DEVELOPMENT AND USE OF COMPUTER ASSISTED INSTRCUTION (CAI) PACKAGE FOR TEACHING OF METALWORK FORGING IN TECHNICAL COLLEGES IN AKWA IBOM STATE

BY

AKPAN,UDEME PETER

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DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION

FEDERAL UNIVERSITY OF TECHNOLOGY,

MINNA

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A RESEARCH PROJECT SUBMITTED TO THE DEPARTMENT OF INDUSTRIAL AND TECHNOLOGY EDUCATION SCHOOL OF SCIENCE AND SCIENCE EDUCATION, FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

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CERTIFICATION

I Akpan Udeme Peter with Matric Number 2007/1/27247BT an undergraduate student of the Department of Industrial and Technology Education certify that the work embodied in the project is original and has not been submitted in part or full for another diploma or degree of this or any other university.

APPROVAL PAGE

This project has been read and approved as meeting the requirement for the award of B. Tech degree in Industrial and Technology Education of the department of Industrial and Technology Education School of Science and Science Education, Federal University of Technology, Minna.

Supervisor	Sign-date
Head of department	Sign-date
External Examiner	Sign-date

DEDICATION

This project is dedicated to Almighty God for his protection favour, grace and mercies over my life throughout the period of carrying out the research.

Also to my late grandmother, Mrs Nko Udo-Obot Udoma and to my lovely parent, Mr. and Mrs. Peter Akpan Udo.

I pray may the Almighty God protect them and make them to enjoy the fruit of their labour, in Jesus name. (Amen).

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I wish to express my gratitude to my Head of Department, Dr. E. J. Ohize, the Project Coordinator Mr T.M. Saba and my mentor Prof. G. D. Momoh for their efforts and useful administration towards making my training in this institution a success. My gratitude also goes to the lecturers for their diligent lectures which have increase my knowledge in industrial and technology education and its related discipline.

May the Almighty God crown and bless you all.

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ABSTRACT

This study was designed to Develop and use a Computer-Assisted Instructional (CAI) Package for teaching Metal Forging Technology (MFT) in technical colleges level. Two research questions and two research hypotheses were formulated to guide the study at 0.05 level of significance. The study used the post-test only type of quasi experimental research design. Three hundred and fifty students from the participating technical colleges and thirty five metalwork teachers were used as respondents in the study from the ten participating technical colleges in Akwa Ibom. One hundred and fifty students each were assigned to the control and experimental groups respectively. The data obtained from the research instrument, establish the reliability of the research instrument (MFTAT) and conduct item analysis of facility of the test. The micro media flash programming was used to develop the CAI package. Both the control and the experimental groups were taught MFT using the demonstration method and CAI package methods respectively and administered with MFTAT in a post-test. The data from the post-test were analyzed using the mean, standard deviation and Pearson Product moment correlation coefficient to answer the two research questions and the two hypotheses in the study. The study confirmed the CAI package and the research instrument valid and reliable for teaching and testing students in MFT in technical colleges. The study also found that, the subjects in the experimental group performed better than their counterparts in the control.

CHAPTER ONE

INTRODUCTION

Background of the Study

The pursuit of scientific and technological education is imperative for any nation that aspires towards maintaining its independence, sovereignty, ensure sustainable industrial, economic, social and political development and be recognized as a developed nation. Yalams (2002) pointed out that development in science and technology has introduced many new things and is making many others irrelevant in an ever-changing world. All sectors of life be it transportation, communication, shelter, food, entertainment, agriculture, trade and commerce, medical and health, and others in the last decade have witnessed and are still witnessing a lot of transformation as a result of those developments. These changes could not have been possible without the developments in science and technology through education and training.

The importance of science and technology in national development has helped in the high priority accorded these sectors in the educational system of developed nations of the world. Developing nations like Nigeria have no alternative than to take a cue from the developed nations and accord science and technology education an utmost importance in the educational system.

The Federal Republic of Nigeria (FRN, 2004) in the National Policy on Education defined Technical education as a comprehensive term which refers to those processes that involve general education, the study of technologies and related science and the acquisition of skill, attitude, understanding and knowledge relating to occupation in various sectors of economic and social life, it went further to state the goal of technical education, among others, as

to provide the technical knowledge and vocational skill necessary for agricultural, industrial, commercial and economic development of the nation. By the above definition and aim, technical education becomes one of the most important paths towards the realization of the industrial, agricultural and economic development strategies of the nation.

The Encyclopedia American International (1989) describes metalwork technology as one of the most prominent early technical occupation in the history of human civilization, especially in the area of art work design, weapon for wars, tools for farming and hunting. Metal work technology is up to date a popular technical occupation practiced in virtually all parts of the country. Metal work technology is a subject that involves the application of scientific ideas to fabricate and produce objects or items from metallic materials which possess metallic luster, malleability, fusibility, high heat and electricity conductivity characteristic. Examples of the metallic materials are gold, tin, steel, silver, aluminum, lead, copper and others. In technical colleges, students are exposed to the following topics: Bench and Fitting Work, Sheet Metal Work, Forging, Foundry, Machine, Welding and Metal Fabrication. Forging being the oldest among these metal working areas.

The process of metal forging is considered to be the oldest of all metal working productionprocesses. The metal forging process could be traced as far back in the history of the primitive men, who worked metals into various uses in 40000B.C. in Egypt and Asia. They made metal tools, utensils, weapons and others by hammering into various shapes from the heat of an open fire, while some metals can be forged at room temperature, the majority of them are made more suitable for forging by heating to certain higher temperature. Some of the metal forging processes are: cutting, drifting, pummeling, flattering, fultering, tapering, drawing out, swaging, bending, upsetting, extruding and twisting. Forging process is used to produce metal

items of high mechanical properties and great strengthen like crank, shafts, gears, axles, marine equipment, railways equipment, mining equipment, construction equipment, agricultural equipment, etc. Hand forging is the simplest form of forging and use the following tools and equipment to form metals into desired shape and size namely: hammer, swage block, anvils, tongs, anvil tools, purchases, drift.

Despite the way metal work technology is taught to students in the technical colleges, it appears they are faced with some problems of teaching and learning in those technical colleges and such problems have often resulted into poor academic performance by students offering the subject and also low enrolment into these subjects especially the female gender. These trends are among the problem that hinder the contribution of metal work technology to the technological development of the country in particular and national development in general.

Oyedeji (1991) in a research found out that, there are some important factors that affect the academic performance of learners in business education. These factors being, gender of the learner, types of institution, ownership of institution, school environment, etc.Ezeliora (2003) asserted that, science and technology educations have recorded poor academic performance of students in various courses or subject at most of the levels of our educational system over the years.

Zakariyyau (2003), in his study on factors responsible for the poor performance of students in schools, concluded that, the critical factor is the instructional method employed in the teaching process. Instructional methods are the methods or procedures used by the teacher to deliver the lecture or lesson to the students (learners). Zakariyyau also reported that, some of the

methods of teaching usually employed in schools in Nigeria are: lecture method, discussion method, project method, demonstration method, field trip, etc.

The desire to solve these widely acknowledged problems of teaching and learning in our technical colleges and tertiary institutions necessitated the development of a computer-assisted instructional package for teaching metal forging technology (MET) at technical colleges. Awotua-Afebo (1999) defined computer as an electronic device or machine that operates under the control of instruction called programme stored in the memory unit. It accepts data (input), process data, produce result of the data (output) and store the data in its memory or other facilities for future uses. According to Abimbade (1996a) computer-assisted instruction (CAI) is a technique of using computer system to carry out the teaching and learning activities, and it can be with or without the teacher in the teaching environment. The computer system is used in computer-assisted instruction to deliver instruction to the learners or students by allowing them to interact with lesson programmed into the computer system. With the advances in technology and the advent of computerization and digitalization various methods of instruction have been devised and used in teaching and learning to solve most instructional problem in developed countries. Though, in Nigeria, most of these innovations are yet to be fully employed in most institutions, they cause instructional problems. Why should the teaching and learning of technical subject especially metal forging technology continue to suffer as a result of our dependence on and over-usage of predominantly lecture method alone? Can't technical education teacher devise other means by which knowledge and skill could be imported on to the learner taking advantage of the modern technologies? This is the concern of this study.

Statement of the Problem

The Nigerian Governments at various levels, individuals and corporate bodies attach great importance to the teaching and learning of technical education subject in Technical colleges. These emphases have been placed on this area of the educational system to meet the scientific and technological objectives of the nation, among others. Yet, these objectives have not been fully achieved over the years due to some problems centrally bordering on teaching methodologies, among others in the Technical Colleges in Nigeria is widely being criticized. Its criticisms mostly surround its failure to meet the demands of students in learning practical skills, among others (Adigun, 1997 and Nnaobi, 2003). The failure of this method of instruction has resulted into ineffective teaching, low learnig poor academic performances by the students, low learning rate, retention and poor performances on the job and making the realization of the scientific and technological objectives of the educational system becomes a mirage, or very difficult to achieve.

In view of these ailing problems, the search for a modern and appropriate alternative teaching approach becomes of utmost importance, which has necessitated this study: "The Development of a Computer-Assisted Instructional Package for Teaching Metal Forging Technology at the Technical Level". It is widely accepted that, computers can improve teaching and learning, students' academic performances, teachers' efficiency and effectiveness through the use of Computer-Assisted Instruction (CAI) in schools and colleges (Abimbade, 1996a). Therefore, improving teaching and learning activities especially In Metal Forging Technology with the use of Computer Assisted Instructional Package is the main focus of this work.

Purpose of the Study

The main purpose of this study is to develop and use a Computer-Assisted Instruction Package for teaching Metal Forging Technology in Technical Colleges. Specifically, the study is designed to:

1. Compare the academic performances of the students taught MFT with the CAI package based on gender.
2. Compare the academic performances of the students taught MFT with the CAI package and that of the students taught with demonstration methods .

Significance of the Study

The findings of this study will provide empirical data on the improvement of academic performances of students in the study of Metal forging Technology. This will be owed to the use of a modern, interesting and effective method of instruction, that is, the Computer-Assisted Instructional Package. Students learning rates and retention will also be enhanced and they will be active participants in the teaching and learning processes since learning with computer system is student-centered, pleasurable and fascinating. The number of students that will transit to the university, for the degree programme will be enhanced as a result of improvement in their academic performances. Also, students will become computer literate when exposed to the teaching of Metal Forging Technology with the use of Computer-Assisted Instructional Package.

This study will make comparisons on the academic performances and interests of students to the study of Metal Forging Technology based on gender. The results of these comparisons will provide an empirical data for the principals of technical colleges, educationists, parents, researchers and others, on the areas of focus for further researches and development.

The result of this study will provide accurate, valid and reliable tests and examination scores which will be safely stored in the computer systems as the learners (students) interact with the CAI Packages. This will encourage the technical college authorities to adopt the Computer-Assisted Instructional Package for the reliability, validity and security of their students' academic records.

The use of Computer-Assisted Instructional Package for teaching will enhance the efficiency and the effectiveness of the teachers in performing their jobs and relieve them of some mundane tasks (Onasanya, 2000). These benefits will also arouse the interests of teachers to embrace Computer-Assisted Instruction (CAI), as a worthwhile alternative approach towards effective teaching other than the lecture method. Also, teachers involved in the use of Computer-Assisted Instructional Package for teaching will become computer literate.

The result of this study will provide information on improvement in the academic performances of the students which will translate into improvement on-the-job performances of the graduates of Technical programme. The government will in turn be achieving some of the objectives of the National Policy on Education, National Committee on Computer Education, the Technical programme and other policies geared towards the scientific and technological development of the nation.

Assumptions for the Study

It was assumed in this study that:.

1. The teachers and students to be used for the study would have adequate computer literacy level for the teaching and learning of Metal Forging Technology with Computer-Assisted Instruction package.

2. The technical colleges to be used for the study would have adequate facilities for teaching and learning Metal Forging Technology with Computer-Assisted Instruction Package and demonstration methods.

Research Questions

1. What is the academic performance of male and female students when taught MFT with CAI package?
2. What is the academic performance of students when taught MFT with CAI packageand that of the students taught with demonstration methods Technical colleges?

Research Hypothesis

The following null hypotheses are formulated to be tested at 0.05 level of significance in the study:

1. There is no significant difference in the mean responses of students taught Metal Forging Technology with Computer-Assisted Instructional Package and those taught with the traditional lecture method.
2. There is no significant difference in the mean performances of male and female students taught Metal Forging Technology with Computer-Assisted Instructional Package.

Delimitation 0f the study

The study is delimited to:

1. The Technical students in AkwaIbom State that have facilities for teaching and learning Metal Forging Technology using Computer-Assisted Instruction Package method
2. Only the following topic of the Technical 1-3(General Metalwork) in Metal Technology. Forging will be used in the study;

a. Introduction and safety in metal forging technology

b. Forging tools and equipment\

c. Method of forging

d. Forging processes

CHAPTER TWO

LITERATURE REVIEW

Introduction

Literature related to the study was reviewed under the following sub-headings

1. Development of Technical Education
2. Computer Assisted Instruction(CAI)
3. Methods of Teaching Technical Education
4. Computers in Education
5. Measurement and Evaluation in Technical Education

6. Summary of Literature Review

Development of Technical Education

There is no dispute in the fact that, technical education had a late formal beginning in Nigerian educational system. This could be attributed to its earlier rejection by the early educational planners and administrators who could not see the need for a formal training of technical education personnel for the economy and the society.

Prior to the introduction of formal western education in Nigeria in 1892 by the then colonial masters, the different ethnic groups in Nigeria were involved in one form of technical occupation or the other. These groups and communities had different ways of training their citizens for production of different materials and services in different occupations such as brewing, building, carving, spinning, hair dressing, pottery, mining, herbalist, agriculture, iron-smiting, etc. These trainings were carried out informally along the family or community line using the apprenticeship system. These handicrafts as practiced in various communities formed the rudiments of technical as offered in the schools and colleges in Nigeria today (Ali, 2000).

Formal technical teacher education started in 1962 with a project for training teachers at the Yaba Technical College, Lagos. The project as sponsored by the International LabourOrganisation (ILO) and the United Nations Development Project (UNDP). At the end of the project in 1966, the Federal Government decided to have permanent institutions for technical education. This led to the establishment in 1967 of the National Technical Teachers College (NTTC) at Akoka-Lagos. The National Technical Teachers College was established to produce technical teachers for the manpower needs of the country. The need to increase the production of technical teachers for technical education led to the establishment of another NTTC located at Gombe. These institutions were involved in the training of technical teachers leading to the award of NCE and Technical Teachers Certificates (TTC). The NCE programme was for those that just completed secondary schools and technical colleges with ordinary level qualifications. The TTC was for those who wish to become professional teachers and have a certificate or diploma in their areas of specialization. These colleges were later converted to Federal Colleges of Education (Technical). In 1981, the Federal Government in another move introduced the Technical Teachers Training Programme (TTTP). The TTTP started with an award of scholarship to candidates for training as technical teachers in the United States of America. About 1,819 Nigerians benefited from this programme between 1981 – 1990. For reasons of costs effectiveness, the TTTP (USA) was stopped and domesticated the training in tertiary institutions in Nigeria since 1991 to date (Nwanoruo, 1998).

The progress made so far in the development of technical education in the area of training of teachers in Nigeria is remarkable. Since the global development in sectors of human endeavour is dynamic, to keep pace with the time more progress is still expected in the

development of technical education. Okorie (2001) suggested the following areas for further development of technical education to meet the demands of individual and society:

i. Schools and their programmes should be developed based on the occupational areas of needs of the country.

ii. The administration and supervision of technical education institutions and programmes should be the kind that will be helpful to the Nigerian society.

iii. Adequate fund should be provided to meet all the demands of the institutions and programmes in terms of quality and quantity.

iv. Curriculum, facilities and instructions should satisfy the needs of students and the society.

v. Research studies should be carried out on curriculum, facilities, instructions and other areas and reforms should be based on the results from the study.

Computer-Assisted Instruction (CAI)

Computer-Assisted Instruction (CAI) is the use of computer that has been programmed with instructional materials for teaching and learning. Akinyemi (1991) defined CAI as an automated instructional programme to a learner through an interactive process. The activities of CAI include presenting materials or problem situations, guiding students thinking, responding to students' questions, assessing students' performances, managing students' path through a course by selecting the materials to be presented assigning tasks to be performed and any combination of the above functions. The CAI is designed and presented in a way to gain the attention of the learner from the beginning of the learning process and to sustain and maintain the attention

through appropriate programming and the stimulus response chain of activities. It assumes direct instructional role, therefore divorces the learner from the instructor through deliberate programming. The CAI can be made to respond to the educational needs of both the able and disabled learners alike. CAI holds great promise for teaching and learning in schools especially that its functions can be limited by man. Similarly, Abimbade (1996a) stated that, CAI increase the time learners devote to learning, enhance speed of availability of data and information, and identify areas of learning strengths and weaknesses. It assists less qualified teachers, increase learners academic progress and teacher efficiency and effectiveness among others.

Characteristics of CAI:

The following features characterize the computer-assisted instruction (CAI) as a medium of teaching and learning in schools:

i. **Learner control instruction:** Proper uses of individualization of instruction in CAI enhance students' control of the instructional process in accordance to his ability and other factors.

ii. **Feedback to the learners (students):** This is the most impressive characteristic of the CAI which the computer renders to the learners. Two types of feedback are built into any programme, namely: the immediate feedback and the delayed feedback.

iii. **Self-pacing:** The CAI is a form of individualization mode of learning whereby the learner goes through the learning activities according to his/her own speed and ability. A learning activity may be timed to see if students are able to respond to the learning tasks within appropriate time frame.

iv. **Adaptability of instruction:** This is the ability of CAI to be modified or changed in method of instruction or content of instruction to meet the needs, abilities or interests of the students.

v. **Lessons with more than one purpose:** A multipurpose lesson allows one learning activity to be used to teach any one of the several different objectives.

vi. **Multiple user characteristics:** Many students can use the same lesson at one time.

vii. **Random access:** The CAI has the random access generator facility which enables it to present students with a variety of entry points of the lessons.

viii. **Editorial ease and revision:** The CAI provides a dynamic instructional thoroughness and modification flexibilities. The possibility of constant updating and improvement of instructional materials makes it the most supreme and dynamic of all learning methods. This provision will make the lesson materials current, up-to-date and keep to the technology or societal development (Akinyemi, 1991).

CAI packages (programme)

Computer-Assisted Instructional packages or programmes are set of instructions written by programmers for processing educational tasks or services. Hence CAI packages are softwares or course wares that are written in computer languages and acts as an interface between the computer user or learner and the computer system and vice versa. The coursewares are usually written in author languages to present the learning materials to the students when he interacts with the computer system. There are several CAI coursewares or packages available for different educational applications like, PLATO, PILOT, LOGO, TUTOR, NATAL and others. Some can be purchased and adapted for teaching different subjects and other are specifically developed for certain applications only. PLATO Package: PLATO is one of the most widely

used CAI package for simulation modes. PLATO, the acronym for the Programmed Logic for Automated Teaching Operations is a CAI package developed at the Computer-Based Education research Laboratoy at the University of Illinois, Urbana-Champaign, U.S.A. It began with PLATO I Project in 1960, funded by the National Science Foundation of America (NSF) (International Dictionary of Information Technology, 1995).

Oshea and Self (1988) said that the aims of PLATO IV project were to demonstrate the technical feasibility of a truly novel computer based education network; prove that the system is manageable, economically viable, and capable of serving a variety of instructions at any educational level. Also to develop curricular materials for the new medium and develop acceptance by instructors, users and students of a new medium designed for increasing the effectiveness and productivity of the instructional process.

PILOT Package: PILOT is the acronym for Programmed Iniquity Learning or Teaching was created by John Starkweather at the University of Californic at San Francisco Medical Centre, U.S.A. in 1968. It was developed as a special-purpose language for the development of CAI materials. The language was originally conceived as an elementary authoring language created for teachers, writers, students or other non-professionals to use for developing instructional materials and administration of students testing and lessons. PILOT was one of the early attempts at combining lessons presentations, testing and interactive response that educational personnel could use without extensive programming knowledge. The strength of PILOT lies with its ease of use and non-technical appearance. It is easy for users to create screen displays such as “True” or “False”, “Wrong” or “Right”, etc. Its weakness resides in its inability to drive sophisticated file-handling routines and complex numerical computations (West and Lording, 1989).

Gambari (2003) said new coursewares are being developed to meet various teaching, learning and training needs. Example of these programmes is the Visual FoxPro Programme (Package) which possess the following characteristics, among others:

i. It is easy to write, understand and user-friendly.
ii. It provides easy access to all information.
iii. It has high quality graphical user interface.
iv. It is easy to debug, revise and maintain.

The problems of using CAI in schools

As good as the CAI is as an innovation in the education sector, it faces a lot of challenges in its use in schools in developing countries like Nigeria. Owoicho, Agunloye and Atabo (2004) stated the following as problems militating against the effective use of CAI for teaching and learning science, technology and mathematics in Nigeria:

i. **Computer illiteracy:** Many teachers and students in Nigeria today are not computer literate despite the government efforts towards the implementation of the reports of the committee on computer education in Nigeria.
ii. **Lack of awareness of benefit of CAI:** Many citizens of Nigeria, students, teachers, parents and others are not aware of CAI in teaching and learning in schools. Some teachers, students, etc. shun the use of CAI for teaching and learning since they are not aware of the benefits.
iii. **High cost of CAI hardware and software:** The introduction of CAI in schools will require the availability of computer hardware and software in adequate quantity and quality for the schools and students. The global economic problems and the meager

fund usually allocated to schools cannot supply and maintain the number and quality of computers required.

iv. **Poor quality of electricity power and telecommunication facilities:** The erratic supply of electricity power and telecommunication services for running the computers and other electronic gadgets pose a serious threat to the use of CAI in schools in Nigeria. These equipment can only function when there is regular and adequate supply of electricity power and telecommunication services.

The prospects of using CAI in schools

Despite the numerous problems that have stood against the use of CAI in schools in Nigeria, there is hope for bright future of acceptance and effective use of CAI in schools. This is possible because of global campaigns, cost-effectiveness of the CAI and the need to catch up with the rest of the world in the area of use of information and communication technology (ICT).

Abimbade (1999) stated the following areas to hold high prospects for use of computers in schools in Nigeria for teaching and learning:

i. Remedial programmes for students who have fallen behind in their studies. Such students are ignored in the conventional classes today and they increase the failure and attribution rates of students.

ii. Use of simulation and tutorial programmes in teaching science and technology-related areas to replace or supplement the costly science and technology equipment, machines, materials and other facilities. In many of these subject areas, practical are difficult if not impossible to hold in schools due to shortage of these facilities and materials.

iii. Higher education courses in Nigeria are usually characterized by very high teacher to students'ratio and others that do not have enough qualified teachers pose serious problems to the development of the sector. The efforts in this direction will encourage the use of CAI for teaching and learning in future to solve these problems.

iv. Distance learning: Nigerian government in its efforts to provide education for all citizens in the past ten years have encouraged distance learning. The National Teachers Institute (NTI) Kaduna has been running the NCE distance learning for some time now. The Federal Government also established the National Open University of Nigeria (NOUN) to provide the distance learning education for the citizens. CAI will facilitate these distance learning programmes in Nigeria.

Methods of Teaching Technical Education

Teaching is an act performed by a teacher with the intention of causing learning to take place. It means that in the event that nothing is learnt, then it will be assumed that nothing has been taught. Like all other life activities, it is goal-oriented and the ultimate goal of teaching is learning. Learning is said to be a change of behaviour of an individual in a desired direction. Teaching is an on-going activity, which is cyclic in nature. Classroom interaction between the teacher and the learner (pupil) is just one part of the activities in the cycle. Teaching or instruction is an activity, which involves passing information, knowledge, skills and values on individuals by a teacher. Teaching is said to be the crowning activity in the educational process (Makama, 2005).

Adigun (1997) said, many new methods of teaching have been developed, tested and adapted for teaching in different learning environments. Teachers should note that, the most suitable methods of teaching will depend on certain factors like: the general objectives of the

course of study, the specific learning objectives to be achieved, the subject to be taught, the size of the class, the type and intellectual ability of the students, the time available for teaching the subjects, the abilities of the teacher and the facilities available and others.

The best method of teaching all courses will be difficult or impossible to identify considering all the above-mentioned factors. A method of teaching that is suitable for a course of study at a given time and factors may not be suitable at another time or under another condition. This is because each method of teaching is effective within certain limits and each method has its own strengths and weaknesses. The following are some methods used for teaching technical education courses or subjects in Nigeria: lecture method, project methods, demonstration method, programmed instructions, computer-assisted instruction (CAI) and others.

Programmed Instruction (PI)

Programmed instruction is the presentation of the materials to be learned by the student (learner) in a series of carefully validated order and small steps. The steps are small enough to ensure that the students will be able to master it before progressing to the next step. Programmed instruction may be written in form of programmed text, laboratory worksheet or programmed textbook. Teaching machines, tape recorder, slides and slide projectors, computer-assisted instruction (CAI), etc. are mechanical and modern forms of programmed instruction (Aina, 2007).

The development of programmed instruction began with the educational ideas of Socratse, Comenius and Maria Montessori. Sidney L. Pressey in 1925 devised a testing machine (system), which provided automatic scoring of multiple-choice tests. By 1960s, Normal A.

Crowder and B.F. Skinner revived and revised the concept of programmed instruction. Skinner worked on the area of linear programming which embodies the psychological principles of operant conditioning. Crowder on the other hand worked on branching programming. Both methods employed the use of programmed texts, which normally consists of sequential and limited size of information, and materials requiring overt responses. Students (learners) are provided feedback with or without reinforcement based on their responses to the materials. The method allows for individual pacing and immediate knowledge of results. With the development in information and communication technology (televisions, radios, tape recorders, computers, etc), teaching machines and computer-assisted instructions (CAI) have provided a more practical application of the theories to solve some of the problems of learning and instruction (Abimbade, 1999).

Programmed instruction is suitable for teaching very large audience and students (learners) learn at their own pace. Also, it is not necessary for the teacher to be present for learning to take place and constant reinforcement gives students satisfaction of their performances. The programme is usually long and difficult to prepare and there is danger of loss of personal contact between the student and the teacher. Also, time of exposure to learning units and responses may be short for slow learners and method allow for little or no initiative of students (Adeoye and Salami, n.d.)

Demonstration Method

Demonstration method emphasizes the teaching of one student at a time either in the workshop, class or laboratory. Its usage is based on the realization that students have different learning abilities and should be taught according to their abilities or other factors.

Computer-assisted instruction (CAI) method

Sanni (1997) defined computer as an electronic device used for solving commercial, scientific and technological problems by undergoing a series of steps or procedures known as a programme. The computer system consists of the hardware which is the physical parts and the software which is the programmes or set of instructions used to direct the computer on what to do. The computer has both primarily and secondary storing facilities which make the retrieval of information possible.

Abimbade (1996a) defined Computer-Assisted Instruction (CAI) as the technique of using computer to carryout the teaching and learning activities and it can be with or without the teacher in the learning situation. The computer system is used to deliver instructions directly to learner by allowing them to interact with lessons programmed into the computer. CAI is an individualized form of information and student-paced. Computer-assisted instruction (CAI) as a method of teaching and learning got its roots from programmed instruction or learning and teaching machine that originated from the educational theories of B.F. Skinner and others. Their concept of teaching and learning technique was characterized by self-paced, self-administered instruction, presented in logical sequence with immediate feedback and repetition as the case may be (Adamu, 2001).

Computer-assisted instruction (CAI) is an automated instructional technique in which a computer is used to present an instructional programme to the learner through an interactive process on the computer. Abimbade (1999) stated the following as the characteristics of computer-assisted instruction:

i. Leaner controlled instruction (student-centre method)

ii. Prompt feedback to the learner

iii. Self pacing-progress at their own speed of learning

iv. Adaptability of instruction (presentation mode, instructional content mode)

v. Lessons with more than one purpose

vi. Multiple user approach

vii. Random access facilities

viii. Facilities for revision and updating

Computer-Assisted Instruction (CAI) can be used for teaching and learning in many forms, e.g. instructional games, drill and practice, turorials simulations handling, modeling program analysis and discovery. The CAI packages are the various software of programmes written or developed for teaching using the computer system. These educational programmes or packages are generally called course ware. The most common packages or set of instruction are Programmed Inquiry Learning or Teaching (PILOT), Programmed Logic for Automated Teaching Operation (PLATO), Tutor and others.

Okafor (2000) stated that, in recent times, the development of computers is one of the greatest technological achievements to mankind and computer assisted instruction (CAI) is one of the greatest benefits of computers enjoyed in the education sector. He also said, CAI has great potential for individualization of instruction by presenting varied and flexible experiences to the individual learner, provide valuable data about how students learn and aids the storage and retrieval of information. It also provides immediate feedback to both the learners and the teachers, minimizes the work of the teacher and makes use of the guided discovery and inquiry methods of teaching thereby applying varieties of proven teaching methods to the learner. The

problems of using CAI are that, computer hardwares and softwares are very costly to acquire, install and maintain and the personal interactions between the learners and the teachers are absent. Persistent electricity power and telecommunications failures and security problems of unauthorized users gaining access to vital information and records due to virus attack and other associated problems, and problems of computer illiteracy among the students and teachers are other problems. CAI is generally suitable for teaching and learning of basic skills and knowledge (Adamu, 2001 and Okafor, 2000).

Computers in Education

The computer system

Computer is an electronic device capable of solving problems or manipulating data by accepting data, performing prescribed operations on the data and supplying the results of these operations. Various types of computers exist, including analog, digital and calculator. Computer is a device for storing large amount of information called data and for processing this data in specified ways in very short period of time. It is a machine specifically designed for the manipulation of coded information and an automatic machine for manipulation of coded information and an automatic machine for performing simple and complex operations far beyond the capabilities of man. Computers accept data, process data and produce an output of data as instructed by the user. The computer system consists of two main features, namely the computer hardware and the software. The hardware are the physical parts of the computer system, like the central processing unit, memory unit, storage system, visual display unit, mouse, keyboard, interfaces and the printer. The computer software consists of the programmed information (programmes) and data fed into the computer. The program controls what the computer does and allows users to do what they want to do on the computer. The computer system requires the

appropriate software (program) to carry out any task or tasks (Obianwu and Azubuike, 1994). Abimbade (1999) said, a computer system without software (program) is useless and vice versa.

Ahmadu (2001) said, computers have the following characteristics:

i. **Speed:** Computer is capable of operating at greater speed to process or manipulate data and its speed of operation is measured in micro seconds or nanosecond.
ii. **Ability to store and access large volume of data:** Computers are capable of storing and retrieving large volume of data.
iii. **Accuracy and consistency:** Naturally, humans are prone to error, but computers by contrast are extremely accurate and consistent in all their functions. They give consistent results every time a process is repeated provided the same data are given.
iv. **Decision-making capability:** A computer can perform certain decision-making instructions automatically.
v. **Imposition of formal approach to working methods:** Computers can only work with a strict set of rules.
vi. Limited in use by unauthorized access and computer fraud, need for specialized personnel in adequate number, inflexibility in use, data has to be presented in an understandable form, high cost of hardware and software and loss of vital information from loss of computer due to fire disaster, rain storm, theft, etc.

Classification of computers

Computers can be classified into four based on the type of data processed, the purpose, and the age of technology (generation) and size. Classification based on type of data processed: consist of analog, digital and hybrid computers. In classification by age of technology, computer can be divided into five distinct generation of technological breakthrough in the development of

computers. The generations are: first, second, third, fourth and fifth generation computers. Computers can be classified based on size as: microcomputers, mini computers, mainframe computers and super computers. Computers can be classified based on purpose as special purpose and general purpose computers (Fapohunda, 2000).

Computer literacy

Computer literacy is the ability to possess general knowledge, learning and fluency in computer uses and applications. The National Business Education Association in Owojori (2000), said computer literacy is the ability of an individual to understand the capabilities and limitations of computer systems and the knowledge and skills necessary for effective participation in information technology oriented society. A computer literate person should be able to understand the computers' abilities, limitations, demonstrate a fundamental knowledge of computers and their effects on society, communicate with others using computer vocabulary and operate the computer effectively. Others are, to access information in the computer, input information with speed and accuracy using keyboarding skills and for solving problems.

Similarly, Abimbade (1996b) defined computer literacy broadly as the abilities of an individual to identify and operate the software and hardware of a computer so as to achieve a desired goal. Computer system and concepts are used in virtually all spheres of life in this century; hence importance of computer literacy for citizens of the world cannot be overemphasized.

The former Minister of Education, Professor JibrilAminu in Lagos on 14th December 1987 inaugurated a Committee on Computer Education in Nigeria. The reasons for the formation of the committee were given as follows:

i. To catch up with the rest of the world.

ii. To be ready to enter into the 21st century of high technology where computer will undoubtedly be at the centre of it all, as the most sophisticated and most enabling tool.

iii. To be able to land on jobs demanding computer knowledge, an almost infinite scope for human Endeavour.

iv. To regulate the proliferation of micro computer and its integration within the education system (Abimbade, 1996b).

The submission of reports of the Committee on Computer Educations in 1988 and subsequent implementation began the presence of computers and computer education in Nigerian schools. The scheme started with pilot computer programmes in federal unity secondary schools and gradually spread to state schools, private schools, primary schools and tertiary institutions. As literacy is the fundamental aim of any education, computer literacy is the main aim or goal of computer education in Nigerian schools and institutions. Computer literacy is an important requirement for employments, promotions, etc. Computer literacy is important for both students and teachers in using computers in education.

Computers and teaching and learning in schools

The history of computers in schools is usually associated with the efforts of known American psychologists called B.F. Skinner. He was worried about a situation in a classroom where teachers use the same method of teaching all the students irrespective of their individual needs, motivations, ability, level and interests. In these cases, the pace of the class is usually determined by the brightest students and the dull ones just drifted. After some years of research, Skinner came up with his teaching machine to his American audience. He was shocked that despite the positive results yielded, American teachers rebuffed the machine on the ground of

fear of mass retrenchment; among other factors. A decade after the teaching machine saw the emergence of computers in the education scene. Although, teachers did not find the innovation of teaching machines appealing, the emergence of computers in the education sector was not challenged in the same way. This can be attributed to the benefits inherent in the use of computer system in all fields of human endeavour. All groups in the society, e.g. military, health workers, business and economic sector, social sector and others in Europe and Americas were using computer technology system for their daily affairs and the school system was being left out. Since late 1960s, computer systems began entry into the school system on a gradual process. There is no gain saying the fact that computers are necessary facilities in the school system in Nigeria, considering the unlimited benefits to be derived in their uses in the education sector. Computers have the capacity to make many of the functions in the school system easier, simpler, faster, more effective and efficient, and others. Similarly, Adamu and Bello (2002) said computers are needed in Nigerian schools because of their utility value, among others in the following areas of the educational process:

i. **Remedial education and individual tutoring:** Computers are used in this area to present instructional materials to students at their own pace. This application is what is known as Computer-Assisted Instruction (CAI). The other major application in this area is computer managed instruction (CMI). Here, the computer is used as an assistant to the teacher in managing the educational process by assessing the students capabilities and prescribing a course of instruction. With computer as an instructional aid, teaching would become more interesting and exciting.

ii. **Developing problem solving skills among students:** Using computer for teaching and learning with problems solving approach will develop their skills in problem-solving.

iii. **Grading of scripts is one task that most teachers dread.** Computer can mark a large number of scripts within a very short time. The computer can also analyze the results of the students' performances and issue reports. This will also minimize students' complain of missing results and victimizations.

iv. **Speech simulation synthesis:** Schools can use this capacity of the computer to solve the problem of shortage of language teachers. The student can speak to the computer via a speech simulator and the computer speaks back to the student in the language that is being taught.

v. **Guidance and counseling services:** Trained guidance and counselors are in short supply in schools and are very essential for the implementation of educational policies. A single computer in a school can help to reduce this problem by providing these services to a large number of students within a short period.

vi. **Distance learning:** In view of the teaming number of candidates seeking access to education and the scarcity of places in the institutions, distance learning education assumes great importance. Computer plays an important role in distance learning. The computer system can be used by the student to receive lessons from any location in the world via the internet connectivity.

vii. **Planning:** The computer can help the school to plan and make the maximum use of available time, space, facilities, etc.

viii. **Record keeping:** The computer can be used as an electronic file cabinet. Using a data base system, the principal or teacher can store and quickly retrieve information on students' record, test/examination results, staff records, equipment inventory, item bank for tests and examinations and full biography of students, etc.

ix. **School secretarial duties:** The computer can be used as an electric type writer with an advantage of vast memory for school secretarial works.

x. **Electronic mail:** This allows the school in a network to send and receive messages which are faster and cheaper than letters and telephones.

xi. **Payroll and accounts:** General purpose accounts and pay rolls of schools can be kept using computer system. This will make the accounting job easier and faster.

xii. **Publishing:** The computer in the school can be used to prepare books, journals, magazines, reports and others for publishing (Abimbade, 1999).

Measurements and Evaluation in Technical Education

Nwankwor (1998) said, in education and training general measurement and evaluation has remained one area of concern to educators and researchers. Education lists and others continue to express their concern about the measurement and evaluation of students' progress, the values and relevance of curriculum and the effectiveness of teaching methods; among others, since efficient measurement and evaluation forms the basis for sound educational decision making.

Measurement in education is the process of determining how much knowledge or attribute a student has acquired in a teaching and learning situation. The major measuring instrument in use at school is the test, but measurement can also be carried out using term papers, assignments, projects, research reports or thesis and practical works. The test and other measuring instruments are used by the teacher in determining how much of what was taught has been understood by students. Tests and other instruments used by the teachers to assess students provide information on the students that participated in the test and this information gathered and transformed into scores or marks (Okoro, 2002).

Evaluation is a word derived from the Latin word “VALEO” meaning to value worth or quality of something. Evaluation is an activity we engage in every day considering the fact that we make judments relating to the value or worth of things we do or experience. Evaluation has been defined in different and similar ways by researchers, educationists and other experts in the education sector. Evaluation in education is the process of passing judgment on the adequacy of the scores or marks obtained by a student in a measurement process. It involves determining whether the scores obtained by a student in the measurement are high, average or low, good, bad, satisfactory, or unsatisfactory, pass or fail and others. This means that it is only when scores or marks have been converted to grades that the process becomes evaluation. These grades allocated to the learners will indicate clearly the level of attainment of the objectives of the lesson or course. Evaluation result that is indicated an ‘A’ grade means that the learner has been judged to be excellent in the subject or course, while ‘F’ grade indicates that the student is poor and judged to have failed the course (Pidgeon& Yates, 1986).

Similarly, Mohammed, Gayus, Ikwuakam& Solomon (2002) said evaluation of learning outcomes in vocational and technical education is an effort to place a true value on goodness, effectiveness or ineffectiveness of learning experiences, teaching activities and their expected outcomes. It aims at determining the weakness and strength or value of learning experiences and outcomes. It also determines the extent to which educational objectives of any programme may have reached by the end of any teaching and learning activity. Evaluation is an orderly and scientific way of thinking and process of finding out the extent and kind of behavioural changes that resulted from instruction or teaching activities in the programme.

Functions of measurement and evaluation

The important functions performed by evaluation in the teaching and learning process cannot be overemphasized especially in subjects like technical education. Technical education subjects or courses require the assessment of students' performances in the three domains of the learning outcome, that is, the cognitive, the psychomotor and the affective domains. The kind and the quality of evaluation used in the technical education programme have implications on the performances of the students.

Measurement and evaluation serve many functions in the education sector and the most important functions are as follows:

(i) to determine whether students understand what they are being taught;

(ii) to enable the teacher know students who need special attention;

(iii) to enable the teacher provide educational and vocational guidance to students;

(iv) to supply information needed for programme evaluation and curriculum development;

(v) assessing the effectiveness of the teacher;

(vi) to determine when students have acquired necessary knowledge and skills to graduate from the programme or enter the work force;

(vii) to obtain information for researches and development (Ajayi, 1999)

Types of measurement and evaluation

There are three main types of measurement and evaluation which are based on the major roles played in the teaching and learning process as follows:

Formative Evaluation: Is the type of evaluation that occurs in the early stages of the teaching/learning process. This type of evaluation may be given to students at the beginning of the course and at the completion of a unit of course to know the previews knowledge of students.

Summative Evaluation: Is usually conducted at the end of a course of study or teaching programme. The main purpose of summative evaluation is to determine if students have failed or passed a course of study and the degree of success or failure. It gives a summary assessment of the performance of each student involved in an educational programme.

Ultimate Evaluation: Is the type of evaluation that takes place after the students have graduated from the programme and working in places of employment. The real test of an educational programme like technical education is how the people trained perform in their places of employment. The main purpose of an educational process should not be the award of certificates, but the acquisition of some knowledge and skills which can be used in a real life situation for the benefit of the individual and the society (Bergan & Dunn, 1991).

Types of tests and examinations

There are different types of tests and examinations used in measurement and evaluation of teaching and learning outcome. The two main types of tests and examinations are the standardized tests and teacher-made tests.

Standardized Tests: Standardized tests are tests which have been tried out with considerable number of students, revised, refined and administered to a very large number of students usually in thousands or millions. From the results, the average achievement is determined and established as a norm. standardized tests are tests prepared and published by publishing companies so that any individual can purchase and make use of them. The tests usually have standards or prescribed methods for administering, scoring and interpreting the test results. The degree of validity, reliability and measurement error of the tests are also stated so that anybody using the tests will know the extent of deviation of scores. Standardized tests may be classified

into four main types, namely: Intelligence Tests, Aptitude Tests, Achievement Tests, and Attitude and Interests Inventories (Okoro, 2002 and Yalams, 2002b).

Intelligence Tests: These are tests developed to measure the inert ability, capacity or general aptitude of individuals. Intelligence test results are supposed to provide the actual intelligence of individuals but usually influenced by heredity, environment and other factors, intelligent test results are usually given in form of intelligence quotient (IQ) scores. The average IQ score is 100 and most individuals have an IQ lying between 80 and 120. Some commonly used intelligence tests are Stanford-Binet scales, the Wechsler scales, California test of mental maturity, analysis of learning potential, the Otis Lennon Mental Ability tests and others (Mehrens& Lehmann, 2001).

Aptitude Tests: Aptitude tests are not very different from intelligence test and the two are often classified together. Intelligence tests measure general aptitude while aptitude tests measure special aptitude or capability in a special area of learning. Aptitude tests are used in identifying students who have potentials to succeed in a particular occupational area. Aptitude tests are very useful in educational and vocational guidance. Examples of attitude tests are College Entrance Examination Board Scholastic Aptitude Test, Differential Aptitude Tests, Torrance Tests of Creative Thinking, Iowa Test of Musical Literacy and others. A good aptitude test should correctly predict future performances of an individual. (Lindval&Nitko, 1997).

Achievement Tests: Standardized achievement tests may be classified into three as follows:

(i) Test designed to measure progress in individual subject area; e.g. English, mathematics, sciences and others.

(ii) Test batteries; provide overall picture of the achievement of pupils in a variety of subjects.

(iii)Diagnostic tests; identify a particular area of the subject matter a pupil is likely to have problems.

Achievement tests are concerned with the present achievement or level of knowledge or skill acquisition of an individual. The aptitude tests on the other hand are designed to predict the future performances of an individual in an area (Ajayi, 1999).

Attitude and Interest Inventories: Standardized instruments used for measuring interests and attitudes are called inventories and do not usually have right or wrong answers. They are not administered in order to pass or fail students but rather to identify their affective characteristics. Some commonly used tests for attitudes, interests, personality and study habits are: Strong Vocational Interest Blank, Survey of Study Habits and Attitudes, Kuder Occupational Interest Survey, the personality inventory, California psychological inventory and others (Pidgeon& Yates, 1986).

Teacher-made Tests: These are tests and other measurement procedures developed by the teacher for use in measuring the rate of progress of the students. Teacher-made tests are not developed by measurement experts and do not usually go through the rigorous of validation procedures which standardized test must undergo. Though teacher-made tests lack refinement of standardized tests, they are very useful and important to the teacher (Okpala, Onocha&Oyedeji, 1993).

Ohuche and Akeju (1988) observed that, teacher-made tests are not usually reliable and valid, that is, they do not measure what they suppose to measure and consistently too. The tests

suffer from poor sampling of the topics taught in the course and lack clarity in wordings and ambiguous. Also instructions, time, difficulty level, weighting questions and sections, etc are usually inappropriately assigned in the tests. Teacher-made tests are most widely used type of tests for most educational purposes and can be classified as follows:

1. Oral interviews/questions (structured or instructed)
2. Written tests: True or false (objective test), Completion of phrases (objective test), Multiple choice (objective test), Matching (objective) test, Short answer essay and Long answer essay tests and identification tests.
3. Performance tests involving direct observation (using checklist, rating scales and others) (Yalams, 2002b).

Oral Examinations (Tests): Is about the oldest method of examination whereby both the examiner and the examinee are in face-to-face contact. Bello (1981) said that, oral test has no chance for the examinee to receive undue assistance (cheating), during the examination. It is easy to score by the examiner and can easily identify the area of the course that is well understood by the students. Also, some students are nervous and frightened to provide correct answers, takes long time and costly to carry out and objective standards are difficult.

Objective Tests: Objective examinations are the type of written test that is scored objectively. It can take any form or a combination of the following: true or false multi-choice response, completion item, and matching tests. In true or false item, a statement is given and the students are asked to judge whether the statement is true or false. In multiple-choice response, a question or statement is given; a number of responses are also provided and the student is asked to select the correct response that most satisfactorily answers the question. In completion items, a half finished statement is given and the student is required to complete the statement. In matching

items, events or items are arranged under one column and the answers are arranged under another column and the student is asked to match the correct answer to the items or event. Objective tests are easily scored objectively and not exposed to human factors. It provides wide coverage of the syllabus and provides equal changes of success to students. The objective tests are difficult to prepare, exaggerate the performances of some students and encourage guessing (Okpala, Onocha and Oyedeji, 1993).

With computers in massive use today, objective testing practice have changed a great deal. Tests are often taken at computer terminals with computers scoring the responses and offering pages of interpretations about the cores. Computer-based tests are readily available and easy to use and print out, looks scientific and complete. Computer tests are liked by teachers since it frees them of the time to administer and mark scripts; it also saves them from blames of failures and yields accurate information. Students complain of computer tests as being impersonal. There is little or no personal contact between the teachers and the learners throughout the process of measurement and evaluation. These contacts are sometimes necessary for control of the environment and others (David Off, 1987).

Long and Short Essay Tests: Are the most common type of examination in schools. Essay tests are the type of tests that the questions start or end with words like: describe, discuss, examine, explain, criticize, enumerate, state, mention, write notes on, etc. Essay tests are popular in schools because it can easily be applied to all subjects and at all levels of the educational system. Yalams (2002b) said, essay tests are easy to construct, give students chance to organize and express ideas and may give actual performance of students. He also said, essay tests may measure students' communication skills instead of knowledge of subject and very difficult to score and grade objectively.

Identification Tests: Is the type of test that requires a student to identify items, equipment, machines, etc, displayed physically or indicated with drawings. Identification test is good for measuring knowledge of such factors like names of tools and materials or location of certain features of a machine or pieces of equipment. Since pictures, drawings and physical items are required, these items may pose problem for the teachers to procure for the tests (Mehrens& Lehmann, 2001).

Performance Tests: These are tests and examinations used to assess the achievement of learners in the psychomotor domain. The psychomotor domain of educational objectives is concerned with the practical or motor skills possessed by students. Practical skills can be measured using essay, objective and other tests, but such tests are usually unreliable in measuring the skills possessed by the learners or students. Technical education courses and subjects are practical skill-based and the most suitable tests that will give a true measure of the practical knowledge and skills possessed by a student and ability to apply the skills is through performance tests. Performance tests require the learner to perform skilled operations and activities learned and perform them under conditions similar to the actual working conditions of the occupations. Performance tests are tools used for both the product and process types of measurement and evaluation. Process evaluation involves observing the student while in the process of carrying out the practical activity and rating him/her on the processes or the procedures adopted. Example, a Metalwork technology student is asked to produce a metal chair. The concern of process evaluation will be how the student designs the chair, interpreted the drawings, cut and weld the materials and finished the chair with appropriate tools, equipment, etc. If the appropriate tools, materials, etc. are used and correct processes carried out, a good product will be the result (Yalams, 2002b and Okoro, 2002).

In product evaluation, the procedure adopted in the construction process is not important but the finished product. In the earlier example of metal chair, the product evaluation will only be concerned with the finished metal chair. The chair will be assessed at finished stage for design, good cuts, weld and finishing. The following are some of the measuring tools used for both the process and product evaluation in technical education: Direct observation schedules, Rating scales, Checklists, Anecdotal records, Interests' inventories, participation (progress) charts and interview schedules. The performance tests provide a more reliable assessment of skills possessed by a learner than other written tests. He also added that, performance tests are capable of assessing complex behaviours relating to performance in an occupational area. These types of complex behaviours cannot be adequately assessed by written tests like essay and objective tests. Performance tests are costly to administer because of tools, equipment and materials used, require much time to set up, administer and grade the test but may test only a small sample of the skills possessed by the students and has low reliability and validity due to limited skills tested, biased grading or assessment, among others (Pidgen& Yates, 1986).

Problems of measurement and evaluation in technical education

Many problems have been identified by researchers and educationists as problems of technical education which emanates from the process of measurement and evaluation. The following are some of the measurement and evaluation problems that militate against the teaching and learning of technical education courses in schools and colleges:

(i) Use of inappropriate methods of evaluation:

The most widely used methods of measurement and evaluation in technical education are the essay and objective tests. These tests are found to be unsuitable for testing the dominant learning domains in technical education, that is: psychomotor and affective domains. Similarly, Olaitan

(1991) observed that, examinations in vocational and technical education at all levels of our educational system are based on mostly evaluation of the cognitive domain of learning. Cognitive domain includes learning of knowledge, comprehensions, application, analysis and synthesis which are known as the "thinking" type of evaluation. Objective and essay types of tests are most suitable for measurement and evaluation of the cognitive learning domain. Olaitan recommended that, Vocational and Technical Education programmes should move from evaluation type of "thinking" into evaluation types of "doing" like the performance tests using process and product evaluation types. The best way to measure the level of achievement in the psychomotor and effective domains of learning is through the performance of the skills and attitudes by the learners and assessed using performance test types.

(ii) Language usage factors:

Nwosu (1999) observed that, many teachers of science, mathematics and technology do not use correct science and technology languages in the conduct of tests and examinations. Sometimes ambiguous statements are also used in tests and examinations. These wrong uses of language and ambiguous statements in examinations and tests lead to misunderstanding of the questions and offer of wrong responses to the questions. These conditions do not provide for the right assessment of the performances of the students in the course. Teachers of science, mathematics and technical education courses should be equipped and implored to use unambiguous statements and correct scientific and technical terms in examinations and tests to avoid such problems.

(iii) Teachers factors:

The achievement of students in a course of study largely depends on the ability, competence and attitude of the teacher. The teachers' knowledge of the subject matter of a course of study is an important determinant of the knowledge the learners will be exposed to. The evaluation of the learners' (students') performances will also be determined by the knowledge of the teacher. Some teachers of technical education in some levels of our educational system examine students in subjects or courses that they are not competent in. similarly, Nwosu (1999) observed that, some teachers of science, mathematics and technology sometimes examine students in subjects that are not well known by them. These conditions will only result in wrong assessment of the students' performances in the course. Teachers with adequate knowledge of a course of study should be assigned to examine learners in the course or subject. Teachers' knowledge of test development and test administration is also important in determining the performance of students in technical education. Measurement and evaluation in technical education require the consideration of the following factors to provide a reliable and valid assessment of students: the nature of the courses, the level of course of study, the type of learning domain to be tested, students' entry behavior and backgrounds, among others.

Akinjidi (1997) observed that, many teachers of technology-related courses lack adequate knowledge of evaluation rules and procedures and have led to wrong assessment of the performances of students. Many teachers of technical education lack adequate knowledge of test development and test administration to conduct reliable and valid test to assess the performances of students. Adequate training of technical teachers in test development and test administration is suggested. This will ensure that technical education teachers prepare and administer reliable and valid tests, which will give true performances of the students in the courses or programmes.

In technical education courses, finished practical projects are usually assessed to determine the performances of students in the occupational area using the product evaluation technique. This in many cases does not provide the actual performances of the students in the subjects, since they may not be part of the making of the practical projects. Olaitan (1991) recommended the use of both process and product evaluation techniques of practical products (projects) undertaken by students of technical education to ameliorate these problems.

Summary of Literature Review

The literature on development of Technical Education indicated that a lot have been done to develop this sector of education over the years. Further efforts are required in the areas of adequate funding relevant curriculum and facilities and research studies. The literature on methods of teaching discussed various methods. It was agreed that lecture method used predominantly in higher institutions is teacher-centered and not suitable for teaching Technical Education courses. Student-centered methods like CAI were recommended. The literature on problems of teaching Technical Education revealed funding, dearth of qualified teachers, inadequate infrastructural and educational facilities and curriculum were some key problems discussed.

Literature on computers in education indicated that, computers are used in schools for remedial and individualized education through CAI, making and grading scripts, vocational and career guidance, distance learning, etc. Some problems and prospects of using computers in schools were discussed. Literature indicated that, measurement and evaluation are used to determine the performances of students and teachers. Problems of use of inappropriate methods, language usage and teachers factors were discussed. They suggested that similar studies are

carried out in other subject areas and at all the levels of our educational system equipped with sound, graphics and animation features.

CHAPTER THREE

RESEARCH METHODOLOGY

This chapter consists of Research Design, area of the study, population of the study, sample and sampling techniquest, Method of data collection, Data analysis and training programmed for the teacher and Research Assistants.

Research Design

The study was conducted using Experimental research design. The design is suitable for the study solicited information from teachers of general metalwork technology in the technical college in AkwaIbom State. The experimental and control group were selected from the participating technical college from the following department.

- Mechanical and craft practice engineering
- Welding and fabrication
- Motor vehicle from STI-ST3, the control group were taught metal forging technology using demonstration method and the experimental group taught using the Computer-Assisted Instructional package for eight (8) week. After the instruction, the metal forgoing Technology Achievement Test (METAT) was administered to both the experimental and control group. The scores of the subject were analyzed to answer the research question and test the hypotheses in the study.

Area of the Study.

This stud was carried out in AkwaIbom State and will cover ten Technical Colleges; six Government owned Technical colleges and four private Technical and vocational colleges.

S/No	School
1	Government Technical College Aback
2	Government Technical College Ewet
3	Government Technical College Oron
4	Government Technical College IkotUkoIka
5	Government Technical College IkotAkatah
6	Union Technical IkpaEket
7	Vocational Centre Etinan
8	Comprehensive Technical School IkotEkpene
9	Comprehensive Technical School AffahiaObong
10	Ukamafun Technical Institute Ukamafun.

(Source Technical College 2012).

Population of theStudy:

The population for the study comprised of students from the selected Department (STI-ST3) and Teachers of General Metalwork Technology. The students were used since Metal Forging Technology is offered at STI – ST3. The total population of STI – ST3 students and teachers in the technical college in AkwaIbom State was 3,715 students and 44 subjects teacher respectively. The total population for the study was 3,759 respondents

Sample and Sampling Technique.

The stratified random sampling Techniques was use to generate the subjects from the intact classes of the participating Technical College that represent the entire population of the study

For both the experimental and control groups from the intact classes of the participating Technical Colleges. Details of the institutions sampled for the study to represent the population wereas follows:-

Details of Teachers and students used in the study

S/No	School	Control Group no of Students	Experimental Group no of Students	No of Teachers
1	Government Technical College Aback	15	15	4
2	Government Technical College Ewet	15	15	3
3	Mainland Technical College Oron	15	15	4
4	Government Technical College IkotUkoIka	15	15	3
5	Government Technical College IkotAkatah	15	15	5
6	Union Technical IkpaEket	15	15	4
7	Vocational Centre Etinan	15	15	4
8	Comprehensive Technical School IkotEkpene	15	15	2
9	Comprehensive Technical School AffahiaObong	15	15	3
10	Ukamafun Technical Institute Ukamafun.	15	15	3
	Total	**150**	**150**	**35**

A total of 300 students were used for the study, consisting 15 students from each of the control group and the experimental group and total of 35 Teachers from the participating Technical Colleges which made up total population of the subjects in the study. This consists of 150

students each in the experimental group and the control group respectively and Teachers making a total of 335

Development of the CAI Package

The CAI package was developed with the some forging foundry and topics in general metalwork in Technical programmed. The package was developed using the Micro media flash package. The package consists of three sections, namely, the Tutorial (lessons) section, the Evaluation section, and the Quit section. .

The Tutorial (Lesson) section consists of the following knowledge and skills to be learned in the package in four (3) stages or frames a follows:-

Lesson I - Introduction and Safety in Forging

Lesson II - Forging tools and Equipment

Lesson III - Methods of forging

Textbooks, lesson notes, diagrams and materials were assembled together and arranged into the three lessons of the CAI package. At the end of each lesson, the summary of the content of the lesson, some self evaluation questions were given. The Evaluation section of the package consists of the research instrument (MFTAT) which was given to the subjects after the instruction. The MFTAT was prepared with the table of specification for the post-test and consists of thirty (30) objective question to be answered by the subjects in thirty (30) minutes.

Using the CAI package.

After the CAI package had been fully and successfully installed into the computer system, the next procedure was to use the package for teaching Metal forging Technology in the classes which it has been designed for.

The Development of the Research Instrument (MFTAT)

The Research instrument used in the study was the Metal Forging Technology Achievement Test (MFTAT). The MFTAT was constructed to be used by both the experimental and control groups in the study. The instrument (MFTAT) was a researcher made Achievement test consisting of thirty (30) objective Questions on the three (3) topics of The Metal Forging Technology taught to the subjects using the table of specifications the thirty items consists of thirty multiple choice objective questions. The MFTAT was administered to both the experimental and control groups in the study after they have received instructions on Metal Forging Technology through the CAI package and lecture methods respectively.

Validation of the Research Instrument (MFTAT)

The developed Research Instrument (MFTAT) was face and content validated by one (1) Metalwork Technology lecturer and one (1) Automobile lecturer from industrial & technology education department Federal University Technology Minna after going through the developed CAI package.

Training Programmed for Teachers and Research Assistants

A refresher course for training the Teachers and the research assistants that were used in the study for both the experimental and control groups was organized. The training programme

was held for two (2) days and three (3) hours a day. The programme was designed to give an orientation to all the Teachers and research assistants to guide them in the conduct of the research in their assigned institution. The areas covered by the programme were, the CAI package, lecture notes, the research instrument (MFTAT), MFTAT marking scheme, the CAI validation questionnaires research instrument (MFTAT) validation questionnaire and MFTAT answer sheet.

Methods of Data Collection:-

The research instrument (MFTAT) which was a researcher-made achievement test consisting of 30 items objective test was administered to both the experimental and control group after they had received instructions with Computer-Assisted Instructional (CAI) package and demonstration methods respectively. The scores of the subjects in the MFTAT and the validation CAI package were used to collect the data for the study.

Methods of Data Analysis

All data collected from the subjects through the MFTAT for both the experimental and control groups in the post test were analyzed using the Mean, Standard Deviation. The data were analyzed to answer the research questions and test the hypotheses at 0.05 level of significance in the study respectively.

The following guidelines were used to interpret and make decisions on the findings of the study to validate the CAI package and the Research Instrument, establish the reliability of the research questions and test the hypotheses in the study. The mean score of 2.50 and above on a four point rating scale was used as base line for the validation of the CAI package, the research instrument (MFTAT) and answer the research questions in the study. To establish the reliability

of the research instrument (MFTAT), Pearson product moment correlation formular was used to obtain the reliability (r) value. The reliability obtained close to 1.00 was used as base line to determine the instrument reliable in the study (Okoro, 2002).

Decision rule

To determine the acceptance level, a mean score of 2.50 is computed in line with four point rating scale. Any items that attracts up to 2.50 and above was considered agreed and any item below 2.50 was considered disagreed. The acceptance level for the hypotheses testing is based on the degree of freedom (df = nl +n2-2) of 138 degree which gives a t – table value at 0.5 level of confidence of = 1.98. Therefore any item with t- calculated value less than ±1.98 was accepted while those equal or greater than ±1.98 was rejected

CHAPTER FOUR

DATA PRESENTATION AND ANALYSIS

Results Presentations

Research Question One

What is the academic performance of male and female Students when taught MFT with CAI package.

Table 1

Mean Score and Standard Deviation of Male and Female Students in Post-Test MFTAT.

Groups	No. of Subjects	Mean	Standard Deviation
Male	95	23.69	5.51
Female	55	23.89	5.13
Total	150	47.58	10.64

The analysis required to answer this research question are presented on. The result presented on Table shows that, the scores of male students' performances in MFTAT obtained a mean of 23.69 and standard deviation of 5.51 and a mean of 23.90 and standard deviation of 5.13 respectively. The female students thereby performed better than the male students.

Research Question Two

What is the academic performance of students when taught MFT with the CAI package and that of the students taught with demonstration methods in Technical Colleges

Table 2

Mean Score and Standard Deviation of Control and Experimental Groups in Post-Test MFTAT.

Groups	No. of Subjects	Mean	Standard Deviation

Control	150	18.06	3.80
Experimental	150	23.76	5.36
Total	300	41.82	9.16

The analyses required to answer this research question are presented on. The result presented on Table shows that, the mean scores of students performance in MFTAT by the control group was 18.06 mean score with standard deviation 3.80, while that of the experimental group was 23.76 mean with standard deviation 5.36. The experimental group thereby performed better than the control group.

Hypothesis One

There is no significant differences in the mean performances of students taught MFT and CAI package and those taught with demonstration method in Technical Colleges

The analysis required to test this hypothesis in the study are presented on Post-Test mean, standard deviation and test values of control and experimental groups.

Table 3

Post-Test Mean, Standard Deviation of Control and Experimental Groups.

Groups	No. of	Mean	S.D	Df	Prob.	t-critical	Decision

	Subjects				Level	value	
Control	150	18.06	3.80				Not
Experimental	150	23.76	5.36	278	0.05	1.96	Significant

Demonstration method (control group) was 18.06 and standard deviation of 3.80. The students taught with the CAI package (experimental group) obtained a mean score of 23.76 and a standard deviation of 5.36. The table also revealed that, the calculated t-value obtained was 3.44 while the t-critical value at 0.05 level of significance was 1.96. Since the calculated t-value of 3.44 is greater than the t-critical value of 1.96, there is a significant difference between the performances of the control and the experimental groups. This hypothesis is hereby rejected in favour of the experimental group students since they obtained a higher mean score in MFTAT.

Hypothesis Two

There is no significant difference in the mean performances of male and female students taught MFT with CAI package

Table 4

Mean, S.D of Male and Female Students in Post-Test MFTAT.

Groups	**No. of**	**Mean**	**S.D**	**Df**	**Prob.**	**t-**	**Decision**

	Subjects				**Level**	**critical value**	
Males	95	23.69	5.51				Not
Females	55	23.90	5.13	138	0.05	1.98	Significant

The analysis required to test this hypothesis in the study are presented on the mean performance of male students was 23.69 and standard deviation 55.1. The female students obtained a mean score of 23.89 and a standard deviation of 5.13. The table also revealed that, the calculated t-value was 0.83 while the t-critical value at 0.05 level of significance was 1.98. Since the calculated t-value of 0.83 is not greater than the t-critical value of 1.98, then there is no significant difference between the performances of male and female students in the MFTAT. This hypothesis thereby upheld, despite the fact that there is difference in the mean score of the male (23.69) and that of the female students (23.90). This hypothesis is upheld because the difference in the performances of male and female students was not statistically significant.

1. What is the academic performance of male and female when taught CAI packages.
2. What academic performance of technical colleges when taught MFT with CAI packages.

Findings

The findings revealed in this study weres arranged here according to the four research questions and three research hypotheses as stated below.

In research question one, the results of the student's academic performances in MFT using the MFTAT revealed that, the students in the experimental groups (Mean- 23.76) performed better than those in the control group (mean-18.06). This was owed to higher mean

score obtained by the students in the experimental group as compared to that of the students in the control group.

In research question two, the findings revealed that, the female students performed better than their male counterparts in the MFTAT. This was because the female students obtained a higher mean score (23.89) compared to the mean score (23.69) of the male students.

The findings in research hypothesis one revealed that, there was a significant difference in the academic performances of students taught MFT with CAI package and those taught with the demonstration method at Technical Colleges. This hypothesis was rejected since the calculated mean (23.76) of experimental were greater than the mean (18.06) of control obtained at 0.05 level of significance.

The findings in research hypothesis two revealed that there was no significant difference in the academic performances of the male and female students taught MFT with CAI package at technical colleges level. This hypothesis was upheld because the calculated mean (23.90) of female was greater than the mean (23.69)of the maleat 0.05 level of significance.

Discussions of Findings

The main purpose of this study is to develop and use a CAI package for teaching MFT in technical colleges.

The findings of this study have been organized and discussed according to the four research questions and the two research hypothesis formulated. The research questions are first discussed and followed by the research hypothesis as outlined below.

In research question one, the findings revealed that, the students in the experimental group taught MFT with CAI packaged better than those students in the control group. This finding was based on the higher mean score obtained by the students in the experimental group as compared to those in the control group. This findings revealed the effect of using new method of instruction, that is, CAI for teaching the experimental group subjects which indicated a positive outcome in favour of the experimental group subjects. This outcome can be attributed to use of a modern method of teaching (CAI package) on the experimental group.

This findings was consistent with the findings of Sanni (1997)in a study which revealed that, the students in the experimental group taught Basic Statistics with CAI performed better than those students in the control group that were not exposed to the revealed that, the female students obtained higher mean performances than their male counterparts when both were exposed to the CAI,

In hypothesis one, the findings revealed that, there was significant difference in the academic performances of students taught MFT with CAI package and those taught with demonstration method. The null hypothesis was rejected. The finding revealed that, the type of instructional method used for teaching has significant effect on the performances of students taught MFT. This can be attributed to the use of a modern method of teaching used on the experimental group students.

This finding was in agreement with the study of Akour (2009) conducted to investigate the effects of Traditional Instruction (TI) plus Computer-Assisted Instruction (CAI) versus TI alone on College students' Achievement in Introductory Computer Science course. An analysis of covariance on the pots-test scores as covariates showed that, the TI plus CAI group performed

significantly better than the TI alone group. The findings indicated that, there was a statistically significant difference in the performances of the subjects in the experimental and the control groups.

This finding was also in Basic Statistical Concepts: The study revealed that, there was a significant difference in the performances of the students of the experimental group exposed to CAI and those in the control group that were not exposed to CAI. The significant difference was in favour of the students in the experimental group who performed better than their counterparts in the control group.

The finding of the study on this hypothesis was also harmony with the findings of Gambari (2003) which revealed that, there was a significant difference between the post-test scores of students in the experimental group exposed to Computer-Aided Learning (CAL) and control group not exposed to CAL. The significant difference was confirmed when the students in the experimental group obtained higher mean score than the students in the control and obtained a calculated t-test value higher than the table t-value.

The finding of this hypothesis was also in agreement with the study of Kara and Yakar (2008) on the effects of Computer Supported Education on the Success of Students on Teaching of Newton's Law of Motion. The findings of the study confirmed that, the subjects in the experimental group support with computer lessons progressed positively than the control group subjects. The findings revealed a significant difference between the two control group subjects. The findings revealed a significant difference between the two groups using the calculated t-test value of 22.0 that was greater than the table t-value. Kara and Yakar observed that, Computer-

Assisted Teaching do not only improve success, but also develop higher level thinking abilities in students' learning.

Similarly, the findings of this research hypothesis was also supported by Funkhouser (2003) in a study on the Effort of Computer-Augmented Geometry Instruction on Students Performances and Attitudes. The study had two groups of subjects in control and treatment groups. The findings of the study revealed that improvement in the knowledge between the control and treatment groups was significant using the calculated t-test values of 2.06 that is greater than the table t-value. The significant difference in the performances of the group was attributed to the use of Computer-Assisted Instruction (treatment).

The finding was also supported by the findings of Ahmadu and Raji (2004) in a study on the Effects of Computer-Based Teaching Methods on Senior Secondary School Students' Performances in Mathematics for Sustainable Educational Development in Nigeria. The study revealed that, there was a significant difference in the performances of the experimental group subjects and the control subjects on the post-test and pretest. The significant difference was in favour of the experimental group subjects using the t-test statistics. The finding of this hypothesis was also in disagreement with the study of Yaakub and Finch (2001) to compare the Effectiveness of Computer-Assisted Instruction in Technical Education with Intelligent Tutoring System (ITS). The result revealed that, ITS was significantly more effective than CAI in Technical Education. This findings provide support on the benefits of ITS in teaching higher order subject matter and higher order skills in technical education.

Though many researchers have found significant differences whenever a new strategy is adopted for instructions in schools, there are very few cases (e.g. Meyer, 2009) that do not find

significant difference between the use of a new strategy and the traditional methods in teaching. The findings in this hypothesis also support the preposition of some instructional theorists in the application of various instructional strategies which can be designed to improve learner's performances, ease teaching and learning, among others (Merril, 1991).

In hypothesis two, the finding revealed that, there was no significant difference in the mean performances of male and female students taught MFT with CAI package. The null hypothesis was upheld. The finding confirms that, gender has no significant effect on the performance of students exposed to teaching and learning of MFT using CAI package in technical colleges.

This finding was in agreement with the study of Gambari (2003) that revealed no significant difference between the performances of male and female students exposed to CAL in Physics. The study also revealed that, female students performed better than their male counterparts, though not of significant value.

This finding was also in agreement with the study of Fagbemi (2003) on the Development and Validation of Self Institutional Computer-Based Package for Teaching Selected Units of Social Studies in Primary Schools in Niger State. The study revealed that, there was no significant difference between the achievement of male and female pupils taught with the package.

The finding was also in agreement with the study of Ahmadu and Raji (2004) on the effects of Computer-Based Teaching Method on Senior Secondary School Students' Performances in Mathematics for Sustainable Development in Nigeria. The findings revealed that, there was no significant difference between the performances of male and female pupils

students in the pre-test and post-test when exposed to the Computer-Based Teaching. This finding was also consistent with the study of Kale and Rokopou (2006) on the Effects of Social Acquaintance and Gender on Performance and Attitudinal Out-comes within Co-ooperative Computer-Base Instruction. The findings indicated that, there was no significant difference in the performances of males and females in the post-test. The males out performed the females in the study as against the case of this study that the females out performed the males.

These findings confirmed that, gender has little or no significant influence on the academic performances of students exposed to Computer-Assisted Instruction lessons. This can be attributed to one of the characteristics of CAI when learners are given the opportunity to learn at their own pace and have provision for repetition until the concept is well understood. In this case, all genders that are involved in the teaching and learning process had equal opportunities to benefit from the learning materials.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter contains summary of the study, summary of findings of the study, the educational implications of the study,conclusion. Recommendations, suggestion for further researchers.

Summary of The Study

The study was the Development and use of a Computer-Assisted Instructional Package for Teaching Metal Forging Technology for technical colleges. Four research questions and two research hypotheses were drawn to guide the study. Literature were reviewed in some areas related to the study.

The study utilized the post-test only type of quasi experimental research design. The area of study was the AkwaIbom State. The population of the study consists of all the technical colleges in AkwaIbom State and General Metalwork Technology teachers in the participating technical colleges. Total of 300 respondents were sampled from the ten participating technical colleges, consisting of 150 students each in the control and experimental groups respectively and 35 metal work teachers.

A CAI package was developed from General Metal Work subject in Technical Colleges. The CAI package was validated using a 27 items questionnaire by two experts. The two experts consist of one lecturer from Metal Work option and one lecturer from Automobile option of Industrial and Technology Education Department in Federal University of Technology, Minna. A research Instrument, Metal Forging Technology Achievement Test (MFTAT) was developed with 30 objective questions. The research instrument was validated using a 27 items questionnaire by the lecturers.

Summary of Findings of the Study

The following findings were revealed in this study:-

i. The CAI package used in the study was confirmed as a valid instrument for teaching MFT in technical colleges
ii. The research instrument (MFTAT) used in the study was confirmed as a valid and reliable instrument for testing students on MFT in technical colleges.
iii. The experimental group students taught MFT using the CAI package performed better than the control group students taught with demonstration.
iv. The female students taught MFT with the CAI package performed better than the male students in technical colleges.
v. The students in the technical colleges taught MFT with the CAI package performed better than their counterparts.
vi. There was a significant difference between the mean performances of students in the experimental group taught MFT with the CAI package as compared to the students in the control group taught with lecture method.
vii. There was no significant difference in the mean performances of male and female students taught MFT with CAI package in technical colleges.
viii. There was no significant difference in the mean performances of students in technical colleges MFT with CAI package.

Implications of the Study

The findings of this study has implications for lecturers, students, parents, government at various levels, educational agencies, teaching and learning in general and Metal Forging Technology in particular.

i. The findings of this provided a valid CAI package for teaching MFT in technical colleges. This package can be used by the teachers and students for teaching and learning MFT in technical colleges.
ii. The findings of this study provided a valid and reliable achievement test: Metal Forging Technology Achievement Test (MFTAT) that can be readily used to test students in MFT in technical colleges by teachers.
iii. The findings of this study provided data on the comparison of the academic performances of students in control and experimental groups taught MFT using lecture and CAI package respectively. This data can be used by teacher for selection of teaching methods and reference materials.
iv. The findings of this study provided data on the comparison of the academic performances of male and female students taught MFT in technical colleges level using a CAI package. This data can be used by teachers as reference material.
v. The findings of this study provided data on the comparison of the academic performances of students in technical colleges taught MFT in Technical Colleges using a CAI package. This data can be used by teachers as reference material.
vi. The findings of this study provided a validation questionnaire for the CAI package and the research instrument (MFTAT). This validation questionnaire can be used by teachers and researchers for validation of similar instruments.

Conclusion

Based on the findings of this study, the following conclusions were drawn:-

vii. It is possible to develop and use a valid CAI package for teaching MFT in technical colleges.

viii. The developed CAI package used in the study for teaching improved students academic performances in MFT in technical colleges.

ix. The research instrument (MFTAT) used in the study was a valid and reliable instrument for testing students in MFT in technical colleges.

x. The developed CAI package used in the study for teaching has significant influence on students' academic performances in MFT in technical colleges.

xi. Gender does not have any significant influence on the performances of students taught MFT with CAI package in the study.

Recommendations

The following recommendations are made based on the findings of the study to improve on the academic performances of students in technical colleges.

i. The proprietors of technical colleges offering metal work programme should ensure that, the school have computer centre equipped with academic number of financial computer systems for teaching and learning. The centre should also have internet facilities and other Information and Communication Technology (ICT) facilities.

ii. All students in the schools should be computers literate adequately to enable them use computers for instructions and learning. All teachers in the schools should be computer literate adequately to be able to develop Computer-Assisted Instructional packages and use them to teach students.

iii. Government should organize seminars, workshops and conferences on teaching method improvements and reviews for teacher. These will keep them abreast with current and relevant teaching methods that will meet contemporary and dynamic needs of the students and the society in general.

iv. School should use the developed CAI package and the research instrument (MFTAT) for teaching and testing students on MFT in the school.

v. Institutions and other educational agencies like, NERDC, NCCE, NBTE, NTI, etc, should adopt the CAI package as a model for designing similar packages for teaching in other school and for other subject.

Suggestions for Further Studies

To provide more research data and information for improving teaching and learning in school, the following are suggested for further researches:-

i. Similar study to be conducted in other subject areas.

ii. Similar study to be conducted at other classes of our educational system.

iii. The study to be replicated in other state of Nigeria.

iv. The study to be replicated using other types of CAI packages (soft wares).

v. Similar study to be carried out to compare CAI package with other new approaches to teaching, like E-Learning, Intelligent Tutoring System (ITS), Video-Tape Assisted Instruction, etc.

vi. Similar study to be carried out to identify the level of computer literacy of students and lecturers, the availability and adequacy of computer systems in the institutions for teaching and learning.

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LESSON NOTES FOR THE CONTROL GROUP

(LESSON ONE)

METHOD OF TEACHING: Demonstration Method

SUBJECT: General Metalwork.

TOPIC: Introduction to Metal Forging Technology.

CLASS: Senior Technical One

INSTRUCTIONAL MATERIALS: Some forged and cast metals/materials.

TIME: 90 Minutes

BEHAVIOURAL OBJECTIVES: At the end of the lesson, the students should be able to:

- Define metal forging
- Differentiate a forged article from others e.g. machined and cast parts.
- Describe the advantages and disadvantages of metal forging.
- Describe some metal forging safety precautions.
- Identify the forging temperatures of various metals.
- Forge articles with minimum error.

PREVIOUS KNOWLEDGE: - The students are familiar with some metallic materials and their characteristics, and are also familiar with some cold working methods of production in Metalwork.

INTRODUCTION: - Introduce the lesson to the students as follows: Metal forging is the process of heating metal to a plastic stage and then deforming it to a specific shape by force while in a hot state. The force applied can either be with a hammer, press, rolls or an upsetting machine. Metal forging technology is a method of forming metal parts by softening with heat and applying hammer blows or pressure to form the desired shape. It is used to shape metal parts where great strength is required. Forging improves the quality of the metal, refines the grain structure and increases strength and toughness.

Hand forging is the commonest type of forging. Forging is probably the earliest method of forming metal. Forged products are superior in mechanical properties to either cast, rolled, or machined parts. Forging is used for the production of components such as crank shafts, gears, axles, marine equipment, rail way equipment, mining equipment, agricultural equipment, etc. some other forging processes include: Tapering, Drawing out, Bending, Twisting upsetting, fullering, swaging, flatting, cutting, punching, etc. metals that can be forge conveniently include wrought iron, steel, copper and brass. Aluminum and zinc can also be forged, but at low temperatures (Figs. 1.1 and 1.3 refers).

PRESENTATION

STEP I: - Present the lesson to the students as follows: The following are advantages and disadvantages of forging.

Advantages:-

i. Forged parts are much stronger than cast or machined parts of the same material and size. Machining cuts through the grain, where as forging causes the grain to follow the shape of the work piece. Metal is strongest in the direction of the grain.

ii. Strong parts of complex shapes can be produced much more economically than by machining and casting.

iii. Since different metallic shapes are produced by forging using hammer or by squeezing, not cutting, much less metal is lost in the process.

Disadvantages:-

i. The high forging temperatures cause rapid oxidation, thereby producing a surface scale which results in a poor surface finish of the parts.

ii. Because of the high temperatures and scaling, close tolerances cannot be obtained.

iii. Contacts with hot metal causes burns and the flying scales are dangerous unlike in metal machining.

STEP II: - The safety rules and regulations to be observed when forging metals include:-

i. Always use the right forging tools for the correct jobs.

ii. Always dress appropriately (use leather apron, gloves, steel toe shoes, eye protection goggles, etc.) to protect your body against injury.

iii. Never hold hot metal with your bare hands to avoid burns.

iv. Never hit or hammer metal while cold to avoid tear of fracture.

v. Never cut metal on the face of the anvil, always use the cutting block.

vi. Hot metals should not be carelessly dropped on the floor or placed on the work bench always use the anvil (Fig. 12. refers)

STEP III:- Forging temperatures:

Forging requires heating of the work piece above the upper critical temperature but not to the point that can weaken or melt the metal. Ferrous materials are forged under temperatures ranging from 927^0C – 1372^0C. from 594^0C – 927^0C for coppers, brasses, and bronzes and from 344^0C – 438^0C for aluminum and magnesium alloys. Each metal has its own critical temperatures which is the basis for determining the forging temperatures. The metal should not be heated above the forging temperatures to avoid loss of surface carbon due to formation of scales. When metals are hammered at lower temperatures, work hardening can occur and the metal may crack or split.

SUMMARY: - The teacher summarizes the lesson by reminding the students of the following points:

i. Forging is a method of forming metal piece by applying hammer blows after it has been softened by heat. `
ii. Forged parts are stronger than cost or machined parts but close tolerances are difficult to obtain.
iii. Always use the right forging tool for the correct job and always dress appropriately. Do not apply hammer blows on cold metals in order to forge it. Doing so may cause crack or tear.
iv. The forging temperatures of steel ranges between 927^0C – 1372^0C. always avoid heating metals above their forging temperatures.

EVALUATION: - Evaluate the lesson by asking students the following questions:

i. What is forging?

ii. State two advantages of two disadvantages of forging

iii. State any four metal forging safety precautions to be observed

NOTES FOR THE CONTROL GROUP

(LESSON TWO)

METHOD OF TEACHING: Demonstration Method

SUBJECT: General Metalwork.

TOPIC: Forging Equipments and Tools

CLASS: Senior Technical Two

INSTRUCTIONAL MATERIALS: Some forging tools, Equipment and their diagrams.

TIME: 90 Minutes

BEHAVIOURAL OBJECTIVES: At the end of the lesson, the students should be able to:

- Identify the forging tools and equipment.
- Use the Forging tools and equipment
- Describe the characteristics of the forging tools and equipment.

PREVIOUS KNOWLEDGE: - The students are familiar with what forging is, forging temperatures, forging safety and the advantages and disadvantages of forging.

INTRODUCTION: Introduce the lesson to the students as follows: There are many tools and equipment used in metal working specifically for forging exercises. These tools and equipment include, the Forge Hearth and its accessories; the Anvil and Standi; Swage Block, Set Hammer, Sledge Hammer, Hnad Hammer, Anvil Tools, such as: Hardie, Blacksmith's chisels (cold set and

hot set), Blacksmith's punches, Drift The Gouge, Top and Bottom fullers, bottom and top swages, etc.

PRESENTATION: Present the lesson to the students as follows:

STEP I: Forge Hearth: Also called Blacksmith's forge is the equipment that is used to supply the needed heat to raise the temperature of metal to the appropriate forging temperatures. The forge hearth usually consists of the following parts:-

The Hearth body which supports the legs usually lined with firebricks for protection. The Tuyere bolted to the hearth back and cooled by means of water bosh. The electric motor of variable speeds to control the blast and fitted with fan and the fuel (coke or charcoal). Rake, shovel or slice and poker are used to maintain the fire in the forge hearth (figs. 2.1 and 2.2 refers).

STEP II: - Anvil is an important equipment in forging. It consists of the Body and Cutting Block used for resting metal on when cutting with a chisel. The beak is left soft and used for bending metal to a radius, forming rings and for drawing down. The punch hole used as a clearance when punching holes in hot metals. The Hardie hole is a square hole to take the shank of the bottom tools, e.g. fullers and hardie for various works. The face contains the hardie hole and a punch hole it is used as a surface for flattening, hammereing, etc (Figs. 2.3 refers) .

STEP III: - The Swage Block is a heavy block of cast or steel constructed with many different grooves and holes which are used to form metal into different shapes and sizes. The swage block can be set up in any position and often takes the place of bottom swages and used with top tools.

The Swages are grooved tools used to smoothen or finish round bars or surfaces. They are used in pairs of bottom swage that fits in the hardie hole in the anvil and the tip swage which has a handle placed over the work and struck with hammer. Each swage is made for a round bar of certain size and also available for other shapes (Figs. 2.4 and 2.5 refer).

STEP IV: The Smith's Hammer:-The head of the hammer has the face slightly convex and the other end has a cross pein which is used for various forging processes like, drawing down, etc.

The Set Hammer: - has a smooth, flat face and used to make square corners and shoulders by placing it on the work, and then striking the other end with a hand hammer or sledge.

The Sledge Hammer: - is a large heavy hammer with a long handle, usually used directly for forging or by a striker working in conjuction with a smith.

The flatter has a flat smooth square face and used for the same kind of work as the set hammer except that the flatter has a larger face and used in conjunction with a sledge hammer.

Hand hammers are the most common hammers and used for light forge work (Figs. 2.6-2.9 refers).

STEP V: The Hardieis a tool similar to a chisel. It has a square shank which is placed in the hardie hole of the anvil and used to cut hot and cold metal. The metal to be cut is laid on the cutting edge of the hardie and struck with a hammer.

The Blacksmith Chisels:-also called cuttes are fitted with handles and used for cutting metals in conjunction with the hardie. There are two kinds; the cold chisel or cold set used for cutting cold metals and the hot chisel or hot set used for cutting hot metals. The cold set is ground with a

cutting-angle of 60^0 and the hot set is ground with a cutting angle of 30^0. Thin metals may be cut on the cutting block of an anvil and others on the hardie.

The Blacksmith's Punches are made in different sizes, shapes and tapered. They are used to punch holes in hot metals. Punching is carried out on the punch hole in the anvil.

The Drift is used to finish the roughly punched holes. It has a long taper at one end and a short taper at the other. The drift is driven right through the hole controlling both size and form.

The Gouge is another form of hot set but possesses a curved cutting edge.

The Fullers are forming tools used to make grooved and hollows in metals. They are used in pairs. The bottom fuller has square shank that fits into the hardie hole in the anvil. The top fuller has a handle. Fullers are used by inserting the bottom fuller in the hardie hole and the work is placed on it and then the top fuller is placed over the work and struck with a hammer. The fullers are used for fullering, stretching and spreading operations (Fig. 2.12 – 2.17 refers).

STEP VI: - Forging Tongs are used to hold hot metal during forging. There are various types of tongs in use, but the following are the commonest.

Straight Tip Tongs also called flat jawed tong and used for holding flat work, can be obtained with open or closed mouth.

Curved-lip tongs also called bolt tong and used for holding round work such as bolts, or screws. The opening behind the jaws allows space for holding the head of a bolt.

Single-Pickup Tongs are used to pick either flat work of round work.

Double-Pickup Tongs are also used to pick up round and flat work.

Rivet Tongs are used to hold square or round work, such as rivets or bolts (Fig. 2.8 refers).

SUMMARY: - The teacher summarizes the lesson by reminding the students of the following points.

i. Forge hearth is the heating place which supplies the heat to raise the temperature of metals for forging
ii. The Anvil consists of the face, beak hardiehole, punch hole and cutting block. It is used as a flat form for many forging exercise.
iii. The anvil tools, e.g. fullers, hardie, hot and cold sets are used for various forging activities with the anvil.
iv. The tongs are of various shapes and used for holding and picking hot metal for forging.

EVALUATION: - Evaluate the lesson by asking students the following questions:

i. What is forge hearth?
ii. What is a swage Block?
iii. List four anvil tools and state their functions.
iv. List four types of tongs and state their functions.

LESSON NOTES FOR THE CONTROL GROUP

(LESSON THREE)

METHOD OF TEACHING: Demonstration Method

SUBJECT: General Metalwork.

TOPIC: Methods of Forging

CLASS: Senior Technical Three

INSTRUCTIONAL MATERIALS: Diagrams showing various methods of forging.

TIME: 90 Minutes

BEHAVIOURAL OBJECTIVES: At the end of the lesson, the students should be able to:

- Enumerate the various methods of forging metals.
- Describe how the various methods of forging a metal piece are carried out.
- Identify the tools and equipment used in various methods of forging.

PREVIOUS KNOWLEDGE:- The students are familiar with what forging tools and equipment and how they are used.

INTRODUCTION: Introduce the lesson to the students as follows: Several forms of forging have been developed and practiced today which make it economical to forge one piece or thousands of interchangeable parts. Hand forging is the commonest and simplest form of forging. Some other forging methods are; drop forging and machine forging. There are also several types of machine forging in use today.

PRESENTATION: present the lesson to the students as follows:-

STEP I:- Hand forging is the oldest and simplest type of forging. It covers the manufacture of small and medium-size components in small quantities, made by means hand tools and with the aid of small power machines. In hand forging, metal is heated in a forge hearth to the forging temperature and shaped over the anvil or vice using various kinds of hand tools and hammers. The tools and equipment used in hand forging include, forge hearth, anvil, tongs, anvil tools, hammers, etc. hand forging is very useful for making repairs on metal parts around the home, farm, schools, workshops and for making hand tools and ornamental ironwork.

STEP II:- Drop forging was introduced to meet the demand of modern mass production, eliminating much of the manual labour associated with hand forging. Drop forging is a mass production technique which hammers the metal between two closed dies. Steam hammer and board hammers are used in drop forging. Half of the die is attached to the hammer and half to the anvil. The hot metal is placed in the lower half of the die and struck one or more times with the upper die. This forces the metal to flow in all directions, filling the die cavity. Excess metal squeezed out between the die forces is suitable for producing small and medium size objects, such as pliers, wrenches, gear blanks, machine parts, some fasteners and engine parts, like connecting rod (Fig. 3.3 refers).

STEP III:- Machine forging is a process developed to give rapid production of certain types of forging. Such forgings are produced on a continuous motion machine, designed for particular types of forging. The action of the machine forging is one of squeezing rather than hammering. There are several types of machine forging processes, namely forging hammers (Mechanical and

hydraulic types). Forging presses, upset forging machines, roll forging machines, swaging machine, etc (Figs. 3.1 and 3.2 refers).

SUMMARY: The lesson is summarized by reminding the students of the following points;

i. There are several methods of forging which have been developed and are in common practices; e.g. hand forging, drop forging and machine forging.
ii. Hand forging is the simplest method of forging and uses hand tools, anvil, hammers, anvil tools and tongs for the forging operations.
iii. Drop forging is a mass production technique which hammers the metal between two closed dies.
iv. Machine forging is a process developed for rapid production by producing forgings on a continuous motion machine. There are several types of forging machines in use.

EVALUATION: - Evaluate the lesson by asking the students the following questions:

i. What is hand forging?
ii. List four tools used for hand forging?
iii. What is drop forging?
iv. What is machine forging?

LESSON NOTES FOR THE EXPERIMENTAL GROUP

(LESSON ONE)

METHOD OF TEACHING: Computer-Assisted Instructional Package Method.

SUBJECT: General Metalwork.

TOPIC: Introduction to Metal Forging Technology.

CLASS: Senior Technical One

INSTRUCTIONAL MATERIALS: Some diagrams of forged and cast metals/materials.

TIME: 90 Minutes

BEHAVIOURAL OBJECTIVES: At the end of the lesson, the students should be able to:

- Define metal forging
- Differentiate a forge article from others e.g. machined and cast parts.
- Describe the advantages and disadvantages of metal forging.
- Describe some metal forging safety precautions.
- Identify the forging temperatures of various metals.

PREVIOUS KNOWLEDGE:- The students are familiar with some metallic materials and their characteristics, and are also familiar with some cold working methods of production in Metalwork.

INTRODUCTION:-Introduce the lesson to the students as follows: Metal forging is the process of heating metal to a plastic stage and then deforming it to a specific shape by force while in a

hot state. The force applied can either be with a hammer, press, rolls or an upsetting machine. Metal forging technology is a method of forming metal parts by softening with heat and applying hammer blows or pressure to form the desired shape. It is used to shape metal parts where great strength is required. Forging improves the quality of the metal, refines the grain structure and increases strength and toughness.

Hand forging is the commonest type of forging. Forging is probably the earliest method of forming metal. Forged products are superior in mechanical properties to either cast, rolled, or machined parts. Forging is used for the production of components such as crank shafts, gears, axles, marine equipment, rail way equipment, mining equipment, agricultural equipment, etc. some other forging processes include: Tapering, Drawing out, Bending, Twisting upsetting, fullering, swaging, flatting, cutting, punching, etc. metals that can be forge conveniently include wrought iron, steel, copper and brass. Aluminum and zinc can also be forged, but at low temperatures (Figs. 1.1 and 1.3 refers).

PRESENTATION

STEP I:-Present the lesson to the students as follows: The following are advantages and disadvantages of forging.

Advantages:-

i. Forged parts are much stronger than cast or machined parts of the same material and size. Machining cuts through the grain, where as forging causes the grain to follow the shape of the work piece. Metal is strongest in the direction of the grain.
ii. Strong parts of complex shapes can be produced much more economically than by machining and casting.

iii. Since different metallic shapes are produced by forging using hammer or by squeezing, not cutting, much less metal is lost in the process.

Disadvantages:-

i. The high forging temperatures cause rapid oxidation, thereby producing a surface scale which results in a poor surface finish of the parts.
ii. Because of the high temperatures and scaling, close tolerances cannot be obtained.
iii. Contacts with hot metal causes burns and the flying scales are dangerous unlike in metal machining.

STEP II: - The safety rules and regulations to be observed when forging metals include:-

i. Always use the right forging tools for the correct jobs.
ii. Always dress appropriately (use leather apron, gloves, steel toe shoes, eye protection goggles, etc.) to protect your body against injury.
iii. Never hold hot metal with your bare hands to avoid burns.
iv. Never hit or hammer metal while cold to avoid tear of fracture.
v. Never cut metal on the face of the anvil, always use the cutting block.
vi. Hot metals should not be carelessly dropped on the floor or placed on the work bench always use the anvil (Fig. 12. refers)

STEP III: - Forging temperatures:

Forging requires heating of the work piece above the upper critical temperature but not to the point that can weaken or melt the metal. Ferrous materials are forged under temperatures ranging from 927^0C – 1372^0C. From 594^0C – 927^0C for coppers, brasses, and bronzes and from

344^0C – 438^0C for aluminum and magnesium alloys. Each metal has its own critical temperatures which is the basis for determining the forging temperatures. The metal should not be heated above the forging temperatures to avoid loss of surface carbon due to formation of scales. When metals are hammered at lower temperatures, work hardening can occur and the metal may crack or split.

SUMMARY: - The teacher summarizes the lesson by reminding the students of the following points:

i. Forging is a method of forming metal piece by applying hammer blows after it has been softened by heat.
ii. Forged parts are stronger than cost or machined parts but close tolerances are difficult to obtain.
iii. Always use the right forging tool for the correct job and always dress appropriately. Do not apply hammer blows on cold metals in order to forge it. Doing so may cause crack or tear.
iv. The forging temperatures of steel ranges between 927^0C – 1372^0C. always avoid heating metals above their forging temperatures.

EVALUATION: - Evaluate the lesson by asking students the following questions:

i. What is forging?
ii. State two advantages of two disadvantages of forging.
iii. State any four metal forging safety precautions to be observed

LESSON NOTES FOR EXPERIMENTAL GROUP

(LESSON TWO)

METHOD OF TEACHING: Computer-Assisted Instructional Package Method

SUBJECT: General Metalwork.

TOPIC: Forging Equipment and Tools.

CLASS: Senior Technical Two

INSTRUCTIONAL MATERIALS: Some diagrams of forging tools and Equipment.

TIME: 90 Minutes.

BEHAVIOURAL OBJECTIVES: At the end of the lesson, the students should be able to:

- Identify the forging tools and equipment.
- Use the Forging tools and equipment
- Describe the characteristics of the forging tools and equipment.

PREVIOUS KNOWLEDGE: - The students are familiar with what forging is, forging temperatures, forging safety and the advantages and disadvantages of forging.

INTRODUCTION: Introduce the lesson to the students as follows: There are many tools and equipment used in metal working specifically for forging exercises. These tools and equipment include, the Forge Hearth and its accessories; the Anvil and Standi; Swage Block, Set Hammer, Sledge Hammer, Hand Hammer, Anvil Tools, such as: Hardie, Blacksmith's chisels (cold set and

hot set), Blacksmith's punches, Drift The Gouge, Top and Bottom fullers, bottom and top swages, etc.

PRESENTATION: Present the lesson to the students as follows:

STEP I: Forge Hearth: Also called Blacksmith's forge is the equipment that is used to supply the needed heat to raise the temperature of metal to the appropriate forging temperatures. The forge hearth usually consists of the following parts:-

The Hearth body which supports the legs usually lined with firebricks for protection. The tuyere bolted to the hearth back and cooled by means of water bosh. The electric motor of variable speeds to control the blast and fitted with fan and the fuel (coke or charcoal). Rake, shovel or slice and poker are used to maintain the fire in the forge hearth (figs. 2.1 and 2.2 refers).

STEP II: - Anvil is an important equipment in forging. It consists of the Body and Cutting Block used for resting metal on when cutting with a chisel. The beak is left soft and used for bending metal to a radius, forming rings and for drawing down. The punch hole used as a clearance when punching holes in hot metals. The Hardie hole is a square hole to take the shank of the bottom tools, e.g. fullers and hardie for various works. The face contains the hardie hole and a punch hole it is used as a surface for flattening, hammering, etc (Figs. 2.3 refers).

STEP III: - The Swage Block is a heavy block of cast or iron or steel constructed with many different grooves and holes which are used to form metal into different shapes and sizes. The swage block can be set up in any position and often takes the place of bottom swages and used with top tools.

The Swages are grooved tools used to smoothen or finish round bars or surfaces. They are used in pairs of bottom swage that fits in the hardie hole in the anvil and the tip swage which has a handle placed over the work and struck with hammer. Each swage is made for a round bar of certain size and also available for other shapes (Figs. 2.4 and 2.5 refer).

STEP IV: The Set Hammer:-Has a smooth, flat face and used to make square corners and shoulders by placing it on the work, and then striking the other end with a hand hammer or sledge.

The Sledge : - Is a large heavy hammer with a long handle, usually used directly for forging or by a striker working in conjuction with a smith.

The flatter has a flat smooth square face and used for the same kind of work as the set hammer except that the flatter has a larger face and used in conjunction with a sledge hammer.

Hand hammers are the most common hammers and used for light forge work (Figs. 2.6-2.9 refers).

STEP V: The Hardie Is a tool similar to a chisel. It has a square shank which is placed in the hardie hole of the anvil and used to cut hot and cold metal. The metal to be cut is laid on the cutting edge of the hardie and struck with a hammer.

The Blacksmith Chisels: - Also called cuttes are fitted with handles and used for cutting metals in conjunction with the hardie. There are two kinds; the cold chisel or cold set used for cutting cold metals and the hot chisel or hot set used for cutting hot metals. The cold set is ground with a cutting-angle of 60^0 and the hot set is ground with a cutting angle of 30^0. Thin metals may be cut on the cutting block of an anvil and others on the hardie.

The Blacksmith's Punches are made in different sizes, shapes and tapered. They are used to punch holes in hot metals. Punching is carried out on the punch hole in the anvil.

The Drift is used to finish the roughly punched holes. It has a long taper at one end and a short taper at the other. The drift is driven right through the hole controlling both size and form.

The Gouge is another form of hot set but possesses a curved cutting edge.

The Fullers are forming tools used to make grooved and hollows in metals. They are used in pairs. The bottom fuller has square shank that fits into the hardie hole in the anvil. The top fuller has a handle. Fullers are used by inserting the bottom fuller in the hardie hole and the work is placed on it and then the top fuller is placed over the work and struck with a hammer. The fullers are used for fullering, stretching and spreading operations (Fig. 2.12 – 2.17 refers).

STEP VI: - Forging Tongs are used to hold hot metal during forging. There are various types of tongs in use, but the following are the commonest.

Straight Tip Tongs also called flat jawed tong and used for holding flat work, can be obtained with open or closed mouth.

Curved-lip tongs also called bolt tong and used for holding round work such as bolts, or screws. The opening behind the jaws allows space for holding the head of a bolt.

Single-Pickup Tongs are used to pick either flat work of round work.

Double-Pickup Tongs are also used to pick up round and flat work.

Rivet Tongs are used to hold square or round work, such as rivets or bolts (Fig. 2.8 refers).

SUMMARY: - The teacher summarize the lesson by reminding the students of the following points.

i. Forge hearth is the heating place which supplies the heat to raise the temperature of metals for forging
ii. The Anvil consists of the face, beak hardiehole, punch hole and cutting block. It is used as a flat form for many forging exercise.
iii. The anvil tools, e.g. fullers, hardie, hot and cold sets are used for various forging activities with the anvil.
iv. The tongs are of various shapes and used for holding and picking hot metal for forging.

EVALUATION: - Evaluate the lesson by asking students the following questions:

i. What is forge hearth?
ii. What is a swage Block?
iii. List four anvil tools and state their functions.
iv. List four types of tongs and state their functions

LESSON NOTES FOR EXPERIMENTAL GROUP

(LESSON THREE)

METHOD OF TEACHING: Computer-Assisted Instructional Package Method

TOPIC: Method of Forging.

CLASS: Senior Technical Three

INSTRUCTIONAL MATERIALS: diagrams showing various methods of forging.

TIME: 90 Minutes

BEHAVIOURAL OBJECTIVES: At the end of the lesson, the students should be able to:

- Enumerate the various methods of forging metals.
- Describe how the various methods of forging a metal piece are carried out.
- Identify the tools and equipment used in various methods of forging.

PREVIOUS KNOWLEDGE:- The students are familiar with what forging tools and equipment and how they are used.

INTRODUCTION: Introduce the lesson to the students as follows: Several forms of forging have been developed and practiced today which make it economical to forge one piece or thousands of interchangeable parts. Hand forging is the commonest and simplest form of forging. Some other forging methods are; drop forging and machine forging. There are also several types of machine forging in use today.

PRESENTATION: present the lesson to the students as follows:-

STEP I:- Hand forging is the oldest and simplest type of forging. It covers the manufacture of small and medium-size components in small quantities, made by means hand tools and with the aid of small power machines. In hand forging, metal is heated in a forge hearth to the forging temperature and shaped over the anvil or vice using various kinds of hand tools and hammers. The tools and equipment used in hand forging include, forge hearth, anvil, tongs, anvil tools, hammers, etc. hand forging is very useful for making repairs on metal parts around the home, farm, schools, workshops and for making hand tools and ornamental ironwork.

STEP II: - Drop forging was introduced to meet the demand of modern mass production, eliminating much of the manual labour associated with hand forging. Drop forging is a mass production technique which hammers the metal between two closed dies. Steam hammer and board hammers are used in drop forging. Half of the die is attached to the hammer and half to the anvil. The hot metal is placed in the lower half of the die and struck one or more times with the upper die. This forces the metal to flow in all directions, filling the die cavity. Excess metal squeezed out between the die forces is suitable for producing small and medium size objects, such as pliers, wrenches, gear blanks, machine parts, some fasteners and engine parts, like connecting rod (Fig. 3.3 refers).

STEP III:- Machine forging is a process developed to give rapid production of certain types of forging. Such forgings are produced on a continous motion machine, desgined for particular types of forging. The action of the machine forging is one of squeezing rather than hammereing. There are several types of machine forging processes, namely forging hammers (Mechanical and hydraulic types). Forging preses, upset forging machines, roll forging machines, swaging machine, etc (Figs. 3.1 and 3.2 refers).

SUMMARY: The lesson is summarized by reminding the students of the following points;

i. There are several methods of forging which have been developed and are in common practices; e.g hand forging, drop forging and machine forging.
ii. Hand forging is the simplest method of forging and uses hand tools, anvil, hammers, anvil tools and tongs for the forging operations.
iii. Drop forging is a mass production technique which hammers the metal between two closed dies.
iv. Machine forging is a process developed for rapid production by producing forgings on a continuous motion machine. There are several types of forging machines in use.

EVALUATION: - Evaluate the lesson by asking the students the following questions:

i. What is hand forging?
ii. List four tools used for Hand forging?
iii. What is drop forging?

What is machine forging

METAL FORGING TECHNOLOGY ACHIEVEMENT TEST (MFTAT) FOR POST-TEST

FOR THESIS 'DEVELOPMENT AND USE OF A COMPUTER ASSISTED INSTRUCTION PACKAGE FOR TEACHING METAL FORGING TECHNOLOGY AT TECHNICAL COLLEGES LEVEL'

BY

AKPAN UDEME PETER

2007/1/27247BT

INDUSTRIAL AND TECHNOLOGY EDUCATION FEDERAL UNIVERSITY OF TECHNOLOGY MINNA, NIGER STATE

JUNE 2012.

METAL FORGING TECHNOLOGY ACHIEVEMENT TEST (MFTAT) FOR CONTROL AND EXPERIMENTAL GROUPS.

INSTRUCTIONS:-

1. Answer all the thirty (30) objective questions in this test in thirty (30) minutes.

2. Questions 1-30 are multiple choice objective questions. Each question is followed by four options lettered A to D. enter the letter of the correct answer against the number into the answer sheet.

1. Which of the following is an operation associated with forging?
   a) Planishing
   b) Fullering
   c) Bossing
   d) Seaming
   e)

2. In forging, the process of reducing the thickness hot metal on one side with flatters is called:
   a) Swaging
   b) Setting down
   c) Upsetting
   d) Drifting

3. For good forging practices, metals must not be heated above the forging temperatures to avoid surface
   a) Crack
   b) Split
   c) Fracture
   d) Scale

4. The forging process that involves working different areas of the metal, one at a time into shapes is called:
    a) Drop forging
    b) Machine forging
    c) Hand forging
    d) Incremental forging
5. In drop forging, the excess metal squeezed out between the die faces is called:
    a) Drop
    b) Flash
    c) Face
    d) Tong
6. The forging process in which metallic parts/components are produced by deforming a metal blank into one or more die cavities by a slow squeezing action is called
    a) Drop forging
    b) Press forging
    c) Hand forging
    d) Squeeze forging
7. The forging process whereby a hot bar of metal is increased in cross-section while the length is correspondingly decreased is called:
    a) Forge welding
    b) Upsetting
    c) Drop forging
    d) Fullering

8. A forging operation whereby two separate pieces of metals are united by heating and hammering is called:
   a) Forge welding
   b) Swagging
   c) Drop forging
   d) Fullering

9. The process of reducing the cross-section of a metal bar and increasing the length in forging is called:
   a) Setting down
   b) Fullering
   c) Upsetting
   d) Drawing down

10. A pair of forging equipment used on the anvil for finishing or smoothening bars of different shapes is called:
   a) Hot and Cold set
   b) Swage block
   c) Fullers
   d) Swages

11. A forging hammer that is similar to a flatter and used for square corners and shoulders in conjunction with another hammer is called:
   a) Flatter
   b) Machine hammer

c) Set hammer

d) Hand hammer

12. The hot set or hot chisel is normally ground to a cutting-angle of:

a) 30^0

b) 60^0

c) 90^0

d) 120^0

13. The forging process that is carried out on the anvil with other tools is known as:

a) Machine forging

b) Upset forging

c) Hand forging

d) Drop forging

14. The correct tool used for removal of clinkers from the forge hearth is called:

a) Slice

b) Poker

c) Raker

d) Tuyeres

15. The tool used for holding hot metal in hand forging process is called:

a) Hammer

b) Tong

c) Anvil

d) Vice

16. Which of these is the main part of a smith's anvil?

a) Tang

b) Edge

c) Tong

d) Beak

17. Which of the following tools is recommended for cutting hot forged metal articles?

a) Cold chisel

b) Cold set

c) Hack saw

d) Hot set

18. The heavy metallic materials found in the forge hearth after heating operations in forging are called:

a) Clinkers

b) Impurities

c) Waste

d) Coal

19. The forging method most suitable for the production of small and medium size components in small quantities is referred to as:

a) Drop forging

b) Machine forging

c) Hand forging

d) Incremental forging

20. In forging, the process of finishing and enlarging a hole in hot metal is called:

    a) Punching

    b) Fullering

    c) Swaging

    d) Drifting

21. An anvil is important equipment in forging, which of the following are correct sets of anvil tools?

    a) Fullers, hardie, flatters

    b) Hardie, set hammers, swages

    c) Swages, fullers, hardie

    d) Hardie, swages, sledge hammer

22. The correct tong to used for holding round work when forging is called:

    a) Curved-lip tong

    b) Straight-lip tong

    c) Square lip tong

    d) Circle-pick up tong.

23. The hardie is an anvil tool used for carrying out:

    a) Cutting operation

    b) Bending operation

    c) Fullering operation

    d) Upsetting operation

24. Which of the following forging processes are referred to as hand forging operations?

a) Cutting, bending and upset forging

b) Upsetting, bending and drop forging

c) Upsetting, flaring and bending

d) Cutting, fullering and hammer forging.

25. The forging called developed for rapid production of parts in a continuous motion process is called:

a) Machine forging

b) Hand forging

c) Incremental forging

d) Drop forging

26. Forging can be defined as a process of producing metal parts by heating metal to a:

a) Plastic state and form to shape

b) Liquid state and form to shape

c) Paste state and form to shape

d) Molten state and form to shape.

27. One of the good characteristics of forging process is that:

a) Much more metal is lost in the process

b) Much less metal is lost in the process

c) Much more metal is gained in the process

d) Much less metal is gained in the process.

28. The forging temperatures ranging between (594^0C – 927^0C) are most suitable for forging:

a) Ferrous metals

b) Mild steel, High carbon steel and stainless steel

c) Ferrous alloys

d) Copper, Bronzes, and brass materials.

29. A bad forging practice is to cut metals on the:

a) Anvil face

b) Anvil block

c) Hardie

d) Hot set

30. When forging, formation of clinkers in the forge has the effect of:

a) Causing the work to burn

b) Lowering the temperature of the forge

c) Introducing carbon into the work

d) Making the work smooth.

MARKING SCHEME FOR METAL FORGING TECHNOLOGY ACHIEVEMENT TEST (MFTAT) FOR THE POST-TEST.

1. B
2. B
3. D
4. D
5. B
6. A
7. B
8. A
9. D
10. D
11. C
12. A
13. C
14. A
15. B
16. D
17. D
18. A
19. C
20. D
24. C
25. A
26. A
27. B
28. D
29. A
30 C

21. C

22. A

23. A

ANSWER SHEET FOR METAL FORGING TECHNOLOGY ACHIEVEMENT TEST (MFTAT).

1. NAME OF STUDENT:…….

2. SUBJECT:…….

3. GENDER:……..

1…… **22……**

2…… **23……**

3…… **24……..**

4……. **25……..**

5……. **26……**

6……. **27…….**

7……. **28……...**

8……. **29……..**

9……. **30……..**

10……..

11……..

12……..

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16…….

17……..

18……..

19……..

20…….

21……..

FORMULAS USED IN THE STUDY

1. The Pearson Product-Moment coefficient of correlation formular is:

$$r = \frac{N \sum xy - (\sum x)(\sum y)}{\sqrt{N \sum x^2 - (\sum x^2)^N \sqrt{\sum y^2 - (\sum y^2)}}}$$

Where: $\sum x = sum\ of\ the\ x\ score$

$\sum y = sum\ of\ the\ y\ score$

$\sum x^2 = sum\ of\ the\ squared\ x\ scores$

$\sum y^2 = sum\ of\ the\ squared\ y\ score$

$\sum y\,x = sum\ of\ the\ products\ of\ paired\ x\ and\ y\ scores$

N = Number of paired scores

r = coefficient of correlation,

(Source: Best, 1981).

2. The formula for calculating Mean is:

$$\bar{X} = \frac{\sum x}{N}$$

Where = $\bar{X}$ = mean

$\sum = sum\ of$

X = scores in distribution

N = number of scores

(Ary, Jacobs and Razavieh, 2002)

3. The formula for calculating the Standard Deviation (SD) $= \sqrt{\frac{\sum(x-m)\ 2}{N}}$

Where SD = Standard Deviation

Σ = sum of

M = mean

X = scores in a distribution

N = number of scores

Source: Best, 1981.

4. The formula for calculating t-test statistics is:

$$= \frac{M_1 - M_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2}}}$$

Where t = t-test

M_1 = mean of experimental group

M_2 = mean of control group

N_1 = Number of subjects in experimental group

N_2 = Number of subjects in control group

S^2_1 = Squared variance of experimental group

S^2_2 = Squared variance of control group

Source: Best, 1981

5. The formula for calculating the facility or difficulty index for the test instrument is:-

$$P\ \frac{R}{T}\ x\ \frac{100}{1}$$

Where P = Facility or difficulty index

R = total number of candidates that responded correctly to the item

T = total number of candidate that attempted the item.

(Source: Okoro, 2002)

6. The formula for calculating the discrimination index for the test instrument is:

$$D = \frac{R_U - R_L}{1/2\ T}$$

Where D = discrimination index

R_U = the number of students in upper group who got the test item right

R_L = the number of students in lower group who got the test item right

T = the total number of students in both groups.

(source: Okoro, 2002)

7. The formula is calculating the Distractor index for the test items of the instrument (MFTAT) is:

$$D = \frac{R_U - R_L}{1/2\ T}$$

Where, D = the distractor index

R_U = the number of students in the upper group that choose the particular distractor

R_L = the number of students in lower group that choose the particular distractor

T = the total number of students in the groups.(Okoro: 2002)