: Metalwork
Topic Casting process
Time allowed: 70 minutes (double periods of 35 minutes)
Age bracket of students: 15 – 18 years
Date: 27th November, 2018

Entry Behaviour: The students have been taught about machining and forging as manufacturing processes.

Behavioural Objectives: At the end of the lesson the students should be able to:

i. Define casting process.
ii. State the uses of common foundry tools.

Teaching aids: Chalkboard/white board and chalk/marker sample of casted object,

Introduction: The teacher will introduce the lesson by asking the students the following questions based on their previous knowledge, while students are expected to listen and respond to the questions;

i. What are the three ways in which a metal object could be produce

Lesson Presentation: The teacher will present the lesson through the following steps;

	Teacher activity	**Students activity**
Step One:	The teacher will define casting as a manufacturing process and it is types. The teacher will pause and allow students to ask questions	Students are expected to listen and ask questions when necessary
Step Two:	The teacher will list, explain and describe the uses of foundry tools and equipment. The teacher will pause and allow students to	Students are expected to listen and ask questions when necessary

	ask questions	
Step Three:	The teacher will explain to the students the processes that are involved in sand casting process. The teacher will pause and allow students to ask questions	Students are expected to listen and ask questions when necessary
Evaluation	The teacher will evaluate the lesson by asking the students the following questions based on the lesson taught to them; i. What is casting ii. List three foundry tools and state their uses. iii. What is sand mould casting	Students are expected to listen and respond to questions asked by the teacher.
Summary and conclusion:	The teacher will give highlights of the whole lesson through emphasizing on the important areas.	

The lesson Plan is developed based on the suggestions and guidelines given by Mele (2018) on drafting of lesson plan.

LESSON PLAN FOUR (4)
TEACHING METHOD: LECTURE

School: Gov. Sci. & Tech. Coll. Damagum
Class: NTC II
Subject: Metalwork
Topic Drilling Process
Time allowed: 70 minutes (double periods of 35 minutes)
Age bracket of students: 15 – 18 years
Date: 4th December, 2018

Entry Behaviour: The students have been taught about punching in sheet metalwork.

Behavioural Objectives: At the end of the lesson the students should be able to:

i. The students should be able to state various drilling machines
ii. The students should state drilling related operations.

Teaching aids: Writing board, chalk/marker and piece of metal plate contained a hole

Introduction: The teacher will introduce the lesson by asking the students the following questions based on their previous knowledge while students are expected to listen and respond to the questions;

i. What is hole
ii. How can a hole be created on a sheet metal work piece

Lesson Presentation: The teacher will present the lesson through the following steps;

	Teacher activity	**Students activity**
Step One:	The teacher will define drilling operation and explain it in detail. The teacher will pause and allow students to ask questions	Students are expected to listen and ask questions when necessary

Step Two:	The teacher will explain and describe various drilling machine using chalkboard. The teacher will pause and allow students to ask questions	Students are expected to listen and ask questions when necessary
Step Three:	The teacher will explain to the students the various drills and their applications. The teacher will pause and allow students to ask questions.	Students are expected to listen and asked questions when necessary
Step Four:	The teacher will explain the procedures that are involved in drilling operation. The teacher will pause and allow students to ask questions.	Students are expected to listen and asked questions when necessary
Evaluation	The teacher will evaluate the lesson by asking the students the following questions based on the lesson taught to them; i. What is drilling operation ii. List three major parts of drilling machine iii. What is the difference between pillar and sensitive drilling machines	Students are expected to listen and respond to questions asked by the teacher.
Summary and conclusion:	The teacher will give highlights of the whole lesson through emphasizing on the important areas.	

APPENDIX VIII
LETTER TO VALIDATES

Department of Technology Education,
School of Science and Technology Education,
Modibbo Adama University of Technology,
Yola.
27th October, 2018

Dear Sir,

REQUEST FOR VALIDATION OF INSTRUMENT FOR DATA COLLECTION

I am a post-graduate student in above mentioned department carrying-out a research titled **"Effect of Constructivist Teaching Method on Metalwork Students' Academic Achievement in Technical Colleges in Yobe State"**

I hereby write to forward my instrument for data collection for you to validate. Your inputs will be highly considered and be affected.

Attached to this letter are the purposes of the study, research questions and the hypotheses as well as the achievement test instrument (questions) and its answers.

Yours Faithfully,

Dabo Umar Yusuf

(M.TECH/TED/17/1149)

APPENDIX IX

VALIDATION REPORT

S/N	Initial Draft	Validate Comment	What has been done
1.	In draft copy of constructivist lesson plan initially there was no time allocated to each step.	But it has been suggested that time to spent on each step have to be specified to avoid unnecessary waste of time during lesson.	It has been done accordingly
2.	Initially in the general information of all the lesson plans (constructivist and lecture lesson plan) there was students' gender.	Validates suggested that knowing or specifying the students' gender has no any implication on lesson plan.	It has been expunged as suggested
3.	In the draft copy of the MWAT, item 4 and 6 in section A were having same options which was corrected as suggested by one of the validates.	It has been suggested that for two different items to have same options can mislead the test takers.	The options have been changed accordingly.
4	In item 11 of the draft copy MWAT, there was no correct answer to the question.	It was realized by the validates	But it has been corrected accordingly in final copy of MWAT.
5.	Similarly in item 24 of the draft copy MWAT, there were two same options.	As realized by validate.	It was also corrected accordingly in final copy of MWAT.
6.	In addition to the above mentioned corrections and	identified by the validates	All the errors were corrected

	suggestion, there were also some minor corrections such as grammatical errors.	accordingly.