COMBINED EFFECT OF COMPUTER TUTORIAL AND DRILL ON SENIOR SECONDARY SCHOOL STUDENTS’ ACHIEVEMENT, INTEREST, AND RETENTION IN BASIC ELECTRONICS IN LAGOS STATE

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THESIS PRESENTED TO THE DEPARTMENT OF VOCATIONAL TEACHER EDUCATION (Industrial Technical Education) FACULTY OF EDUCATION UNIVERSITY OF NIGERIA, NSUKKA

JUNE, 2012
Appendix A

Department of Vocational Teacher Education,
Faculty of Education,
University of Nigeria,
Nsukka.
Date:

Dear Sir/Ma,

Request for Validation of Instrument

I am a postgraduate student in the above Department and University currently undertaking research project aimed at determining the effect of Combined Effect of Computer Tutorial and Drill on Senior Secondary School Students’ Achievement, Interest and Retention in Basic Electronics in Lagos State.

The attached is a draft copy of the instruments for the study. You are pleased requested to vet the items on clarity, wording, relevance and total coverage in use in collecting data for the study. The research questions and purpose of study are attached for your easy reference.

You are also requested to put down your comments, suggestions and advice for improving the quality of the instrument.

Yours faithfully,

Igweh, A. U.
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CHAPTER 1

INTRODUCTION

Background of the Study

Technology the world over is dynamic. With advancement in technology, electronic gadgets and other products that are imported or assembled in Nigeria are coming with new devices to such an extent that technological development is in a constant state of flux and change. The influence of technological development in electronics industries has rendered traditional skills inadequate for work while creating the need for new and often sophisticated skills. Capri, Ozseevgec, Sayilkan and Emre (2004) noted that because most students get information via visual content sources like computer which are used in daily life very much, it is more difficult to teach students by conventional means. If principles of how students learn are taken into account, richness of the visual content makes instruction more lasting and effective Mudasiru and Adedeji, (2010). One possible solution to these challenges is the use of computer assisted instructional teaching approach.

Computer Assisted Instruction (CAI) or Computer Aided Instruction (CAI) refers to use of computer as a tool in teaching and learning. Computer Assisted Instruction according to Rabia (2004) is an interactive instructional technique whereby a computer is used to present the instructional material and monitor the learning that takes place. In a computer assisted instruction the students receive feedback from the computer and maintain some degree of control (Okundaye, 2005). Some of the computer assisted instruction methods include simulation, tutorial, drill and practice.

Tutorial provides generally new information to the students in much the same manner as a human teacher or tutor might. According to Mevarech (1985) CAI tutorials are based on the principles of programmed learning or instruction.
Instructional activities are presented either in linear or branching method which uses hyperlink for videos and, graphs. CAI tutorial gives immediate feedback, create proficiency in computer usage, and gives students a sense of control over learning, calls for using sight, hearing and touch (Bialo and Silvin, 1990).

Drill involves a sequence of tasks, exercises, or words repeated over and over until they can be performed faultlessly. In a CAI drill and practice design, the computer screen presents the student with questions to respond to or problems to solve, the student responds, the computer informs the student whether the answer is correct and if the student is right, he or she is given another problem to solve, but if the student responds with a wrong answer, he or she is corrected by the computer (Mudasiru and Adedeji 2010). Drill and tutorial are interactive and help students remember the concepts they have been taught previously (Rabia, 2004).

The CAI tutorial when used in combination with drill provides instruction in such a way that each tutorial lesson has a series of frame or branches. The frame or branch poses questions to students at the end of each lesson. Student answers questions about the lesson and gets immediate feedback. On each answer, if the student answers correctly, he will be told to proceed to the next frame but if the response of the student is wrong, the package will take him or her back to the frame where the answer could be found or on the alternative gives the correct answer to the student before proceeding to a new frame. The student has to respond to every framed questions in the exact order presented and there is no deviation from this presentation but the student does have the freedom to work through the material at his or her own pace (Mudasiru and Adedeji 2010).

In addition, the use of computer tutorial and drill for instruction brings with it several benefits as a teaching/learning medium. These include self-paced learning, self-directed learning, the exercising of various senses and the ability to represent content in a variety of media. With self-paced learning, learners can
move as slowly or as quickly as they like through a program. According to Cotton, K. (2001), tutorial and drill allow students to progress at their own speed of learning as they offer learners controlled instructions, provide prompt feedback, allow for adaptability of instructions (presentations mode and instructional content mode) using authoring systems, provides lessons with more than one purpose, random access facilities, and provides facilities for revisions and updating. With self-directed learning, learners can decide what they want to learn and in what order. Various studies (Entwistle, 1981; Schmeck 1988; Ford and Chen, 2001) have shown that when learners learn in a way that suits them, improvements in the effectiveness of the learning process normally occur. Humans are multi-sensory animals. The more senses through which we receive information, the easier it is to remember. According to Fletcher (1990), people remember 20% of what they hear, 40% of what they see and hear and 75% of what they see, hear and do. The fact that the computer can exercise various senses and present information in a variety of media can enhance the learning process. Meskill and Mossop (1997) reported that computer assisted instruction encourage learning as it enhance students’ interaction with the learning environment which in turn help sustain students’ interest in learning and consequently improve students’ achievement and retention of learning.

Students’ achievement refers to performance in a school subject as designated by a score or mark obtained in an achievement test. According to Anene (2005) achievement is quantified by a measure of the student’s academic standing in relation to those of other students of his age. Interest is a persisting tendency to pay attention and enjoy some activities. Interest has been viewed as emotionally oriented behavioural trait which determines a student’s vim and vigour in tackling educational programmes or other activities (Chukwu, 2002). Retention of learning on the other hand, refers to a repeated performance by a learner, of
behaviour earlier acquired, elicited after an interval of time (Momoh-olle, 1997). It is affected by degree of original learning, the method of learning and learner’s memory capacity, among other factors. In a study, Momoh-olle found that male generally outperformed girls in retention test in Physics while (2003) found a similar result in technology education. Students’ interest, achievement and retention in any learning activity are sustained by the active involvement of the learner in all aspects of the learning process. Ogwo and Oranu, (2006) and Ngwoke (1995) emphasized that unless the teacher stimulates students’ interest in learning, students’ achievement will be minimal. Hence, it is essential that technical teachers use teaching method which ensures students’ active involvement in learning and provide suitable learning environment to improve achievement, retention and stimulate interest of students in Basic Electronics.

Basic Electronics is one of the vocational subjects offered at senior secondary school (SSS) level in Nigeria. According to Adesina (2002), electronics is a field of study that is both science and technology related. It is concerned with the ways in which the movement of electrons through space is controlled and manipulated. Its applications feature in radios, televisions, computers, transmitters, receivers, aeronautics and other related equipment. The objectives of studying basic electronics in senior secondary schools in Nigeria according to Federal Ministry of Education (FME, 1985) are to: develop a further understanding of the basic concepts and principles of electronics; build and test simple electronic devices; develop skills in circuit fault tracing and repairs; apply simple electronic devices in the construction of electronic system and; prepare students adequately for further work in electronics. The National Policy on Education (2004) stipulated that Electronics should be one of the Vocational courses to be taught in Senior Secondary School to provide trained manpower and give training necessary for an acquisition of skills to individual who shall be self-reliance economically. But the
way topics in Basic Electronics are taught appears to lack instructional procedure that creates interactive style. Berryman (2000) noted that the implication is that the instructions are not logically sequenced to fit the ability of the learners as teachers could not provide teacher-led practice to engage in reciprocal teaching.

According to Boyle, Duffy and Donleavy (2003) the methods are based on behavioural learning theory, emphasize knowledge transmission from teachers to passive students and encourage rote memorization of facts. Campbell and Campbell (1999) noted that when students are passive in the classroom, they become apathetic and repulsive to learning. The consequence is that students are unable to retain their learning and apply it to new situation (Roegge, Wentling and Bragg, 1996). The shortcomings of the present teaching methods partly accounted for the poor performance of students in the Senior School Certificate Examination and National Examination Council (NECO) Examinations. In West Africa Examination Council Chief Examiners’ reports (1989 and 1990) showed that the performance of senior secondary school students in basic electronics was very poor. The council advised among others, that vocational subjects of which Basic Electronics is one of them should be taught with appropriate teaching methods to achieve better results. WAEC results showed that average failure rate in basic electronics in the years 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005 and 2006 were 86%, 94.29%, 68.85%, 72%, 30.76%, 24%, 28.82%, 40.14%, 56.84%, 59.57% and 42.49% respectively (WAEC National Office, Lagos Public Affairs Unit Vol.05/L/PR/92). In the same vein, statistics of NECO examination results showed that average failure rate in basic electronics in the years 2001, 2002, 2003, 2004, and 2005 were 79.90%, 58.65%, 75.34%, 94.63% and 68.27% respectively.

The increasing effects of globalization and the rapid rate of technological changes on work places have informed the recommendation by United Nations,
Educational, Scientific and Cultural Organization (UNESCO) and International Labour Organization (ILO) (2002) that all technical and vocational education system in the 21st century should be geared towards lifelong learning. This requires that schools should in addition to academic skills; inculcate workplace basic skills such as learning to learn, creativity, problem-solving skills, collaborative skills and higher order thinking skills in order to increase the students’ flexibility and job mobility which will make them adaptable to the present and envisaged changes (Hallak and Poisson, 2000 and Paris, 1998). In this context, Rojewskin (2002) noted that a shift from teacher-centred instruction to learner-centred instruction is needed to enable students acquire the new 21st century knowledge and skills. In order to attain to students centered method of teaching Basic Electronics, Computer Assisted Instruction (CAI) was to be used.

However, several studies have been conducted on CAI in many subjects. These studies indicated very different results. Some of the studies found no significant difference between CAI and conventional teaching methods on students’ achievement, retention and interest (Nurettin, Şimşek, Özlem and Çakır, 2009; Cetin, 2007; Alacapinar, 2003; Bayraktar, 2001). Some other researches found CAI more effective in improving students’ achievement, interest and retention than the use of conventional teaching methods (Liao, 2007; Bryan, 2006; Wilder, 2006; Brooks, 2005; Preciado, 2004; Moodly, 2004; Cater, 2004; Yenice, 2003; Brophy, 1999, Child 1995; Morse, 1991; Cotton, 1991). Additionally, studies such as Onasanya, Daramola and Asuquo, (2006), which examined effect of gender on achievement of students taught Introductory Technology with CAI have shown that there was no significant difference in the mean achievement of male and female students. Gender is a psychological term, which describes behaviours and attributes expected of individual on the basis of being a male or a female (Uwameiye and Osunde, 2005). The obvious implication of these findings
showed that the use of CAI in teaching is not significant in all subjects for students’ achievement, interest and retention.

**Statement of the Problem**

Learning outcome of every student according to Bakare, 2009, majorly depends on the type of teaching methods, teaching strategies, and instructional techniques or approaches employed by the teacher during instruction. Traditional teaching methods such as lecture, demonstration and field trip adopted for teaching basic electronics in senior secondary school by teachers are often referred to as conventional teaching method termed to be teacher centered instead of students centered (Sonola, 2007). This method of teaching technical subjects according to her, discouraged creativity and disallowed students from thinking beyond what is presented to them by their teachers. The students are reduced to passive learners and as a result become apathetic and repulsive to learning.

Since literature review showed that there was no perfect superiority of CAI over conventional teaching methods, the researcher decided to study combined effect of Tutorial and Drill on Senior Secondary School students’ achievement, interest and retention in basic electronics to find out whether it will be more significant than the use of CAI.

The report from Federal Ministry of Education (1993, WAEC 1996-2006) (NECO 2001-2005) identified lack of application of effective methodology for teaching technical subjects as major reason for low academic achievements of students in senior secondary schools – Cambell and Cambell (1999), also explained that traditional method of teaching do not adequately equip teachers with contemporary views of students intelligences and their vast learning capabilities. Recommendation of UNESCO and ILO (2002), that vocational and technical education system in the 21st century should be geared towards life long learning cannot be achieved by traditional teaching methods use by the teachers of senior
secondary school to teach basic electronics. Hence, this traditional teaching methods used by these teachers may be responsible for the low academic achievement in basic electronics.

In view of the need to use computer technology to provide student-centered and interactive knowledge environment, several studies had been conducted to determine the effect of Computer Assisted Instruction (CAI) on students’ achievement, interest and retention in various disciplines. These studies ended up with many different results. While some of the studies found no significant difference between CAI and traditional teaching methods.

Some of the studies found significant difference between CAI and traditional teaching methods on students’ achievement, interest and retention. Hence, this study therefore is to determine the combine effect of Computer Tutorial and Drill as alternative teaching method on senior secondary school students’ achievement, interest, and retention in Basic Electronics in Lagos state.

**Purpose of the Study**

The purpose of this study was to determine combined effect of Computer Tutorial and Drill on senior secondary school student’s achievement, interest and retention in Basic Electronics in Lagos State. Specifically, the study sought to:

1. Determine the achievement scores of students taught Basic Electronics with Computer Tutorial and Drill and those taught using the conventional teaching methods.
2. Determine the interest of students taught Basic Electronics with Computer Tutorial and Drill and those taught using the conventional teaching methods.
3. Determine the retention of students taught basic electronics with Computer Tutorial and Drill and those taught using the conventional teaching methods.
4. Compare the achievement scores of boys and girls taught basic electronics using Computer Tutorial and Drill.
5. Compare the interest scores of boys and girls taught basic electronics using Computer Tutorial and Drill.

6. Compare the retention of boys and girls taught basic electronics using Computer Tutorial and Drill.

**Significance of the Study**

The benefits that shall accrue from this study are many, specifically, teachers will benefit from the result of this study in that they will use the instrument to evaluate the students, rather than the teacher-made test. The achievement, interest and retention scores of students taught basic electronics with computer tutorial and drill and those taught using the conventional teaching methods would enlighten technical teachers on the effectiveness of computer tutorial and drill. Technical teachers’ work will become easier and interesting as they will be playing supervisory roles. This will bring great improvement in technical teachers’ morale. The knowledge gained from the skills in the use of computer tutorial and drill method of teaching basic electronics will be better as opposed to the present conventional teaching method which is teacher centered. Technical teachers will use student centered interactive knowledge classroom environment to secure and sustain the attention of the students in learning basic electronics. The knowledge of computer tutorial and drill if found effective will help the teachers to improve their instructional delivery to bridge the gap in achievement, interest of boys and girls in basic electronics.

The findings of this study if found to have positive effect and implemented will also be of benefit to students’ participation and interest in the classroom activities. There will be improvement in students’ achievements and interest through the use of Computer Tutorial and Drill command to achieve active engagement, frequent interaction, and connection to real world of work. This in turn will enable students to pass their SSCE examinations in basic electronics.
Consequently, it will help to reduce the number of unemployed secondary school leaver’s rate of drop out, crime rate, violence, substance abuse and the rise of political extremism associated with it.

Ministry of Education (Technical Division) will benefit from the findings of this study. Effectiveness of Computer Tutorial and Drill will no doubt influence the decision of the Ministry of Education on the need to provide computers and laboratories in senior secondary schools if found to have positive effect. Furthermore, findings will also sensitize the Ministry to organize conferences, workshops and seminars to train basic electronics teachers on the use of Computer Tutorial and Drill to improve their instructional delivery.

The significance of this study is particularly in the area of curriculum development. The result will be of immense benefit to the basic electronics curriculum development experts. They will find it valuable especially in the provision of empirical evidence on the effectiveness of computer tutorial and drill in the teaching of basic electronics. The information obtained, will hopefully influence future trend in basic electronics curriculum review. The findings of this study will provide curriculum planners with the information which could lead to the recommendation of Computer Tutorial and Drill in teaching basic electronics in senior secondary schools.

Lastly, this study will also serve as source of literature to schools and educational researchers.

Research Questions

The following research questions were formulated to guide this study:

1. What are the mean achievement scores of students taught basic electronics with Computer Tutorial and Drill and those taught using the conventional teaching methods?
2. What are the mean interest scores of students taught basic electronics with Computer Tutorial and Drill and those taught using the conventional teaching methods?

3. What are the mean scores of students taught basic electronics with Computer Tutorial and Drill and those taught using the conventional teaching methods in the retention test?

4. What are the mean achievement scores of boys and girls taught basic electronics using Computer Tutorial and Drill?

5. What are the mean interest scores of boys and girls taught basic electronics using Computer Tutorial and Drill in the interest inventory items?

6. What are the mean scores of boys and girls taught basic electronics using Computer Tutorial and Drill in the test for retention of learning?

Hypotheses
The following null hypotheses were tested at 0.05 level of significance.

Ho₁: There is no significant difference between the mean achievement scores of students taught basic electronics with Computer Tutorial and Drill and those taught using conventional teaching methods.

Ho₂: There is no significant interaction effect of treatments given to students by gender with respect to their mean scores in the basic electronics achievement test.

Ho₃: There is no significant difference between the mean interest scores of students taught basic electronics with Computer Tutorial and Drill and those taught using conventional teaching methods in interest inventory items.

Ho₄: There is no significant interaction effect of treatments given to students by gender with respect to their mean scores in basic electronics interest inventory items.
Ho$_5$: There is no significance difference between the mean scores of students taught basic electronics with Computer Tutorial and Drill and those taught using conventional teaching methods in the test of retention of learning.

Ho$_6$: There is no significant difference between the mean achievement scores of boys and girls taught basic electronics using Computer Tutorial and Drill.

Ho$_7$: There is no significant difference in the mean interest scores of boys and girls taught basic electronics using Computer Tutorial and Drill.

Ho$_8$: There is no significant difference between the mean scores of boys and girls taught basic electronics with Computer Tutorial and Drill in a test of retention of learning.

Ho$_9$: There is no significant interaction effect of treatments given to boys and girls with respect to their means scores in Basic Electronics retention of learning.

**Delimitation of the Study**

The study is delimited to determining the combined effects of Computer Tutorial and Drill on achievement, interest and retention of Senior Secondary School Students in basic electronics in Lagos State as well as the effects on the learning outcomes with regards to gender. Other aspects of Computer Tutorial and Drill such as simulation, games and others are not covered in this study.
CHAPTER II
REVIEW OF RELATED LITERATURE

The review of related literature to this study is organized under the following sub-headings:

1. **Conceptual Framework**
   - Computer Assisted Instruction
   - Computer Tutorial
   - Computer Drill
   - Basic Electronics
   - Conventional Teaching Methods in Secondary Schools
     - Lecture Method
     - Project Method
     - Demonstration Method
     - Field Trip
   - Computer Technology use for Teaching and Students’ Achievement in Learning.
   - Achievement, Interest, Retention and Gender.
   - The Teaching of Basic Electronics in Secondary Schools.
   - The Use of Computer Tutorial and Drill in the Teaching of Basic Electronics.
   - The Need to Change Teaching Strategy for Basic Electronics.

2. **Theoretical Framework**
   - Cognitive Learning Theory and use of Computer Technology for Improving Students’ Achievement.
• The Operant Conditioning Model and Stimulus Response (SR) Associated Theory

3. Review of Related Empirical Studies

* Studies on the Combined Effect of Computer Tutorial and Drill Instructional Package on students’ Achievement.
* Studies on Combined Effect of Computer Tutorial and Drill on Students’ Achievement, Interest and Retention in Learning.

4. Summary of Review of Related Literature

Conceptual Framework

Computer Assisted Instruction

Computer Assisted Instruction (CAI) or Computer Aided Instruction (CAI) refers to the use of computer as a tool in teaching and learning. It includes drill and practice, tutorials, simulations, instructional management, supplementary exercises, database management, word processing and other types of computer applications (Okundaye, 2005). According to Okundaye (2005) CAI may also refer to as an automated instructional technique in which computer is used to present an instructional programme to the learner through an interactive process on the computer. The students receive feedback from the computer and maintain some degree of control. CAI as a supplement to conventional teacher – directed instruction produces achievement effects superior to those obtained with conventional method alone. (Akudolu, 1998). Examples of CAI applications include guided drill practice exercises, computer visualization of complex objects, and computer – facilitated communication between students and teachers. The guided drill is a computer program that poses questions to students, returns feedback and selects additional questions based on the student’s responses. Recent guided drill systems incorporate the principles of education in addition to subject
matter knowledge into the computer program. Some of the CAI tools, (such as word processors, spreadsheets and database) collect, organise, analyse and transmit information. They also facilitate communication among students, between students and instructor, and beyond the classroom to distant students, instructors and experts.

Computer Assisted Instruction (also called Computer Aided Instruction) is the use of computer and its accessories in providing learning experiences and self directed instructions to a learner using tutorial and simulation packages, with little or no assistance from instructors. In developed countries, the use of computer as a teaching tool has reached an advanced stage (Mudasiru and Adedeji 2010). Drill and practice programs according to Okundaye (2005) are probably the most common and best known educational application of computer. He explained that just as it implies, students are assigned to teachers to see them for drill and practice in performing particular set of discrete skills. In tutorials, components are used to teach course materials that are designed to allow students to learn at their own pace and ability. Simulation packages provide tools for simulating (providing an animated situation) experiments that would otherwise be too costly and take too long to produce. While drill and practice programs can be used adequately for theoretical study, the simulation programs are most suited for practical experiments in sciences.

Computer Assisted Instructions (CAI) brings with it several potential benefits as a teaching/learning medium. These include learner controlled instruction, immediate knowledge of result, adaptability of instruction, revision and updating and self-pacing. With self-paced learning, learners can move as slowly or as quickly as they like through a program. According to Onasanya, Daramola and Asuquo (2006) CAI allows students to progress at their own speed of learning as they offer learners controlled instructions, provide prompt feedback
to the learner, allow for adaptability of instructions (presentations mode and instructional content mode) using authoring systems, provides lessons with more than one purpose, random access facilities, and provides facilities for revisions and updating. With self-directed learning, learners can decide what they want to learn and in what order. Various studies (Entwistle, (1981); Schmeck (1988); Ford and Chen, (2001) have shown that when learners can learn in a way that suits them, improvements in the effectiveness of the learning process normally occurs. Humans are multi-sensory animals. The more senses through which we receive information, the easier it is to remember. According to Fletcher (1990), people remember 20% of what they hear, 40% of what they see and hear and 75% of what they see, hear and do. The fact that the computer can exercise various senses and present information in a variety of media can enhance the learning process. Meskill & Mossop (1997) reported that computer assisted instruction encourage learning as it enhance students’ interaction with the learning environment which in turn help sustain students’ interest in learning and consequently improve students’ achievement and retention of learning.

**Computer Tutorial**

The subject-matter is literally taught by the computer programme. Explanations are given orally through audio-tape and needed visuals presented in cathode ray tube as in television. The student responds on a typewriter keyboard or by pointing on the screen with a light pen. The computer reacts to student’s response by ‘talking’ to him. Student makes further response. A kind of dialogue takes place between student and machine. CAI tutorials are based on the principles of programmed learning. The student responds to each bit of information presented by answering questions about the material and then gets immediate feedback on each response. Each tutorial lesson has a series of frames. Each frame poses a question to the student. If the student answers correctly, the next frame appears on
screen. There is disagreement among educators on how these frames should be arranged. Some educators are proponents of the linear tutorials. While others prefer the branching tutorials. The linear tutorial presents the student with a series of frames each of which supplies new information or reinforces the information learned in previous frames. The student has to respond to every frame in the exact order presented, and there is no deviation from this presentation, but the student does have the freedom to work through the material at his/her own speed. The branching tutorial allows more flexibility in the way the material is covered. The computer decides what material to present to each student. The pupil’s responses to the questions determine whether the computer will review the previous material or skip to more advanced work (Mudasiru and Adedeji, 2010).

**Presentation of Lectures with Computer Tutorial and Drill**

The following methods are used:

1. Linear Lesson: Linear lesson in tutorial and drill is a lesson with forward cycle branching. It also has backwards cycle branching.
2. Jumping Lesson is a lesson that a student can jump or skip any part and select the section he/she wants to study.
3. Branching lesson is a lesson that is arranged in branches. Any branch can be selected and studied at any time.

**Categories of Computer Tutorial and Drill**

- Single menu: This is a program that is single.
- Linear sequence menu: This is a program whose lesson is arranged in linear sequence.
- Tree structure menu: This is a program whose lesson is illustrated using trees.
Network menu: This is a program whose lessons are networked among users.

Computer Drill

Drill software differs from tutorial software in a key way. It helps students remember and utilize skills they have previously been taught, whereas a tutorial teaches new material. Students must be familiar with certain concepts prior to working drill programs in order to understand the content. The typical drill programs design includes four steps:

1. the computer screen presents the student with questions to respond to or problems to solve;
2. the student responds;
3. the computer informs the student whether the answer is correct; and
4. If the student is right, he or she is given another problem to solve, but if the student responds with a wrong answer, he or she will be corrected by the computer (Mudasiru and Adedeji 2010).

Basic Electronics

Electronics as a field of study is both science and technology related. It is concerned with the ways in which the movement of electrons through space or solids is controlled and manipulated. It deals usually with very small currents in contrasts to the science of electricity, which deals with the generation and use of large currents.

The whole science of electronics according to Adesina (2002) started in 1904 when the English Electrical Engineer, John Ambrose Fleming, inserted a metal plate into an electric light bulb. The lighted bulb filament being very hot boiled off electrons and the metal plate being cold, did not which shows that, electrons could get across the gap from filament to the plate but not from the plate
to the filament. In this way, the first measure of control of electrons i.e. a movement in one direction only was effected.

Some contributions of basic electronics to national and social developments according to Nweke, 2007 are as follows:-

(1) Modern communication through radio, television, telephone, fax, telex, internet and radar.

(2) The use of electronic communication system such as telephone, internet etc to make banking transaction e.g. ATM (Quick withdrawals) electronic money transfer (using money gram, western union money transfer, e-dividends, e-payments), checking accounts balance.

(3) Using electronic communications systems to facilitate teaching, learning and information acquisition using the radio, television, GSM, internet browsing, electronic projectors, CDs,

(4) Using computers, photocopiers, teleprinters, e.g. WAEC, NECO, Census Board to process results.

(5) E-mail, E-library, E-shopping.

(6) Engineering design, production and manufacturing using auto cads, CAD/CAM.

(7) Data and information storage using computers, CD, DVDs.

(8) Planning and decisions making using computers.

(9) E-business using internet, fax, telex, printing of ID cards, license, passports.

(10) Entertainment through music and sports.

(11) Mass media.

(12) Desktop publishing/typesetting.

(13) Industrial automation.

Conventional Teaching Methods in Secondary Schools
Okubote (2002) has stated that the traditional approach to teaching in schools involve the use of items such as chalkboard, chalks, posters and charts by instructors to disseminate information to the learners. The teaching session usually last for a period of 35 to 45 minutes, for a particular topic to be written on the chalkboard. The instructor illustrates with few examples before giving out assignments. Alo (2003) pointed out further that in this approach, the teacher has a one – to many relationships with the students. He is able to project his ideas in the best form known to him and he evaluates the students’ response from their facial expressions and attitudes. However, the traditional approach has some shortcomings, which can not be overlooked. The dissemination of instruction in this approach is mostly through verbal medium and this can be affected by a number of communication flows. Instructions may be understood or misinterpreted as the case may be. Situ, (1999) in his view, highlighted that similarly, an instructor may not be patient enough to give out the information required in a step-by-step fashion. Rather than doing that, he is only concerned about covering the syllabus on time and this may have adverse effect on the learner. Okubote (2002) further stated in her work that since every learner has different learning paces, it will be difficult for the instructor to carry every person along thus the traditional approach will not allow learners learn at their own pace.

Teaching according to Akudolu (1994), is a deliberate effort by a mature or experienced person to impart information, knowledge, skills to an immature or less experienced person through a process that is morally and pedagogically acceptable. Similarly, Moore, (1998) defined teaching as the action of a person imparting skills or knowledge or giving instruction. In the same vein, Clark and Star (1986) maintained that teaching is an attempt to assist students in acquiring or changing some skill, knowledge ideal, attitude or appreciation. Therefore, teaching involves the setting up of activities to enable somebody learn something which can improve
the person’s knowledge, skills, attitudes and values. Thus, the aim of teaching is to facilitate learning. For teaching to facilitate learning, Akudolu (1998) emphasized that the content to be taught has to be worthwhile and the procedure has to be educationally acceptable for activity to be classified as teaching. In this context, teaching can therefore be defined as a systematic activity deliberately engaged in by somebody to facilitate the learning of the intended worthwhile knowledge, skills and values by another person and getting necessary feedback.

Central to the process of teaching is the concept of effective teaching. Effective teaching is one that produces demonstrable result in terms of cognitive, affective and psychomotor development of the students. Effective teaching depends on the teacher’s use of appropriate instructional methods and techniques (Cabrera and La Nasa, 2002). In vocational and technical education, teaching methods and techniques are aimed at developing in the learners, the ability to acquire the knowledge and skills useful for work. These methods and techniques can vary in depth and time, depending on the level of students and the materials available for instruction.

According to Nwachukwu (2001) the task of organizing for effective teaching is crucial in any educational setting. The crucial decisions at all instructional levels of the organization will be centered on such factors as what to teach, when to teach and how to teach it. These decisions are made by the teacher himself and a good insight and understanding of their decisions will assist the teacher greatly in developing a good plan for teaching.

At the classroom level Nwachukwu (2001) maintained that how to teach the selected elements depends on the teacher. In vocational and technical education, Nwachukwu pointed out that teaching methods and techniques aim at developing in the learner the ability to acquire the knowledge and skills useful for work. Teaching methods are used by all teachers to present skills, knowledge and
appreciations to the learners in the classroom and to engage learners in the tasks involved while teaching techniques are processes adopted by veteran teachers to inject variety, in their teaching, stimulate it and maintain the learners’ interest in it (Ogwo and Oranu, 2006; Ukoha and Enegwe, 1996). They maintained that instructional techniques are subsumed in teaching methods as ancillaries or adjuncts to ensure the effectiveness of the method. A comprehensive study of available literature in vocational and technical education reveal extensive listings of teaching methods as conceived and classified by various authors.

Conventional teaching methods relate to my study in that both teachers used the same lesson notes and evaluation questions. It is only the use of computer for the experimental group that makes the difference.

**The Lecture Method**

The lecture method involves a formal discourse or exposition on a subject matter in order to attain a stated instructional objective; the teacher does the talking while the learners listen and occasionally take notes (Ukoha & Eneogwe, 1996). According to Okoro (1999) in lecture method the teacher or some other knowledgeable person supplies information to the students. Awotua & Efebo (2002) explained that lecture method is a teaching method whereby the teacher transmits information (subject matter, content) verbally to the students. Sometimes, it involves writing on the chalkboard or using instructional materials. The students listen and take notes of facts that are considered important; sometimes the students are allowed to ask questions for clarification.

Lecture method according to Ukoha & Eneogwe (1996) encourages self study and research; the method is convenient for teaching large number of students at the same time, it is useful to cover a considerable amount of lesson content in a very short time. It is essential for setting out course objectives, providing explanations and analyzing relevant aspect of a course of study, and finally using
the lecture method, the learners develop communication skills such as note taking, listening and summary writing. However, Ukoha & Eneogwe noted that lecture method is a further extension of the traditional viewpoint that the teacher is an embodiment of knowledge. It is thus, the responsibility of the teacher to dish out or disseminate the knowledge to the learners who are supposedly ignorant and blank. They maintained that lecture methods is one-way communication affair which appears autocratic and encourages students passivity; rote learning and is inappropriate for teaching and encouraging students to think for themselves. Nwachukwu (2001) contends that good teaching always provides for a two-way communication between the teacher and the students and for this reason other methods such as demonstration are more effective than the lecture method in many situations. However, Nwachukwu said that short talks and verbal explanations are common and necessary in all practical instruction.

Thus, lecture method is useful in vocational and technical education. Ericson (1998) explained that fact to be learned in connection with the work performed is often as important as the tool and processes involved in the performance. According to Ericson, to tell facts to students in vocational and technical education may be the shortest way to the acquisition of such facts; and while the argument has been advanced that telling is not teaching, it offers at least opportunities for obtaining useful and essential facts at a minimum express of a time. Okoro (1999) in his own point of view noted that the lecture method has only limited use in vocational and technical education. Teachers should resist the temptation to give lengthening lecture since such lectures are usually dull and are incapable of stimulating and sustaining the interest of students.

The Project Method
The project method is also one of the methods which are predominantly used in teaching in the secondary schools. The project method at the same time is one of the standard teaching methods in vocational and technical education. It is a means by which students develop independence and responsibility, and practise social democratic modes of behaviour (Ericson, 1986). Project method of teaching is suitable for large group, small group and individual instruction (Okoro, 1999; Ukoha and Eneowe, 1996). Ukoha & Eneogwe, explained that the project method originated in the early twentieth century. It was greatly influenced by Dewey’s problem method of teaching and it is an original work of W.H KillPatrick who advocated purposeful activity, problem solving and the needs and interest of the individual child in action, learning and conduct. The underlying principle of the method according to them is that learning takes place through direct contact with materials.

A project method according to Nwachukwu (2001) implies a practical problem, which a student and the teacher plan to execute. The planning and the executing must be concrete in nature. It should involve the design, arrangement of materials, availability of equipment and tools and a good environment for the activity. On the part of the teacher, he/she must have an excellent understanding of the individual after learning has taken place. The execution should meet the following objectives; to encourage the individual; to assist the individual and to direct the individual for specific changes. Similarly, Ukoha & Eneogwe (1996) stated that a project is a learning activity selected, planned, designed and executed by learners collectively or individually to clarify facts, acquire new knowledge, skills, appreciation and to solve identified problems under the teacher’s guidance and supervision. They asserted that whether group or individual project there must be a clearly stated purpose to be achieved by the group or individual. The effectiveness of any project depends on its purpose and usefulness. Knoll (2004)
added that project has four phases; purpose, planning, executing and judging. The ideal progression is when all the four phases are initiated and completed by the students. Therefore, he maintained that the role of the teacher in providing guidance and direction to the students should not be completely eliminated. This is because it is true that students tend to exaggerate their power of execution and to select project that is beyond them.

**The Demonstration Method**

According to Ericson (1998), from the time vocational technical courses were introduced into the school subjects, the demonstration method has stood out as the most definite and valuable means of instruction. It continues to be so whenever it is desirable to have students learn exact and acceptable procedures in mechanical operations.

Demonstration method of instruction according to Nwachukwu (2001) is one of the very effective methods applied by the teachers in achieving objective learning in real-life situations. Nwachukwu noted that demonstration usually involve a process in which the learner follows a manner of planned and organized steps. These steps help the method become a realistic and impressive one and also prove a true learning experience where actual object, good models or apparatus are used. Writing on the importance of demonstration method, Nwachukwu (2001) said that the importance of demonstration method using the appropriate techniques is highlighted for the following reasons.

(1) The demonstration method of instruction helps to enlist the various senses in human being. The senses include the sense of sight, the sense of hearing, the sense of feeling and the sense of recall.

(2) It helps to motivate students, especially when skilled teachers carry it out. The method helps students develop interest and attention.
(3) The participatory nature of the demonstration method helps students for effective communication. No effective learning will take place unless there is a two-way traffic approach to learning.

(4) It saves time and energy especially for the teachers.

(5) The method helps to enhance the prestige of the teacher, as students get convinced of the teacher’s command of the subject.

(6) There is measure of positive reinforcement in which case students repeat what the teacher has demonstrated.

(7) It gives a real-life situation of the course of study as students acquire skills in real-life situation using tools, materials in actual job situation.

(8) It allows process and product evaluation.

In the same vein, Ericson (1998) opined that demonstration methods as performed by the teacher are unfailing in developing and maintaining interest among students for the following reasons:-

(1) There is an appeal to the sense of vision.

(2) Skilful performance in hand manipulation always attracts attentions.

(3) Students see immediately, progress as a result of effort.

(4) A desire is around to emulate work of the teacher.

In using demonstration method for instruction, Okoro (1999) pointed out that for demonstration to be effective, the teacher should

(1) Plan the demonstration

(2) Prepare students for the demonstration.

(3) Carry out the demonstration process and re-state the important points connected with it.

The demonstration as performed by the teacher according to Ericson (1998) is unfailing in developing and maintaining interest among students for the following reasons:
- There is an appeal to the sense of vision.
- Skilful performance in hand manipulations always attracts attention;
- Students see immediate progress as a result of effort;
- A desire is aroused to emulate the work of the teacher.

Demonstration method is divided into three classes namely: class demonstrations, group demonstration and individual demonstration. Class demonstration is a type of demonstration given to an entire class at one time in one subject. The use of class demonstration that involves the entire class saves the teacher’s time. However in using class demonstration, the following factors are important for a successful demonstration according to Ericson (1998):

The class should feel a need for the demonstration: It may be the task of the teacher to use some artificial means to produce such an attitude, but in most cases the need for information about work which students are eager to do can be the determined factor for the time of the demonstration primarily because they had been planned in advance for a certain date.

Confine the demonstration to single unit of work: Teachers often fail to analyze the instructional material into sufficiently small units. As consequences the demonstration becomes long, and uninteresting. Teachers should emphasize a small unit and enable the class to practise as quickly as possible after proper interest has been aroused in the unit taught.

Have equipment and materials in readiness: All devices to be used in a demonstration must be at hand. While the teacher goes to the tool room or send students to bring instrument else where during the demonstration, attention is diverted and the emphasis on the unit of instruction is weakened or destroyed.
Make demonstration accessible to learners: During demonstration in the school shop, teachers should assume a position that will enable all the students to see in detail and hear the oral explanation.

Use effective oral explanation: Oral explanation and discussion are needed for effective demonstration but must serve to focus and hold attention upon the work being performed.

Practise privately: Every demonstration covering a new unity of work, which has not been recently performed by the teacher, should be practised beforehand. It happened too often that the teacher runs against some unforeseen difficulty when he relies upon his imagination and previous experiences and thus the class loses confidence in the teacher and interest in the work.

Teacher should not demonstrate on student’s work: It is unfair to give one individual student the benefit of the work done in the demonstration. The teacher should perform on a separate article, which may belong to him or to the shop when completed.

Do not quit too soon: It is better for the teacher to give a longer demonstration carried out to a satisfactory completion, than to stop short of goal and attempt to cover the remainder through oral discussion. Care must be taken to stop the demonstration mid-way so as to prevent the impression that the teacher is afraid to try to perform certain processes because of lack of skill.

Use common tools: To reserve the newest and best looking tools for the teacher’s demonstration bench is a mistake. Such tools may not work better, but they appear as if they might, and thus create suspicion. Give the new tools to students and use older ones for demonstration. This will show that the outward appearance of tools has little to do with the work they perform if they are in proper condition. The same sizes of tools should also be used as those given to students.
Give example in accuracy: The excuse by the teacher that he is not taking the time to do the work as well as he wants it done by the class is not always acceptable by the students. No greater accuracy or better technique can be demanded rightfully at anytime in shop than is set as a standard by the teacher’s work.

Use acceptable trade method: The teacher should use the acceptable procedure necessary for carrying out the task in a trade to facilitate the understanding of the unit of lesson. Check the success of the demonstration: Before requesting the student to practice what they have learnt teacher should ensure that the demonstration has served its purpose. At the best there will be need for correcting wrong impression, assisting in establishing correct habits, and encouraging those who lack confidence to go on.

Other methods used in technical and vocational education are discussion and field trip. The discussion method is based upon extensive contributions of ideas and expressions from the members of the class (Ericson, 1998). This method gives students an opportunity to derive information from themselves and teacher. According to Ericson, the assumption is that everyone in the class has something to contribute. The students and the teacher are actively involved in talking, unlike in lecture method where the teacher does all the talking. Ukoha & Eneogwe (1996) added that two key points should be noted when using discussion method; discussion required a clearly stated objective to serve as a focus and guiding post. Neglecting this criterion may hamper the realization of the set objectives, as discussion may degenerate to mere informal debate on superficial issues and the emergence of a star speaker who eventually will dominate the discussion. Secondly, to ensure effective participation of the members, prior knowledge of the discussion topic is essential. The discussion topic could be derived from several controlled experiences of the learner, such as going on a field trip, viewing an
educational filing, listening to a lecture or reading an assigned book. Demonstration is one of the conventional or traditional methods employed for teaching vocational and technical education subjects in senior secondary schools. It was also compared with computer tutorial and drill in this study.

**Field Trip**

Field trip offers students opportunity to study industrial process and relate what they learn in the school with what actually obtained in the world of work. Learning provided by field trip is concrete, sensory and basic. This is because students are provided with opportunity to see and observe things, places, people and processes in real life settings. (Nwachukwu, 2001), explained that, if it is not learning oriented it is not field trip. It is important to note that field trip should not be embarked upon unless there is a fully developed plan with a clear objective for the students. Furthermore, after the field trip teachers should request the students to submit report of what they have learnt and this should be discussed in class. This actively makes the field trip learning experiences rather than mere site seeing. In this study, field trip was not among the conventional methods compared with computer tutorial and drill.

**Computer Technology use for Teaching and Students’ Achievement in Learning**

Students’ achievement connotes performance in school subjects as symbolized by a mark or score on an achievement test. According to Epunam (1999) academic achievement of student is defined as the learning outcomes of the students which include the knowledge, skills and ideas acquired and retained through his course of study within and outside the classroom situations. It is quantified by a measure of the student’s academic standing in relation to those of other students of his age (Anene, 2005). Students’ achievement is dependent upon
several factors, among which are teachers’ qualifications (teachers’ experience and education), instructional methods and learning environment.

Teacher quality is a very important determinant of the quality of education. According to Rivkin, Hanushek and Kain (2000) measurable characteristics of teachers such as teacher experience, and education, explain variation in teacher effectiveness. Demmert (2001) opined that solid content knowledge, sound pedagogy, outstanding interpersonal skills, understanding of cognitive development and the different learning stages of students, are well-established characteristics of effective teachers that produce greater students’ achievement.

Over the past decades, educational research has focused on the question of what influences academic achievement or, more generally, what influences learning. Most studies support theories that focus on the interaction between the student and the learning environment. The interaction approach, assumes that academic achievement or learning is a result of the complex interaction between the students and the learning environment. Interaction is a more important facilitator of learning. Educational technologists have, of course, always understood that a student must interact with an environment for learning to occur (Winn, Hoffman, Hollander, Osberg, Rose and Char, 1997). Similarly, (Osberg, Winn, Rose, Hollander, Hoffman and Char (1997) noted that interaction is a critical component to students' knowledge construction. Brewer (2003) opined that computer-based technologies are powerful pedagogical tools and can turn the passive students into an active participant in the learning environment. According to UNESCO (2002) computer technology provides powerful tools to support the shift to student-centred learning and is capable of creating a more interactive and engaging learning environment for teachers and learners.

Computer enhances how students learn by supporting four fundamental characteristics of learning: Active engagement, participation in groups,
connections to real-world contexts, frequent interaction and feedback (Basham, 2007). Strong and Smith (2001) stated that human/computer interface has a direct relationship to stress on the user’s cognitive ability. When designing instructional materials for computer use as well as subject matter mastery, stress is reduced if a user can easily make use of the interface, comprehend the functions, and use the tool to solve problems. Students must be able to easily navigate in a computer environment in order to focus on the topic.

According to Cotton (2001) the use of computer based learning produces achievement effects superior to those obtained with traditional instruction. Cotton explained further that student learning rate is faster with computer based learning than with conventional instruction. For instance, cotton noted that in some research studies, the students learned the same amount of material in less time than the traditionally instructed students, besides, students receiving computer-based learning learn better, faster and have more positive attitudes towards learning than students receiving conventional. Other benefits of the computer based learning include: Locus of control, Attendance, Motivation/time-on-task, and Cooperation/collaboration

Therefore, nowadays, it is a generally held position that the process of learning will improve when learners are given computer-based learning that allow for interactive access tuned to the specific needs of each individual learner. Computer artifacts for learning should therefore be both interactive and articulated. Interactive learning environments can be seen as engines for education that facilitate learning by having learners interact with a simulation of the subject matter. Bialo (1990) expresses that students like working with computer for the following reasons:

• Computer never get tired
• Allow students to work privately
• Never forget to correct or praise
• Are self paced
• Do not embarrass students who make mistakes

In the same vein, Edward (1985) opined that computer enhances students’ achievement in the following ways
• Help students improve their spelling
• Call for using sight, hearing and touch
• Give a sense of control over learning
• Is excellent for drill and practice
• Give immediate feedback
• Saves time than conventional teaching
• Encourages individualised learning
• Minimizes the problem of large class
• Conserves the teacher’s energy

Achievement

Achievement according to Longman Dictionary of Contemporary English (New Edition) is something important that you succeed in doing by your own efforts. Academic achievement according to Lavin Theory (1965) refers to some methods of expressing a student’s scholastic standing. This can be regarded as a source or subject grade, an average for a group of courses/subjects in a programme of study for example in basic electronics. The theory further stresses that there are two dimensions to academic achievement namely: good and poor achievements. Good academic achievement leads to success while poor academic achievement leads to failure. Each of these two achievements is experienced by students in one form or the other.
In this study, any student who scores between 50 and 100 out of the obtainable 100 marks is considered to have good academic achievement while those who scores between 0 and 49 are considered to have poor academic achievement. Tella (2007) states that a number of motivational processes are involved in achievement. The processes are intrinsic motivation which is based on internal factors such as self determination, curiosity, challenge and effort, and secondly extrinsic motivation which involves external incentives such as rewards and punishments. Some students (e.g. basic electronics students) study hard because they are internally motivated to achieve high standards in their work (intrinsic motivation) while other students study hard because they want to make good grades or avoid parental disapproval (extrinsic motivation). Achievement of student in any subject or occupation depends on his interest.

**Interest**

Musa, (2006) defines interest as a zeal or willingness of participating in activity from which one derives some pleasure. He further observed that interest is a tendency to become absorbed in an experience and to continue in it. From the foregoing, interest in a particular thing is a feeling manifested in an activity.

Umunadi (2006) observes that students’ interest is closely associated with their achievement in basic electronics. Umunadi (2006), further states that one’s success in basic electronics is influenced by his interest in it which might be due to the type of approach used in teaching basic electronics. If you have an interest in something or someone, you will want to know or learn more about them. Ukwungwu (2001), views interest as a tendency to pay attention to and enjoy some activities that pleases or engages the attention of the learner. According to Akano (1996), interest is an organisamic condition that results in a desire for further stimulation from a particular type of object, idea or experience. All the above definitions from several scholars suggest that interest has been conceptualized as
the internal state of mind or predisposition to the experiences of individuals. Obioma & Ohuche (1988) reported that students performed significantly better in those areas they had interest, and performed poorly in the areas they lack interest. This lack of interest of students in basic electronics due to the teaching method used, make them also to lack retention of learning in the subject.

Situ (1999) defines interest as an expression of likeness or dislikeness which plays a significant role in learning all subjects or courses. Situ further stressed that if a student is interested in any subject, such student will spend more time studying that subject. Osuafor (2001) observes that the effective disposition of a student has direct relevance to his interest in learning. He further stressed that interest is an effective behaviour that can be aroused and sustained in teaching and learning through appropriate teaching method.

Ifeakor (2004) investigated on the influence of production and utilization of instructional materials on secondary school student’s interest in chemistry. He used 700 SS II students randomly selected for use as a subject of the study in Anambra State. It was a survey research and he used 4 – point scale questionnaire to assess the interest of students on the production and use of instructional materials on the students. He analyzed his data using frequency count and percentage. The result revealed that students showed greater interest in the production and utilization of instructional material.

Eze (2006) studied effects of Geo-board on junior secondary school students Achievement and interest in Geometry. The study employed a quasi experimental design. The sample comprised 360 JSS II students drawn from Obollo Afor Education zone of Enugu State. The study comprised 8 intact classes, 2 from each of the four co-educational secondary schools sampled. Two intact classes one for experimental and the other for control groups were used from each of the 4 school for the study. He used Geometry Achievement Test and Geometry interest
inventory as his instruments. He analyzed his data using adjusted mean, standard deviations and Analysis of covariance. The result showed that Geo-board improved achievement and interest of students in geometry. It is relevant to say that interest is a stronger factor in the teaching and learning of various disciplines in which basic electronics in senior secondary school in Nigeria is of no exception. The extents of behaviour towards basic electronics are largely determined by the kind of interest developed by the students.

Researchers have made recommendations on the way to improve the interest of students in their various areas of specialization. Such recommendations include students’ motivation; making teaching more meaningful by improving on the teaching method adopted; making teaching more concrete and concise. The above creates the need for adoption of innovative techniques or method of teaching in basic electronics. The use of Computer Tutorial and Drill may facilitate, develop, sustain and retain the students’ interest in basic electronics. Therefore, the degree at which the adoption of the use of Computer Tutorial and Drill can affect interest in basic electronics creates the need for this research work.

Nwachukwu (2001) states that the learners’ interest is very important in the study of any subject because the interest of a learner is in many ways the reflections of his/her deeds as well as strong indicators of timeless and relevance. Therefore, it is pertinent to say that the interest of a student in a particular subject or course has a long way in the academic achievement of such student.

The Federal Ministry of Education (1993) in her report showed that senior secondary school students are always not being interested in vocational subjects because of un-motivating and unchallenging methods and approach used by their teachers. Interest, according to Agwagah (1993), is the preference for particular types of activities, which is the tendency to seek out and participate in certain activities. Situ (1999) defines interest as an expression of likeness or dislikeness
which plays a significant role in learning all subjects. It is therefore the zeal or willingness to participate in any activity from which one derives some pleasure. This implies that if a student is interested in any subject, such student will spend more time studying that subject. Adeyegbe (2003) observes that students’ interest in a subject is closely associated with their achievement in that subject.

According to Osuafor (2001), the affective disposition of a student has direct relevance to his interest in learning. He further stressed that interest is that attraction which forces or compels a student to respond to a particular stimulus.

Therefore, interest is an affective behaviour that can be aroused and sustained in teaching and learning through appropriate teaching method. Teachers of basic electronics should device the ways and means of selecting various teaching methods that will arouse students’ interest in the subject.

However, teacher’s attitude to teaching and learning in basic electronics go a long way in academic achievement, interest and retention of the students. This was reaffirmed by Okereke (2006) who observed that more than anything else, teaching methods affect the responses of students and determine whether they are interested, motivated and involved in the lessons in such a way as to be engaged in good learning.

Retention

According to Momoh – Olle (1997), retention is viewed as the repeat performance by a learner of the behaviour than an acquired piece of knowledge is always intended to elicit in the learner (without practice) after an interval of time.

Momoh-Olle (1997) further contended that although retention initially fails with time (that is, it decreases rapidly with time), it later stabilizes to a plateau or permanent knowledge and that retention is affected by several factors among which are the degree of original learning, the method of learning, the method of measuring it and the time at which retention is measured after learning. Riding,
Grimely, Dahraei and Banner (2003) identified an individual’s working memory capacity and cognitive style as other factors affecting retention of learning. They explained that working memory refer to an active information processing resource of limited capacity which is necessary for performing cognitive tasks such as comprehension, reasoning and learning. The working memory system comprises three components: the central executive slave systems, the phonological loop and the visuo-spatial sketch pad. Riding et’al added that there are individual differences in working memory capacity and this accounts for differences in individual’s information processing efficiency. On the other hand, they further explained that cognitive style refers to an individual’s preferred and habitual approach to organizing and representing information and that there are various style labels which could be accommodated within two fundamental style dimensions, that is, the Wholist Analytic styles where the individuals tend to organize information in wholes or parts and the verbal-imagery dimension for individuals who are inclined to represent information verbally or in mental pictures during thinking. To learn and retain new knowledge, a comprehensive teaching method such as computer assisted instructional method is needed.

Retention simply refers to how much a person remembers after an interval of time without practice and that it is the difference between what is initially learnt and what is later forgotten. (Haynie, 2003) defines retention learning as learning which lasts beyond the initial testing and it is assessed with tests administered two or more weeks after the information has been taught and tested. Haynie further explained that retention of learning is measured with two tests: the initial test and the delayed retention test. The initial test is the test employed at the time of instruction or immediately thereafter while the delayed retention tests are those tests administered two or more weeks after instruction and initial testing to measure retained knowledge.
Okoye (1995) in her research investigated the effects of teaching methods (simulation and lecture) on academic retention of students in geography. The study was a quasi-experimental design. The data collected were analyzed using one way analysis of variance and two way analysis of covariance.

The hypotheses were tested at 0.05 significant levels. The results show that the students taught using simulation method had significantly higher retention ability than those taught using lecture method. Amuludun, Lemo and Usoro (2006) in their study on effects of multidimensional learning model on student’s academic retention and achievement in technical drawing used a quasi experimental design. The data collected were analyzed using ANCOVA and the hypotheses were tested at 0.05 significant level. The result shows that students taught with multidimensional learning model had higher retention ability than those taught with conventional lecture method.

Eze (2006) in his study investigated the effects of multiple intelligence based achievement and retention of learning in introductory Technology used a quasi experimental design. He used 100 JSS 2 students of introductory Technology in Etim Ekpo Local Education Committee zone of Akwa Ibom State and tested his hypotheses at 0.05 significant levels. He analyzed his data using ANCOVA and his result shows that the students who were taught with multiple intelligence based instructional approach performed better and have higher retention ability than those taught with conventional lecture method – in Introductory Technology.

Bracey (1987) in his study confirmed that students taught with computer assisted instruction retain electronic learning more than those taught with the conventional teaching method. He opined that students’ scores on delayed tests indicate that the retention of content learned using Computer assisted instruction is supervisor to retention following traditional instruction alone.
These studies are related to the present study in terms of the design adopted and the methods of data analysis employed for answering research questions and testing null hypotheses formulated. Both studies are experimental studies. There is still a gap to be filled hence, the work did not cover combined effect of computer tutorial and drill on students’ achievement in basic electronics.

**Gender**

On the issue of gender and gender related differences, the controversies in the school achievement and classroom behaviour according to Eze (2006) have continued to be inclusive. Eze opined that attempts have been made by researcher to account for and provide the theoretical bases of the so-called Gender related differences in school achievement.

Odusanya (2008) saw gender differences in another perspective. He saw female low enrolment in vocational subjects hence women think that vocational course is for men alone. He further stated that this makes women to occupy low status jobs that do not require specialized vocational training. He recommended that government should include vocational subjects like basic electronics, applied electricity, technical diaries, introductory technology etc as core subjects in the secondary school curriculum.

Identified with gender differences in academic achievement in languages in favour of boys than girls Kavale & Glass (1982) on CAI tutorial and drill concluded by saying that there appears to be some evidence that CAI is differentially effective for improving the academic performance and attitudes of young boys. Campbell and Swigger (1983) found that pre-school boys and girls spent equal free choice time on the computer hence CAI has no superior on either boys or girls. Watkins and Abram (1985) reported contrary to what is usually found in most conventional programs that boys performed as well as girls on a reading test following reading CAI tutorial and drill.
According to Oyenuga (2008) science and technology have assumed a certain stereotype image. For instance, scientific traits are believed to include remoteness, abstraction impersonality, detachment and objectivity. More often than not, these traits are readily associated with the male in the society while passivity, coyness, nurturance and subjectivity (Birke, 1986) are held to be feminine attributes. With this association, science is given a masculine image. Again, this image and other social and psychological barriers alienate girls with potentials from the subject area. In order for females to fit into feminine stereotypes, they often make choices which include them from the physical sciences, thus making science and technology (most especially basic electronics) exclusive domain of men.

(Kann, 1987) stated that computer assisted instruction used as a supplement to traditional instruction produced an educationally significant improvement in students’ final examination achievement. He opined that boys performed better than girls on the use of computer assisted instruction.

More females need to study basic electronics for a number of reasons. Firstly there is the need for equality of opportunity in order for both sexes to be part of the mainstream of development in basic electronics industry. Secondly, basic electronics subject is important for any nation to attain technological achievement, and it is essential to harness the vast human resources of both males and females in the promotion of socio-economic and technological development (Oyenuga, 2008). Consequently, less participation or involvement of females in basic electronics subject may constitute a drawback in the development process because their potentials for technical education would be left unutilized. Thirdly, there is a need for more females in electronics field in decision making positions as this would enable them to control the direction of basic electronics research and promote policies which will favour female species. According to Manthorpe (1982), men
make decisions about technologies that even affect females because women are under-represented in decision-making on technological development.

Various student’s centred teaching methods or strategies like computer tutorial and drill, Computer Assisted Instruction (CAI) and AUTOCAD software instruction could be used to balance unequilibrium situation between male and female in basic electronics or other vocational subjects as found out in this study.

**The Teaching of Basic Electronics in Secondary Schools**

According to Adesina (2002), electronics is a field of study that is both science and technology related. It is concerned with the ways in which the movement of electrons through space is controlled and manipulated. Electronics is the study of electrons. Various students’ centered teaching methods or strategies like Computer Tutorial and Drill, Computer Assisted Instruction (CAI), AUTOCAD, Software instruction could be used to balance un-equilibrium situation between male and female in basic electronics or other vocational subjects as found out in this study.

The objectives of studying basic electronics in senior secondary schools as one of the vocational subjects according to FME 1985 are to:

1. Develop a further understanding of the basic concepts and principles of electronics;
2. Build and test simple electronic devices;
3. Develop skills in circuit fault tracing and repairs;
4. Apply simple electronic devices in the construction of electronic system;
5. Prepare adequately for further work in electronics.

The importance of electronics cannot be over emphasized in the development of any nation. Its application is in numerous places such as: e-banking, e-learning, data processing, e-mail, industrial automation, radios,
television, computers, and aeronautics to mention but a few. The 21st Century can be named electronic age.

Okereke (2006) observes that during classroom instruction many teaching methods have been used in the past for teaching basic electronics at the senior secondary school level but still poor achievement persists. These instructional teaching methods include the use of the following: graph board, Oscilloscope, electronic kits, practical demonstration, lecture method and prior knowledge of instructional objectives. In senior secondary school where teaching of vocational subjects are involved, the inability of basic electronics teachers to identify and use the most appropriate and easy to understand method of teaching basic electronics has affected the students’ ability to acquire the necessary employable skills in the subject. This is why this study is focusing on the effects of using computer tutorial and drill instructional strategy in teaching basic electronics in Lagos State.

The Use of Computer Tutorial and Drill in Teaching of Basic Electronics

The CTD program started in 1986 by a single lecturer who recognized the pedagogical opportunity presented by a small classroom in Olson Hall and a closet full of unused Apple Compliers (Encarta, 2007). The program has grown steadily since then. Currently the composition program is offered in classroom. CTD programs are developed in various subject areas such as in mathematics, sciences, social sciences, administration and liberal arts. Several Computer Study courses have existing CTD program. Another program was designed by the University of the Witwatersrand for freshman year in general chemistry and is also suitable for advance placement chemistry student (Kulik, 1983).

CTD program is very interactive in the following areas: nuclear chemistry colligates properties, Coulomb’s Law, Electrolysis, and Solubility, periodic table trends etc all with a helpful guide and take each student 10-30 minutes to complete.
In a well equipped computer classroom and with proper training, instructors can do everything they could do in a standard classroom, but the computers allow them to accomplish many additional goals that would otherwise be difficult or impossible.

Projection screens enhance demonstration and allow for shared screen work; local network servers facilitate paper transfer of files; access to the internet can turn each seat into a library; and online conferencing can stimulate active, written participation by every student. Several works are being initiated by students and lecturers in Universities, Polytechnics and Colleges of Education such as development of ICT – Based Software (Courseware) and its Application in Teacher Education in Nigeria by Mudasiru and Adedeji (2010). The use of English Language for Junior Secondary School by Alo (2003), Situ (1999) on Child Centered Play therapy with computer simulation and animated and effect to improve teaching and learning of computer in primary school.

CTD is defined by many authors in many ways. Encarta (2007) defines CTD as diverse and rapidly expanding spectrum of computer technologies that assist the teaching and learning process. CTD refers to instruction or remediation presented on a computer. CTD includes Computer Tutorial software, drill software and simulation. Other instructions category includes computer managed instruction (CMI), Computer assisted testing (CAT) and test banking. CTD uses instructional or educational software known as courseware to aid classroom instruction. Information that helps teach or encourages interaction can be presented on computers in the form of text or in multimedia formats, which include photographs, videos, animation, speech and music. A CTD lesson can be taught by computer tutorial and drill, or simulation software. The guided drill is a computer program that poses questions to students, returns feedback, and selects additional questions based on the students’ response. Recent guided drill systems incorporate the principles of education in addition to subject matter knowledge into the
computer program. Computers also can help students visualize objects that are difficult or impossible to view e.g. electron movement, molecular structure or even human anatomy. Computer programs are interactive and illustrate a concept through attractive animation, sound and demonstration. They allow students to progress at their own pace and work individually or problem solved in a group. Computers provide immediate feedback, letting students know whether their answer is correct. If the answer is not correct, the program shows students how to correctly answer the question. Computers offer a different type of activity and a change of pace from teacher-led or group instruction.

Computer tutorial and drill improves instruction for students with disabilities because students receive immediate feedback and do not continue to practice the wrong skills. Many Computer programs can move through instruction at the student’s pace and keep track of the student’s errors and progress. Computers capture the students’ attention because the programs are interactive and engage the students’ spirit of competitiveness to increase their scores. Also computer assisted instruction moves at the students’ pace and usually does not move ahead until they have mastered the skill. Programs provide differentiated lessons to challenge students who are at risk, average or gifted.

The best way to make learning more concrete is to make use of real objects (Akinwale, 2004). In some situations, real object may either be too large or complex that hidden details are obscured. This situation arises in the study of basic electronics. For example the working principle of flow of electron in a circuit, the creation of electric field in a current carrying conductor. Teaching and learning must be brought down to the learner’s level using CTD animation, colours, photograph and audio.

**The Need to Change Teaching Strategy for Basic Electronics**
A lot of factors have necessitated the need to change teaching strategy or method. Among these are the effects of globalization and the rapid rate of technological changes and the need to address individual differences most seriously in the class room.

Teaching and learning process should be student centered and one way to bring about a change of emphasis in teaching from the teacher directed approach to a facilitated approach is to change the method of instruction (Kearsley 2000). This shows that technical education need total overhaul in terms of package and medium of instruction. Teachers should utilize appropriate strategy to pass across knowledge and enhance achievement, interest and retention.

According to Ogwo (1996) cited by Neekpoa (2007), Nigeria is saddled with educational problems of great magnitude, which the traditional methods of teaching and learning alone cannot solve. Roegge, Wentlin and Bragg (1996) stressed and reiterated that the traditional approach of delivery knowledge and skill through lecture must be improved or even abandoned and replaced with methodologies which allow students to learn needed skill in the context within which the skills are used in the real world.

With the recent trend in the electronics industry, there is a great need for basic electronics students in senior secondary schools to be well trained for the maintenance, repair and service of the latest electronics gadgets. For this to be achieved there must be a change in the conventional/lecture techniques adopted in teaching the students to a more fascinating strategy that could enhance good performance. This study therefore adopted the use of Computer Tutorial and Drill as an alternative technique in the teaching of basic electronics in senior secondary schools in Lagos State.

Theoretical Framework
Cognitive Learning Theory and use of Computer Technology for Improving Students’ Achievement

Learning is a relatively permanent change in behaviour (or behavioural potential) due to experience (Wade & Tavris, 1993). Ngwoke (2004) supporting this view of learning pointed out that learning is a process which causes a change in behaviour of an individual. This change in behaviour according to Ngwoke results from experience or interaction between the individual and his environment. He explained further that human learning is a process of adaptation which may lead, hopefully, to better adjustment to the demands of life. Learning is a continuous process which goes on throughout life. It may be observed in the form of development or change of attitude, interests, adjustments, skills, values, beliefs, cognitive structures, insights, mannerism, and gesture. However, behavioural change due to maturation or temporary conditions of the organisms (for instance instinct, reflex action, and imprinting, fatigue, the influence of drugs, and so on) are not learning (Nwachukwu, 1995; Hilgard, Atkinson and Atkinson, 1975). Learning can be said to have taken place when individual can act or think differently or when he has acquired new knowledge or skills (Abdullahi, 1982). It is determined by events in the individual’s living environment.

Learning involves the process of storing, transformation and retrieving of information. The problem of understanding how humans learn is essentially the problem of understanding how information is stored in memory, how the transformation of the stored information may occur and how stored information is retrieved for use in the further learning and problem solving (Steward and Aiken, 1982). The cognitive learning theory sees learning as a reorganization of knowledge structure. The knowledge structures are stored in semantic memory as schema or cognitive maps (UNESCO, 2002). The main emphasis of cognitive theory is on sequence of learning materials and experiences in a well organized
environment so as to create order, meaningfulness and understanding, that is, learner-environment interacting meaningfully (Shell, 1986). Some of major proponents of the cognitive theory are Piaget, Bruner and Ausbel. These proponents’ theories and their implications for the use of computer technology to achieve students-centred learning environment for improving achievement are discussed below:

The developmental psychology of Jean Piaget recognizes the active role of both learner and his environment in the learning process. Piaget asserts that the basis of all learning is the learner’s activity as he interacts with his physical and social environment. For learning to take place, the environment must be stimulating and encouraging learning (Nwachukwu, 1995). Based on his research on the development of learner’s cognitive functions, Piaget observed that learning occurs through adaptation to interactions with the environment. Disequilibrium (mental conflict which demands resolution) gives rise to Assimilation of a new experience, which is added to the existing knowledge of the learner, or to Accommodation, which is modification of existing understanding to provide for the new experience (UNESCO, 2002).

Specifically, Piaget posited that the existing cognitive structures of the learner determine how new information is perceived and processed. If the new information makes sense to the existing mental structure of the learner, then the new information item is incorporated into the structure (i.e., Assimilation). If, however, the information is very different from the existing mental structure of the learner, the information is transformed in ways that it fits into the mental structure (i.e., Accommodation) (Ngwoke and Eze, 2004). The learner has an active role in constructing his or her own knowledge in both of these ideas. According to UNESCO (2002) Piaget was of the notion that as children assimilated new information into their existing mental structures, their ideas gained complexity and
power, and their understanding of the world grew in richness and depth. These ideas are core concepts of the constructivism view of the learning process.

Bruner in his own theory emphasized that learning is an active process in which learners construct new ideas or concepts based upon their prior knowledge and experience (Nwachukwu, 1995). According to UNESCO (2002) Bruner identified three principles that guide the development of instruction. These include: (1) instruction must be concerned with the experiences and contexts that make the student willing and able to learn (readiness); (2) instruction must be structured so that the student can easily grasp it (spiral organization); and, (3) instruction should be designed to facilitate extrapolation and/or fill in the gaps (going beyond the information given).

Ausbel (1963) in his theory known as ‘sub-sumption model’ advocates for “meaningful” as opposed to “rote learning.” According to him, meaningful learning occurs when there is an interaction between the students’ appropriate elements in knowledge that already exist and the new materials to be learnt. However, where such interaction does not take place, rote learning occurs. Those parts of the learner’s cognitive structure (organization of knowledge) which can provide for the interaction necessary for meaningful learning are called “subsumers”. A subsumer is a principle or a generalized body of knowledge that the learner already acquired that can provide for association or “anchorage for the various components of the new knowledge, while subsumption model is an instructional device in which central and highly unifying ideas are stated in terms already familiar to the learner, to which he can meaningfully relate new learning materials by subsumption.

Generally, most of the theories discussed believe in the environmental influences on the learner’s achievement in learning and that meaningful learning occur as learner and his environment are always participating in a simultaneous mutual interaction. Thus, given interesting and rich learning environments and
Cognitive Learning theory in relevant to the study in that prepared materials for Computer tutorial and drill are Organised and arrange sequentially so as to create, order meaningfulness and understanding to students in order to determine effects of CTD on academic achievement, retention and interest of students in basic electronics.

**Need Achievement Theory of Motivation and the use of Computer Technology for Stimulating Students’ Interest in Learning**

Motivation has been defined as the level of effort an individual is willing to expend toward the achievement of a certain goal. Biehler & Snowman (1993) stated that motivation is typically defined as the forces that account for the arousal, selection, direction, and continuation of behaviour. According to Nwachukwu (1995) motivation refers to all those phenomena which are involved in the stimulation of action towards particular objectives where previously there was little or no movement towards those goals. Both definitions imply that motivation comes from within a person. Therefore, teachers’ responsibility is to create learning environment that will enhance students’ motivation to pursue academic goals actively over a long period of time.
The need achievement motivation theory rests on the belief that most persons want to achieve and experience levels of aspiration in a given environment. Contributors of achievement motivation theory are John W, Atkinson and David McClelland. According to Atkinson when an individual is actively involved on a task, he sets himself a standard to conquer (Ngwoke, 2004). This standard is called the level of aspiration. Nwachukwu (1995) pointed out that level of aspiration is a longing for what is above one, with advancement as its goal. Aspiration has to do with the desire to improve or to rise above one’s present status. There are two set of factors which interacts to determine the level of aspiration. They are the personal factors and the cultural factor/environmental factors. Ngwoke explained that personal factor relate to such personality traits as intelligence, interest, gender, self concept, activity level, socio-economic status and previous training experience. Cultural and environmental factors include parental ambition, social values and social reinforcement. Need achievement is more influenced by environmental factors. Some environmental factors encourage the development of immediate aspiration.

According to Ngwoke (2004) the implication of need achievement theory is that the teacher should create learning environment conditions that will help learners adequately assess their abilities and opportunities available so that they can set realistic and attainable goals. In this way learners will experience success in school activities and thereby build positive self-concept which enhances need achievement motive. Owing to the dominance of the teacher in the traditional teaching approaches, students are not engaged in the classroom activities because such environment is not provided. This results into rote learning and memorization of facts with little transfer of knowledge. Opara (2002) observed that the method hardly increased students’ enthusiasm and interest. Teaching methods based on cognitive learning theory such as use of computer technology provides students’
interaction with the learning environment which invariably provides meaningful learning activities. Meaningful learning activities built on prior knowledge motivate students and foster their interest in their effort to executively control their own cognitive process.

Need achievement theory is also found related to the study in that the learning environment where experiment was conducted is assumed to be adequately allow learners to assess their abilities and opportunities available, therefore set relationships and attainable goals.

**The Operant Conditioning Model and Stimulus Response (SR) Associated Theory**

In a school setting, the frequency of various behaviours can be seen as depending on the immediate consequences of those behaviours. For example, if a basic electronics student performs very well in an examination and he is rewarded with praise or gift or any other motivated things, he will tend to repeat his performances. According to Stoner (1982), the operand conditioning process may be expressed as: Stimulus – Response – Consequences – Future Response

The above means that the individual’s own voluntary behaviour (responses) to a situation or event (stimulus) is the cause of specific consequences outcomes. If a teacher uses a technique or strategy that is more understandable by the student, he will tend to have interest and retention in that subject. If the teaching method or technique is difficult to understand, the individual student will tend to lose interest or avoid such subject. This suggest that if a basic electronics teacher want to arouse his student’s interest in the subject, he must use a strategy or method which can arouse student’s interest and retention, this will make learning to be attractive or interested. Such technique or strategy is the use of computer Assisted Instruction.
According to Skinner (1969) and Watson (1980) in their experiment illustrating infant’s behaviour, Watson said; give me a dozen of healthy infants well formed and my own specific task is to bring them up to any desirable specialist of choice, be it an engineer, doctor, lawyer, artist, merchant, radiographer, surveyor, business tycoon regardless of his talents, traits, tendencies, abilities, vocation, race or even ancestry. The operant condition theory by B. F Skinner was highly acclaimed to be effective in training lower animals, human beings and especially young people. This study therefore, is anchored on the operant conditioning model and stimulus response associated theory.

Review of Related Empirical Studies

Studies on the Combined Effect of Computer Tutorial and Drill Instructional Packages on Students’ Achievement

The need to get students involved in the classroom learning activities has called for the need for teachers to use teaching methods which are student-centred to minimize rote learning and memorization of facts in the classroom. However, the present methods of teaching basic electronics to the secondary schools students remain predominantly teacher-centred. These methods include demonstration and lecture methods (Federal Ministry of Education (FME), (2000). Oranu (2003) maintained that these methods which are teacher-centred do not give students enough opportunities to participate in the classroom instructions. The learners are reduced to passive learners and as a result become apathetic and repulsive to learning. The shortcoming of these methods of teaching may have contributed to poor performance of students studying basic electronics at public examinations (Umunadi, 2006)

The preparation of workers for entry-level jobs and advancement in the workplace requires the use of teaching methods that provide not only job skills, but
also higher-order thinking and, problem solving skills in the students. Doolittle and Camp (1999) indicated that teaching methods which are teacher-centred do not adequately equip students with higher-order thinking and problem solving skills. Besides, students taught with the conventional teaching method are unable to retain their learning and apply it in new situations (Doolittle and Camp, 2000; Ukoha and Eneogwe, 1996). Moreover, basic electronics is concerned with science and technology. Technology, the world over is dynamic. With the interaction of globalization and technological development, work organizations are getting increasingly flexible, process-based and multi-tasking. This apparently is to suit demands of the prevalent knowledge in the society and ample use of information and communication technology in work places and changes in the organization of work (Ogwo and Oranu, 2006; International Labour Organization, (ILO), 2003). Hence, there is need for educational institutions to adjust to changes in work places so as to produce students with work place basic skills required to thrive in the 21st century knowledge-based economy and society (Rojewskin, 2002; Qureshi, 1997).

According to UNESCO (2002), the adjustment requires educational institutions to embrace new technology in order to make teaching student-centred.

Akudolu (1998), investigated computer assisted language learning as a teaching mode for promoting students interest in French language in Enugu Education Zone. The study was a quasi-experimental study involving the use of non-equivalent control group design. A French Language Interest Inventory (FLII) which comprised thirty items aimed at revealing the degree of each student’s interest was used. The population comprised all the 450 JSS III students reading French and a sample of 62 students. 32 students in experimental school and 30 students in control school. Pre - test and post test were administered to two intact groups, the control and the experimental groups. Pearson product moment correlation coefficients were used while the hypothesis was tested with one way
analysis of variance. The result revealed that the students taught using Computer Assisted Language Learning (CALL) showed a lot of interest in the French language throughout the period of the experiment. It was also revealed that mode of instruction had no significant effect on the interest rating of the students. The performance of CALL did not vary with interest. The study revealed that the use of CAI is as well effective as the use of conventional teaching method in improving students’ interest in French. The study also confirmed the fact that not in all subjects that the use of CAI significantly improves students interest than the use of conventional teaching method.

There exists a relationship between the two studies because there are both cause – effect studies using quasi experimental design, mean and ANCOVA for data analysis in order to answer research questions and testing hypotheses there is still a gap to be bridged. Effects of CAI was determined in this study while combined effect of computer tutorial and drill on students achievement in basic electronics was accounted for.

Okereke (2005) examined the impact of the electronic calculators on the cognitive achievement and overall development of the Nigerian learners’ mathematical abilities in speeded and difficult arithmetic problems. The study was a quasi experiment. A pre - test post - test control group design was adopted. The researcher constituted two equivalent groups, the control and the experimental. The experimental group was taught with electronic calculators while the control group
was taught without calculators using the conventional teaching method. The data were analyzed using mean and standard deviation while t-test statistics was used to compare the mean achievement scores of the pupils who were in the experimental and control groups. The result of the study showed that the group taught mathematics without electronic calculator performed significantly better than the group taught mathematics without calculator.

This study is related to this present study in that the calculator used is a computer product. The studies are cause-effect. They were carried out to know the effect of one or more technological methods or strategies on academic achievements of students in a subject.

Ashilokun (2006) carried out a study on effects of Computer Autocad Software assisted instruction on the performance of secondary school students in technical drawing. The population for the study consisted of all Senior Secondary II (SSII) students of St. James Secondary School Agbara, Lagos that are offering technical drawing in the 2004/2005 academic session. The samples were made up of 100 students selected from SSIIABC classes of the college. The 100 selected students were divided into the control and experimental groups. While the experimental class was exposed to computer AutoCAD software assisted instruction (CAS) on the general principle of technical education, the control group was taught in the conventional way for six weeks. Pre-test and post-test were conducted for the two groups. The statistics used were frequency, mean, standard deviation, t-test and ANOVA. It was revealed that AutoCAD Software Assisted instruction has effect on the performance of students offering technical drawing as a subject in secondary school. The indicator of this fact is that the mean performance of the students exposed to CAS is sixty two (62) and the mean for conventional method is fifty five (55).
The two studies are related. AUTOCAD software assisted instruction used in the study of Ashilokun is application software that still depends on computer for its operation just like computer tutorial and drill in the present study. Also the procedures adopted for achieving purposes of study of Ashilokun are equally used in the present study.

Adedokun (2004) studied the effects of Computer Assisted Instruction (CAI) on the performance of Technical College Students. The research was carried out at Federal Science and Technical College, Yaba – Lagos with a population of ninety (90) students randomly sampled from the Mechanical, Electrical/Electronics and Building technology departments of the College. It was quasi-experimental research with pre-test and post-test and two intact groups, (the experimental and the control groups). In the experimental group, (45) students were taught with Computer Assisted Instruction (CAI) while in the control group, 45 students were also taught conventionally. The instrument used was students’ achievement test and the statistics used were frequency, mean, standard deviation, t-test and Analysis of Variance (ANOVA). The finding shows that CAI has effect on the academic performance of the technical college students. The mean performance of students exposed to CAI for four (4) weeks was sixty three whereas the mean performance of the control group that was taught conventionally was fifty eight. This implies that the application of computer in teaching and learning will be of great benefit in science and technical subjects.

Relationship exists between the two studies. The effect of CAI on students’ achievement was determined. The CAI as an independent variable in this study is still part of computer dependent instruction just like computer tutorial and drill.

Odogwu (2002) conducted a study on the effects of computer assisted instruction (CAI) on the achievement of senior secondary schools students in mathematics. The sample size of the study was 160 SS2 students drawn from
private schools in Lagos state. 80 students were randomly assigned to experimental group and the remaining 80 to control group. The study adopted pre-test post-test control group design. t-test statistics was used for data analysis. The result showed that there was a significant difference in the mathematics achievement of experimental and control group in favour of the experimental group. Also, there was no significant gender difference in the achievement of students taught with CAI.

This study is related to the present study in that CAI is still part of instructions that depend on computer for its operation or usage just like computer tutorial and drill. Without computer, both instructions cannot work. The same procedures were used for the studies.

Nwoji (2000) carried out a quasi experimental research on improving the teaching and learning of introductory technology through the use of media. The study compared the effectiveness of Video Taped Instruction and Audio Tape Instruction in Introductory Technology class. The study involved all the Junior Secondary School 1 (JSS1) students in Nsukka urban education zone of Enugu State. Out of the six secondary schools, two were randomly selected for the study. Four hundred and seventy two (472) JSS1 students were randomly selected using balloting techniques. The data analysis used for the study was mean and t-test. The instrument for data collection was a teacher made 20 items multiple choice questions with graphic presentations based on types and function of woodwork and metalwork equipment/materials. Two groups (A and B) were used. Group A was taught with Video Taped Instruction while students in Group B were taught with ATI. The treatment lasted for four weeks (4wks). The pre-test was conducted two days before the treatment started while the post-test was conducted at the end of the experiment. The total mean scores for the Video Taped Instruction is 123 and Audio Tapped Instruction is 71. This shows that students who received their
lectures under Video Taped Instruction performed better than their counterparts who were taught with Audio Taped Instruction.

Relationship exists between these studies, the Audio and video taped instructions used in this study of Nwoji are computer instruction dependent. The procedures adopted are the same with the present study. They are all cause – effect study. But the contents of the studies are different. One was carried out in introductory technology while the other was carried out in basic electronics.

Mudasiru and Adedeji (2010) carried out a research on effects of Computer Assisted Instruction (CAI) on secondary school students’ performance in Biology. The sample size was 120 SS1 students using 3 x 2 factorial designs. The findings of the study showed that students taught Biology using CAI performed better than those students taught using conventional teaching method.

The study is related to the present study in that the CAI used for teaching experimental group during the experiment is computer dependent instruction like computer tutorial and drill. But difference exists in the contents or the two studies, one in biology and other in basic electronic in different study areas.

**Studies on Combined Effect of Computer Tutorial and Drill on Students’ Achievement, Interest and Retention in Learning**

At present, the primary application of micro-computers in special education like music is Tutorial, Drill and Practice methods of CAI (Becker, 1983; Maddux, 1984). Computerized drill and practice has been equated with worksheets and reviled as an inefficient application of microcomputers (Golden, 1986; Haven, 1985; Reinhold, 1986; Slesnick, 1986). Nevertheless, CAI drill and practice has been shown to have a positive effect on the achievement of elementary school children (Kulik and Bangert – Drowns, 1985) as well as learning disable and un-achieving students (Bellotti, 1985) Clark (1982) noted that students often report
enjoying the instructional method from which they learn the least. However, Clark (1982) suggested that a computer learning environment has the potential to reverse this trend and improve both learning and academic interest. Swigger and Cambell (1983) observed CAI drill and practice students expressed significantly more positive attitudes towards academic work on the computer than towards similar academic tasks undertaken in the regular classroom.

Swigger and Cambell (1983) further observed that students learn a course’s content best when exposed to the subject matter using a variety of teaching styles. This enhancement can be achieved through interactive computing that can provide students with supplementary explosive to the fundamental concepts in basic electronics as well as to give them an opportunity to apply and further explore these concepts.

Mudasiru and Adedeji (2010) Suggest that because drill and practice is an instructional strategy rather than an evaluation procedure, special effort should be put into providing abundant, precise and quite specific feedback. The authors further stress that while it is true that drill and practice exercises necessarily help to evaluate students performance, their principal purpose should be instructional.

Martin 1973 investigated the effects of a computerized drill and practice program on the achievement and attitudes of third and fourth grade students of different ability levels. Participants outperformed controls and low ability students gained more than middle or high ability students no attitude differences were noted.

The implication of this research is that drill and practice can serve a very important role in bringing the learner to a level of “mastery” on lower level sub skills so that the learner can more easily perform some higher level complex skill.

**Summary of Review of Related Literature**
The various literatures reviewed so far revealed that computer assisted instruction and computer tutorial and drill have added a new dimension to teaching and learning. It was discovered that learning activities labeled as “drill and practice” were often looked down upon because they only address low-level skills or knowledge. However, Martin 1999 points out that recent research on cognitive learning suggests that the role of drill and practice in learning may be more important than has previously been realized. Martin 1999 further stated that what has traditionally been identified as fundamental units of knowledge and skill can often be broken into still smaller units. It is in learning these “sub skills” that a drill and practice approach seems to fit best. For example, a musician learning a new piece of music, once the mechanics of the piece have been mastered, the musician can then focus attention on interpretation.

The implication of this study is that drill and practice can serve a very important role in bringing the learner to a level of “automaticity” on lower to level sub skills so that the learner can more readily perform some higher level complex skill. The review also revealed that basic electronics which is one of the vocational subjects taught at the senior secondary schools is still being taught with methods which are based on the behavioral learning theories. These methods do not provide for student adverse disposition and encourage rote memorization, which does not promote retention of learning. The method does not provide ample opportunity for the incorporation of instructional techniques such as computer tutorial, drill and practice which is student centered. It rather uses the conventional method which is teacher centered. Many authors blamed poor teaching methods for the poor performance of students in basic electronics. This prompted the call for alternative methods of teaching. This is why this study has chosen Tutorial, Drill and Practice methods of CAI to find out whether it will produce effective result.
It has also been found that there have been challenges in workplaces as a result of the effects of globalization and the rapid revolution in information and communication technology. These changes have called for a realignment of curriculum content and instructional techniques in line with current realities if vocational education products are to survive in the continuously changing and competitive world. Moreover, the review has revealed that there are no empirical studies done in Nigeria on the effects of computer tutorial, drill and practice based on instructional approach on students’ achievement, interest and retention of learning in basic electronics.

Review of literature in this study showed that many studies were carried out in Computer Assisted Instruction (CAI) in areas such as simulation, games, data processing and practice. Studies in biology, music and history showed the effect of CAI on senior secondary students’ performance when exposed to Individualized Computer Assisted Instruction (ICAI), Cooperative Computer Assisted Instruction (CCAI) and those exposed to conventional teaching method. A study on the combined effect of computer tutorial and drill is needed to probe further on the investigations already carried out in this area. This is in fact the gap this study intends to fill.
CHAPTER III
METHODOLOGY

This chapter is presented under the following subheadings: research design, area of the study, population for the study, sample and sampling technique, instruments for data collection, validation of the instruments, reliability of the instruments, method of data collection, experimental procedure and method of data analysis.

Research Design

The study was conducted using quasi–experimental design. Specifically, the pre - test post – test non-equivalent control group design was used. This implies that intact classes (non-randomized groups) were used in the study. According to Ofo (2002), quasi experimental research design permits the use of intact classes. This design was adopted because it was not possible for the researcher to randomly sample the subjects and assign them to groups without disrupting the academic programme and the timetable of the secondary schools involved in the study. Hence, the design was considered quite suitable for conducting this study. The design is illustrated below:

\[ E: 0_1 x_1 \, \, 0_2, 0_3 \]
\[ C: 0_1 x_2 \, \, 0_2, 0_3 \]

Where; \( E = \) Experimental Group,
\( C = \) Control Group
\( X_1 = \) Treatment 1 (Computer Assisted Instruction);
\( X_2 = \) Treatment 2 (conventional teaching methods)
\( 0_1 = \) Pre - test
\( 0_2 = \) Post - test
Area of the Study

This study was carried out in Lagos State, covering the nine senior secondary schools offering basic electronics as vocational subjects at Senior School Certificate Examination (SSCE) level. These secondary schools are: Federal Government College, Ijanikin; Ifako International School, Ifako; Keke High School, Ifako; Nigerian Navy Secondary School, Ojo; St. Finbarr’s College, Akoka and University of Lagos International School, Akoka. Roseville College, Ikeja, Grace High School, Gbagada and Federal Science and Technical College, Yaba.

Population for the Study

The population for the study comprised all the 161 SS1 basic electronics students from the nine senior secondary schools offering basic electronics at SSCE level. This is made up of 120 boys and 41 girls as shown in Appendix D.

Sample and Sampling Technique

The sample size for this study was 117 SS1 basic electronics students which comprised 84 boys and 33 girls. Purposive sampling technique was used to select six out of the nine senior secondary schools that offer basic electronics in Lagos State. The reason for the selection was that those six schools are of the same equivalent example; they have adequate computer sets, qualified basic electronics teachers with computer knowledge and conducive computer laboratories needed for the research work.
Simple random sampling by balloting was used to select 3 intact schools as experimental group and 3 intact schools as control group. Three schools were labeled experimental group and 3 schools also labeled control group. The 6 schools were mixed in a sack and were selected randomly.

The populations of the 6 schools were used as sample size since the schools were purposively selected for the study. The senior secondary schools selected are as follows:
(i) Federal Government College, Ijanikin 25 (17 boys and 8 girls), (ii) Ifako International School, Ifako 22 (17 boys and 5 girls), (iii) Keke High School, Ifako 22 (15 boys and 7 girls), (iv) Nigerian Navy Secondary School, Ojo 17 (13 boys and 4 girls), (v) Unilag International School, Akoka 21 (15 boys and 6 girls), (vi) Federal Science and Technical College, Yaba 10 (7 boys and 3 girls). Total number of students was 117.

In each of the schools selected, there was only one intact class for basic electronics students because the students were few. Since the experiment required two groups (i.e. experimental and control), three schools were selected for the experimental group through simple random sampling and the remaining three schools were also selected through simple random sampling for control group. The students in each of the six intact classes constituted the sample (117 students) used for this study.

**Instruments for Data Collection**

The instruments, the researcher used for collecting data for the study were:

i. Basic Electronics Achievement Test (BEAT)

ii. Basic Electronics Interest Inventory (BEII)

The Basic Electronics Achievement Test was a 45 item multiple choice type which was developed by the researcher from the eight content areas used for the study. The multiple choice items were drawn using the table of specification. The
The second instrument used for data collection was the Basic Electronics Interest Inventory. The instrument was a 30 items likert type scale designed to measure students’ interest in Basic Electronics. The instrument was a 5 – point likert scale worded as follows: Strongly Agree (SA) 5 points, Agree (A) 4 points, Undecided (UD) 3 points, Disagree (D) 2 points and Strongly Disagree (SD) 1 point. The Basic Electronics Interest inventory is shown in appendix (g).

**Validation of the Instrument**

The Basic Electronics Achievement Test was face and content validated by 3 experts in Vocational Teacher Education and 2 experts from Measurement and Evaluation Department all from University of Nigeria Nsukka. Ninety Basic Electronics Achievement items (BEAT) were face validated by the experts in terms of relevance, suitability, clarity and coverage. The instrument was also subjected to content validation using Table of Specification. The validators of the test instrument made suggestions, which led to removal of some items. On the whole, 45 test items survived.

The Basic Electronics Achievement Test was subjected to item analysis after the trial testing on 25 students of Alagbado Secondary School, Ogun State. The difficulty index (DI), Item difficulty (ID) and item discrimination index of the items on the instrument were found. The analysis of these psychometric qualities of the instrument reduced the number of items from 65 to 45. The summary of the item analysis is presented in Appendix J.

The Basic Electronics interest inventory was also subjected to face and content validation by the 5 experts as mentioned above and at the end of validation, 30 items survived.

**Reliability of the Instruments**
The reliability of the Basic Electronics Achievement Test was found using the test retest reliability technique and the Kuder Richardson 20 (K-R20) approach. The test retest reliability coefficient of the BEAT was found to be 0.72 using Pearson Product Moment Correlation Coefficient while the use of KR20 in assessing the test of internal consistency yielded a reliability index of 0.85. The internal consistency of Basic Electronics Interest Inventory (BEII) using Cronbach Alpha yielded index of 0.92 while Pearson Product Moment Correlation Test yielded 0.89. See appendix L. This shows that the test was highly reliable.

**Experimental Procedure**

Two instructional approaches were used for the study. The use of Basic Electronics instructional package in teaching the experimental group while conventional lesson plan and chalk-talk approach were used for the control group. The used Basic Electronics instructional package lesson plan was identical to the conventional lesson plan in terms of content to be taught, instructional objectives and method of evaluation. The only difference between them was in the instructional activities (teacher’s performance and student’s performance activities). This was where the use of Basic Electronics instructional package employed practical illustrations and activities during the instruction whereas the conventional approach proceeded normally without employing the use of the Basic Electronics instructional package in teaching during the class instructions.

The pre-test was administered to both the experimental and control groups before the experiment commenced. After they have administered the pre-test, the regular Basic Electronics class teachers in the various schools started the experiment. Each teacher used the appropriate instructional procedure developed from the test blueprint for his group. Their guiding principle was the five days training received during the pre-experimental conference which was conducted for
them by the researcher. During the training, the researcher discussed with them what should be required of them during the experiment. The experiment was done during the normal school hours using the school timetable for classes. The duration for the experiment was eight weeks. At the end of the experiment, the teachers administered the post-test to the subjects in the two groups. The pre-test and post-test achievement questions were the same in content for both groups but were rearranged. After two weeks of post-test, retention test was carried out using the post test questions. The students were not informed about the test in advance. The data collected from the pre-test, post test and retention test on the instruments (Achievement test and interest inventory), were kept separately for the two groups. These were used in answering the research questions and also testing the hypotheses for the study.

**Control of Extraneous Variables**

The Extraneous variables, which might occur during the experiment, were controlled in order to ensure valid and reliable results. These variables included those arising from the teacher, inter-group, instructional procedure and test takers’ interaction.

**Teacher Variable**

The researcher did not do the actual teaching of the experimental and the control groups in the various schools. The actual teaching was done by the regular Basic Electronics teachers of the various schools under the supervision of the researcher. In order to ensure that errors which might arise from teacher variable did not affect the findings of the study, the researcher organized five day training for all the teachers that were used for the study before the commencement of the experiment. The training took care of the teacher’s individual differences by giving them the same pattern of instruction to be used for the study. A uniform lesson notes were used by the teachers for the study in each of the groups.
Inter-group Variables

Since the participating intact classes are non-equivalent groups, Analysis of Covariance (ANCOVA) was used for data analysis to take care of the initial differences between the groups in order to eliminate the errors of non equivalence.

Instructional Procedure Variable

The extraneous variable which might arise from instructional procedure was controlled by ensuring that the instructional procedure was the same for the teachers in all the schools used for the study. The same lesson notes were provided for the teachers in each group.

Training of Teachers for the groups

In order to ensure that errors which might arise from teacher variable will not affect the conduct of the study, the researcher organized training for all the participating teachers. The teachers that taught the experimental group were given five days training and detailed explanations on the use of the lesson plan, basic electronics computer tutorial and drill package and basic electronic interest inventory. The teachers that taught the control group were also given five days training and detailed explanations on the use of the lesson plan developed by the researcher for the control group and basic electronics interest inventory. This is to ensure uniformity of instruction across the groups. The training plans for the teachers are shown in Appendix E.

Computer Tutorial and Drill Instructional Package (CTDIP)

The computer tutorial and drill instructional package was developed by the researcher with the assistance of a computer programmer using Dreamweaver and flash: that was written in hypertext Mark up Language (HTML) with illustrations converted to Graphics Interchange format (GIF). The package developed was given to the teacher that taught the experimental group for the treatment, on the first day the treatment started. In the development of the package four
methodological phases were strictly followed: analysis, design, implementation and validation. It contained eight lessons structured into modules and treatment covered eight weeks.

**Subject Interaction**

In each of the six schools used for the study, the researcher used one intact class for each school. This is to avoid the experimental group students from mixing up with the control group students to exchange ideas. This might be controlled by not allowing them know that they were used for the study which could be achieved by teaching all the classes by their original teachers.

**Method of Data Collection**

The test scores generated from the pre-test and post-test were collected using Basic Electronics Achievement Test (BEAT) and Basic Electronics Interest Inventory (BEII).

**Method of Data Analysis**

The psychometric properties of BEAT items were determined by individual item analysis. An item in the BEAT was judged suitable if it meets the following conditions (Okoro, 2006):

(i) has a difficulty index of between +20 to +80  
(ii) has a discrimination index of +0.2 and above  
(iii) has all its distractor negative indices.

Mean was used to answer the research questions while the analysis of covariance (ANCOVA) was used for testing the hypotheses at 0.05 level of significance. Since the research involved pre and post tests of intact classes, the statistical technique adopted for analyzing the hypotheses was ANCOVA which helped to remove initial group differences (Non-equivalence). The use of ANCOVA also helped to compare the mean of the two groups.
CHAPTER IV
PRESENTATION AND ANALYSIS OF DATA

This chapter presents the results of the data analysis for the study. The presentation was organized according to the research questions and null hypotheses that guided the study.

Research Question 1

What are the mean achievement scores of students taught basic electronics with computer tutorial and drill and those taught using the conventional teaching methods?

Table 1

Mean of Pre-test and Post-test Scores of Experimental and Control Groups in the Achievement Test

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Pre – test $\bar{X}$</th>
<th>Post - test $\bar{X}$</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>68</td>
<td>5.22</td>
<td>40.51</td>
<td>35.29</td>
</tr>
</tbody>
</table>
The data presented in Table 1 show that the experimental group taught basic electronics with computer tutorial and drill had a mean achievement score of 5.22 in the pre-test and a mean achievement score of 40.51 in the post-test making a pre-test, post-test mean gain in experimental group to be 35.29. The control group taught basic electronics with conventional method had a mean achievement score of 5.28 in the pre-test and a post-test mean achievement score of 20.16 with a pre-test, post-test mean gain of 14.88. With this result, the students in the experimental group performed better in the achievement test than the students in the control group.

### Research Question 2

What are the mean interest scores of students taught basic electronics with computer tutorial and drill and those taught using the conventional teaching methods?

**Table 2**

*Mean of Pre-test and Post-test Scores of Experimental and Control Groups in the Interest Inventory Items*

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Pre – test</th>
<th>Post - test</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>68</td>
<td>122.56</td>
<td>143.29</td>
<td>20.73</td>
</tr>
<tr>
<td>Control</td>
<td>49</td>
<td>122.10</td>
<td>133.33</td>
<td>11.23</td>
</tr>
</tbody>
</table>
Table 2 shows that the experimental group taught basic electronics with computer tutorial and drill had a mean interest score of 122.56 in the pre-test and a mean interest score of 143.29 in the post-test making a pre-test, post-test mean gain in experimental group to be 20.73. The control group taught basic electronics with conventional teaching methods had a mean interest score of 122.10 in the pre-test and a post-test mean interest score of 133.33 with a pre-test, post-test mean gain of 11.23. This result indicates that interest of students in the experimental group is higher than the interest of the students in the control group.

**Research Question 3**

What are the mean scores of students taught basic electronics with computer tutorial and drill and those taught using the conventional teaching methods in the test of retention?

Table 3
*Mean Achievement Scores of Experimental and Control Groups in the Achievement Post-test and Test for Retention of Learning*

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Post-test</th>
<th>Test for Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>68</td>
<td>40.51</td>
<td>35.97</td>
</tr>
<tr>
<td>Control</td>
<td>49</td>
<td>20.16</td>
<td>15.42</td>
</tr>
</tbody>
</table>

Table 3 shows that students in the experimental group taught basic electronics with computer tutorial and drill had a post-test mean achievement score of 40.51 and a mean achievement score of 35.97 in the test for retention of learning, while the students in the control group taught basic electronics with conventional teaching methods had a post-test mean achievement score of 20.16 and a mean achievement score of 15.42 in the test for retention of learning. The result therefore indicates that students taught basic electronics with computer tutorial and drill retained their learning better than those taught with the conventional teaching methods.
Research Question 4

What are the comparative mean achievement scores of boys and girls taught basic electronics using computer tutorial and drill?

Table 4

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Pre – test</th>
<th>Post – test</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>49</td>
<td>5.30</td>
<td>40.63</td>
<td>35.33</td>
</tr>
<tr>
<td>Girls</td>
<td>19</td>
<td>5.00</td>
<td>40.21</td>
<td>35.21</td>
</tr>
</tbody>
</table>

The data presented in Table 4 show that boys taught basic electronics with computer tutorial and drill had a mean achievement score of 5.30 in the pre-test and mean achievement score of 40.63 in the post-test making a pre-test, post-test mean difference of 35.33, while the girls taught basic electronics with computer tutorial and drill had a mean score of 5.00 in the pre-test and a mean score of 40.21 in the post-test, making a pre-test, post-test mean difference of 35.21. With this result, boys taught basic electronics with computer tutorial and drill performed better than girls taught basic electronics with the same computer tutorial and drill in the achievement test.

Research Question 5

What are the comparative mean interest scores of boys and girls taught basic electronics using computer tutorial and drill in the interest inventory items?

Table 5

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Pre – test</th>
<th>Post – test</th>
<th>Mean Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boys</td>
<td>49</td>
<td>122.69</td>
<td>143.45</td>
<td>20.76</td>
</tr>
</tbody>
</table>
The data presented in Table 5 show that boys taught basic electronics with tutorial, drill and practice methods of Computer Assisted Instruction (CAI) had a mean interest score of 122.69 in the pre-test and mean interest score of 143.45 in the post-test making a pre-test, post-test mean gain of 20.76, while the girls taught basic electronics with computer tutorial and drill had a mean interest score of 122.21 in the pre-test and a mean interest score of 142.89 in the post-test, making a pre-test, post-test mean gain of 20.68. With this result, the interest of boys taught basic electronics with computer tutorial and drill is higher than the interest of girls taught basic electronics with the same computer tutorial and drill in the interest inventory items.

**Research Question 6**

What are the comparative mean scores of boys and girls taught basic electronics using tutorial and drill in the test for retention of learning?

Table 6

*Mean of Boys and Girls Taught Basic Electronics with computer tutorial and drill in the Achievement Post-test and Test for Retention of Learning*

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Post – test</th>
<th>Test for Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>49</td>
<td>40.63</td>
<td>36.26</td>
</tr>
<tr>
<td>Female</td>
<td>19</td>
<td>40.21</td>
<td>35.26</td>
</tr>
</tbody>
</table>

The data presented in Table 6 show that boys had a mean achievement score of 40.63 in the post-test and a mean score of 36.26 in the test for retention of learning. The girls also had a mean achievement score of 40.21 in post-test and a mean score of 35.26 in the test for retention of learning. The result indicates that the boys taught basic electronics with computer tutorial and drill performed better than girls taught basic electronics in the test for retention of learning.
Hypotheses

Ho₁: There is no significant difference between the mean achievement scores of students taught basic electronics with computer tutorial and drill and those taught using conventional teaching methods.

Ho₂: There is no significant interaction effect of treatments given to students and their gender with respect to their mean scores in the basic electronics achievement test.

Table 7
Summary of Analysis of Covariance (ANCOVA) for Test of Significance between the Mean Scores of Experimental and Control Groups and Interaction Effect of Treatment given to Students and their Gender with Respect to their Mean Scores in the Basic Electronics Achievement Test

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
</table>


The data presented in Table 7 shows F-calculated values for test of significance between the mean scores of experimental and control groups and interaction effect of treatment given to students by their gender with respect to their mean scores in the basic electronics achievement test. F-value for groups is 1857.000 with significance of F at .000, which is less than .05. The null-hypothesis is therefore rejected at .05 level of significance. With this result, there is a significance difference between the mean scores of students taught basic electronics with computer tutorial and drill and those taught using conventional teaching methods in the achievement test. The F value for interaction effect (Group Gender) is 3.774 with significance of F .055 which is greater than .05. Therefore, the null hypothesis is accepted. This indicates that there is no significant interaction effect of treatment given to students and their gender with respect to their mean scores in the Achievement Test.

**$H_{03}$**: There is no significant difference between the mean interest scores of students taught basic electronics with computer tutorial and drill and those taught using conventional teaching methods in interest inventory items.
H04: There is no significant interaction effect of treatments given to students and their gender with respect to their mean scores in basic electronics interest inventory items.

Table 8
Summary of Analysis of Covariance (ANCOVA) for Test of Significance between the Mean Scores of Experimental and Control Groups and of Interaction Effect of Treatment given to Students and their Gender with Respect to their Mean Scores in the Basic Electronics Interest Inventory Items

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>Df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>2861.202</td>
<td>4</td>
<td>715.300</td>
<td>212.434</td>
<td>.000</td>
</tr>
<tr>
<td>Intercept</td>
<td>226.350</td>
<td>1</td>
<td>226.350</td>
<td>67.223</td>
<td>.000</td>
</tr>
<tr>
<td>Pre – test</td>
<td>.103</td>
<td>1</td>
<td>.103</td>
<td>.031</td>
<td>.861</td>
</tr>
<tr>
<td>Group</td>
<td>2367.808</td>
<td>1</td>
<td>2367.808</td>
<td>703.204</td>
<td>.000</td>
</tr>
<tr>
<td>Gender</td>
<td>28.326</td>
<td>1</td>
<td>28.326</td>
<td>8.412</td>
<td>.004</td>
</tr>
<tr>
<td>Group Gender</td>
<td>6.847</td>
<td>1</td>
<td>6.847</td>
<td>2.033</td>
<td>.157</td>
</tr>
<tr>
<td>Error</td>
<td>377.123</td>
<td>112</td>
<td>3.367</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2267689.000</td>
<td>117</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>3238.325</td>
<td>116</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at sig of F< .05

The data presented in Table 8 shows F-calculated values for test of significance between the mean scores of experimental and control groups and interaction effect of treatment given to students by their gender with respect to their mean scores in the basic electronics interest inventory. The F-value for groups is 703.204 with significance of F at .000, which is less than .05. The null-hypothesis is therefore rejected at .05 level of significance. With this result, there is a significant difference between the mean interest scores of students taught basic electronics with computer tutorial and drill and those taught using conventional teaching method in the interest inventory items. F value for interaction effect (Group Gender) is 2.033 with significance of F .157 which is greater than .05.
Therefore, the null hypothesis is accepted. This indicates that there is no significant interaction effect of treatment given to students and their gender with respect to their mean scores in the Interest Inventory Items.

HO₅: There is no significance difference between the mean scores of students taught basic electronics with computer tutorial and drill and those taught using conventional teaching methods in the test for retention of learning.

Table 9
Summary of Analysis of Covariance (ANCOVA) for Test of Significance between the Mean Scores of Experimental and Control Groups Taught Basic Electronics with computer tutorial and drill in the Test for Retention of learning

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corrected Model</td>
<td>12029.624a</td>
<td>2</td>
<td>6014.812</td>
<td>1973.000</td>
<td>.000</td>
</tr>
<tr>
<td>Intercept</td>
<td>332.989</td>
<td>1</td>
<td>332.989</td>
<td>109.216</td>
<td>.000</td>
</tr>
<tr>
<td>Post – test</td>
<td>12.368</td>
<td>1</td>
<td>12.368</td>
<td>4.057</td>
<td>.046</td>
</tr>
<tr>
<td>Groups</td>
<td>478.702</td>
<td>1</td>
<td>478.702</td>
<td>157.009*</td>
<td>.000</td>
</tr>
<tr>
<td>Error</td>
<td>347.573</td>
<td>114</td>
<td>3.049</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100008.000</td>
<td>117</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>12377.197</td>
<td>116</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant at sig. of F< .05

Table 9 shows that the F-value for group is 157.009 with significant of F at .000, which is less than .05. The null-hypothesis is therefore rejected at .05 level of significance. With this result, there is significant difference between the mean scores of students taught basic electronics with computer tutorial and drill and those taught using conventional teaching method in the test for retention

HO₆: There is no significant difference between the mean achievement scores of boys and girls taught basic electronics with computer tutorial and drill.

HO₇: There is no significant difference in the mean interest scores of boys and girls taught basic electronics using Computer Tutorial and Drill.
Ho$_8$: There is no significant difference between the mean scores of boys and girls taught basic electronics with Computer Tutorial and Drill in a test of retention of learning.

Ho$_9$: There is no significant interaction effect of treatments given to students by their gender with respect to their mean scores in Basic Electronics retention of learning.

The data presented in Table 8 shows that F-value for gender stood at 8.412 with significant of F at .04, which is less than .05. Hence, the null-hypotheses were therefore rejected at .05 level of significant. This result implies that there is significant difference between the mean scores of boys and girls taught basic electronics with computer tutorial and drill in the achievement test and test for retention of learning. The result also indicated that there is significant difference between the mean interest scores of boys and girls taught basic electronics with computer tutorial and drill methods in the interest inventory items.

**Findings of the Study**

The following findings emerged from the study based on the data collected and analyzed and hypotheses tested:

1. Students taught basic electronics with computer tutorial and drill had a higher mean achievement score than those students taught using the conventional teaching method in the achievement test.

2. Students taught basic electronics with computer tutorial and drill had a higher mean interest score than those students taught using the conventional teaching method in the interest inventory items.

3. Students taught basic electronics with computer tutorial and drill had a higher mean score than those students taught using the conventional teaching method in the test for retention of learning.
4. The study revealed that boys taught basic electronics with computer tutorial and drill had a higher mean achievement score than girls taught with the same computer tutorial and drill in the Achievement test.

5. The study revealed that boys taught basic electronics with computer tutorial and drill had a higher mean interest score than girls taught with the same computer tutorial and drill in the interest inventory items.

6. Boys taught basic electronics with computer tutorial and drill performed better than girls taught basic electronics with the same computer tutorial and drill in the test for retention of learning.

7. There was a significant difference between the mean scores of students taught basic electronics with computer tutorial and drill and those taught using conventional teaching method in the achievement test.

8. There was no significant interaction effect of treatment given to students and their gender with respect to their mean scores in the Achievement Test.

9. There was a significant difference between the mean interest scores of students taught basic electronics with computer tutorial and drill and those taught using conventional teaching method in the interest inventory items.

10. There was no significant interaction effect of treatment given to students and their gender with respect to their mean scores in the Interest Inventory Items.

11. There was a significant difference between the mean scores of students taught basic electronics with computer tutorial and drill and those taught using conventional teaching method in the test for retention.

12. There was no significant difference between the mean achievement scores of boys and girls taught basic electronics with computer tutorial and drill in the achievement test.
13. There was no significant difference between the mean interest scores of boys and girls taught basic electronics with computer tutorial and drill in the interest inventory items.

14. There was no significant difference between the mean scores of boys and girls taught basic electronics with computer tutorial and drill in the test for retention of learning.

**Discussion**

The data presented in Table 1 provided an answer to research question one. Finding revealed that students taught basic electronics with computer tutorial and drill had a higher mean achievement score than those students taught using the conventional teaching method in the achievement test. In the same vein, analysis of covariance was used to test the first hypotheses, Table 7, at the calculated F-value (1857.000), significance of F (.000) and significance level of .05. There was a statistically significant difference between the mean scores of the group taught with computer tutorial and drill and those students taught using the conventional teaching methods in the achievement test. The implication of this finding therefore is that computer tutorial and drill is more effective than conventional teaching methods in enhancing students’ achievement in basic electronics. This finding is similar to the finding of Odogwu (2002) who found that there was a significant difference in the mathematics achievement of experimental group taught with CTD and control group taught with conventional teaching methods in favour of the experimental group. Kulik, Bangert and Williams (1983) in their study on “Effects of Computer – Based Teaching on secondary school students” also found out that the use of CTD in teaching electronics students improved their achievement in the subject than the students taught electronics with traditional instructional methods. The findings is also in line with the assertion of Cotton (2001) who pointed out that the use of computer based learning produces achievement effects superior to those
obtained with traditional instruction. Cotton explained further that student learning rate is faster with computer based learning than with conventional instruction.

This finding is also in line with the finding of Audu (2007) who carried out a study on effect of constructivist approach on students’ performance in building construction trade and found experimental group had higher mean scores that the control group in the pre-test and post-test.

This is an indication that treatment has positive effects on students’ achievement which is also in agreement with the finding of this study. The difference in the academic achievement of the students in basic electronics is similar with the studies carried out in other fields of learning on students’ academic achievement by Demen (2003), Olson and Pratt (2000) Coitman (2002) and Kotrlik (2004) who in their separate studies found that the adoption of any treatment as an instructional framework greatly imploies students’ academic achievement. The result could be explained by the fact that teachers’ adoption of various instructional techniques appeal to the students’ various intelligence address their diverse learning styles and consequently increase their motivation to learning and improve their academic achievement.

This support the view of Jarvis (1998) students learn best when computer is used for instruction delivery. The author explained further that students learn better and retain more of what is taught in the class.

Analysis of Covariance was used to test hypothesis two Table 7. At the calculated F-value (3.774), significance of F (.055) and confidence level of 0.05 there was no significant interaction effect of treatment given to students and their gender with respect to their mean scores in the Achievement Test. This result showed that the effectiveness of treatments on students’ achievement in basic electronics does not depend on the level of gender. Hence, there were no differential effects of treatments over levels of gender (male and female), which
implies that computer tutorial and drill is more effective than conventional teaching methods in improving students’ achievement in basic electronics regardless of Gender.

It has been established that the learner’s own feeling toward the subject matter will largely determine how much of the material will be learned and how thoroughly it will be learned. According to Ogwo and Oranu (2006) to facilitate learning, the teacher must secure and sustain the attention and interest of the learner. They emphasized that unless attention is maintained and interest sustained, learning can hardly be accomplished. A state of sustained interest is shown by continued and determined readiness to learn on the part of the student as evidenced by a state of readiness to learn.

Computer enhances how students learn by supporting four fundamental characteristics of learning: active engagement, participation in groups, connections to real-world contexts, frequent interaction/feedback (Basham, 2007). Owing to the dominance of the teacher in the traditional teaching approaches. Opara (2002) observed that the method hardly increased students’ enthusiasm and interest. Teaching methods such as use of computer technology provides students’ interaction with the learning environment which invariably provides meaningful learning activities. Meaningful learning activities built on prior knowledge motivate students and foster their interest in their effort to executively control their own cognitive process. The data presented in Table 2 provided answer to research question two. Finding revealed that students taught basic electronics with computer tutorial and drill had a higher mean interest score than those students taught using the conventional teaching method in the interest inventory items. Analysis of covariance was used to test the third hypothesis, Table 8, at the calculated F-value (703.204), significance of F (.000) and confidence level of .05 there was a
statistically significant difference between the mean scores of the group taught with computer tutorial and drill and those students taught using the conventional teaching methods in the interest inventory. The finding indicates that a computer tutorial and drill is more effective in stimulating students’ interest in basic electronics than the conventional teaching methods. Active engagement of students and frequent interaction through the use of computers make the classroom instruction student-centred, and focused on the cognitive development and construction of knowledge in the students (Brewer, 2003). Strong and Smith (2001) stated that human/computer interface has a direct relationship to students’ cognitive ability. Hence, the obvious implication of the use of computer in the classroom is to facilitate students’ interaction with the learning environment so as to sustain students’ direct interest which increases the strength of involvement of the learners and which does not allow the learners to be distracted by trivial extraneous events in the perceptual environment.

Analysis of covariance was also used to test hypothesis four, Table 8, at the calculated F-value (2.033), significance of F (.157) and confidence level of .05, the interaction effect of treatment and gender was not found to be significant. This implies that the effectiveness of treatments on students’ interest in basic electronics does not depend on gender level (male and female), and which also implies that computer tutorial and drill is more effective than conventional teaching methods in stimulating students’ interest in basic electronics regardless of Gender.

The data presented in Table 3 provided answer to research question three. Finding reveals that the students taught basic electronics with computer tutorial and drill retained their learning better than those taught with the conventional teaching methods. Analysis of covariance was used to test the fifth hypothesis, Table 9, at the calculated F-value (157.009), significance of F(.000) and
confidence level of .05 there was a statistically significant difference between the mean scores of the group taught with computer tutorial and drill and those students taught using the conventional teaching methods in the test for retention of learning. The finding indicates that computer tutorial and drill are more effective in enhancing students’ retention of learning in basic electronics than the conventional teaching methods. Active engagement of students in the learning activities according to Cotton (2001) improves students’ creativity which enhances transfer of learning in new situation. The provision of active learning environment by the use of computer based learning for teaching makes the students to engage in higher order thinking task such as analysis, synthesis and evaluation which in turn improve students’ cognitive achievement and also retention of learning. This support the view of Jonaasan (1996) students learn best when they are actually involved in the learning process.

The data presented in Table 4 provided answer to research question four. Finding revealed that boys taught basic electronics with computer tutorial and drill performed better than girls taught basic electronics with conventional method.

The data presented in table 8 shows that F-value for gender stood at 8.412 with significant of F at .04, which is less than .05. Hence, the null-hypotheses were therefore rejected at .05 level of significant. This result implies that there is significant difference between the mean scores of boys and girls taught basic electronics with computer tutorial and drill in the achievement test and test for retention of learning. The result also indicated that there is significant difference between the mean interest scores of boys and girls taught basic electronics with computer tutorial and drill methods in the interest inventory items.
CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Re-statement of the Problem

Basic electronics is one of the vocational subjects offered at the senior secondary school level. Basic electronics is a field of study that is both science and technology related. Technological development in electronics is in a constant state of flux and change. Moreover, with the interaction of globalization and technological development, work organizations are getting increasingly flexible, process-based and multi-tasking. This apparently is to suit demands of the prevalent knowledge society and ample use of information communication technology in workplaces and changes in the organization of work (Ogwo and Oranu, 2006; International Labour Organization, (ILO), 2003). In this context, there is need for educational institutions to adjust to changes in workplaces so as to produce students with workplace basic skills required to thrive in the 21st century knowledge-based economy and society (Rojewski, 2002; Qureshi, 1997). According to UNESCO (2002) the adjustment requires the educational institutions to embrace new technology and appropriate computer technology as a learning tool to transform the present isolated, teacher-centred and text bound classroom into rich, students-centred interactive knowledge environment.

Irrespective of this development, lecture and demonstration methods are the main teaching/learning methods employed for teaching basic electronics to the students in the secondary schools. Lecture and demonstration methods are content driven and teacher-centred which do not give students enough opportunities to participate in the classroom instructions. The learners are reduced to passive learners and as a result become apathetic and repulsive to learning. Doolittle and Camp (1999) pointed out that teaching methods which are teacher-centred do not adequately equip students with higher-order thinking and problem solving skills.
Besides, students taught with the methods are unable to retain their learning and apply it in new situations (Doolittle and Camp 2000; Ukoha and Eneogwe, 1996). Apparently, the adoption of conventional teaching methods by the technical teachers to teach basic electronics in the secondary schools in Lagos state has partly resulted into ineffective use of varieties of instructional techniques required to naturally increase students’ commitment and involvement in learning and also partly responsible for inability of students studying basic electronics to pass their SSCE examinations. See appendix C1 and C2.

UNESCO (2002) has noted that computer technology provides powerful tools to support the shift to student-centred learning and is capable of creating a more interactive and engaging learning environment for teachers and learners. According to Cotton (2001) students’ retain their learning, have more positive attitudes and interest towards learning with computer based learning than with conventional instruction. Perhaps, if computer based learning is used for teaching basic electronics to the secondary school students in Lagos state the students will improve in achievement, retain their learning and develop more interest than the use of conventional method. This situation therefore prompted the researcher to determine effects of computer tutorial and drill on senior secondary school students’ achievement, interest and retention in basic electronics in Lagos state.

**Summary of Procedures Used**

The study was a pre-test, post-test, non-equivalent control group, quasi-experimental research, designed to determine effects of computer tutorial and drill on senior secondary school students’ achievement, interest and retention in basic electronics in Lagos State.

Specific objectives of the study were to;
• Determine the achievement scores of students taught basic electronics with computer tutorial and drill and those taught using the conventional teaching methods.
• Determine the interest of students taught basic electronics with computer tutorial and drill and those taught using the conventional teaching methods.
• Determine the level of retention of achievement of students taught basic electronics with computer tutorial and drill and those taught using the conventional teaching methods.
• Compare the achievement scores of boys and girls taught basic electronics using the computer tutorial and drill.
• Compare the interest scores of boys and girls taught basic electronics using the tutorial, drill and practice methods of CAI.
• Compare the level of retention of learning of boys and girls taught basic electronics using the computer tutorial and drill.

To fulfill these objectives, six research questions were formulated. The population of the study was all 161 SS1 basic electronics students from the nine senior secondary schools offering basic electronics at SSCE level in Lagos State. The sample size was 117 students from which 68 SS1 students constituted the students in the experimental group and 49 SS1 students constituted the students in the control group. The instruments used in this study included: Basic Electronics Achievement Test (BEAT) and Basic Electronics Interest Inventory (BEII). To ensure content validity of the BEAT, a test blue print (Table of Specification) was built for the test given due consideration to the emphasis placed on each objective and major topics in the basic electronics syllabus for senior secondary school. Based on the Table of specification, a total of one hundred and twenty multiple choice items were drawn for the BEAT. The BEAT, BEII, and the lesson plans
developed for the experimental and control groups were subjected to face validation by five Experts. The BEAT was trial tested for the purpose of determining the psychometric indices of the test. A total of 45 items of the BEAT had good difficulty, discrimination and distractor indices. A trial test for determining the coefficient of stability of the BEAT was carried out using test re-test reliability technique. The reliability coefficient of the BEAT was found to be .72 using Pearson Product Moment correlation coefficient. Cronbach Alpha was used to determine the internal consistency of the BEII items. The reliability coefficient computed for the Basic Electronics Interest Inventory (BEII) was .92. The data collected were analyzed using Mean to answer the research questions while ANCOVA was used to test the eight hypotheses formulated to guide the study.

Summary of Findings

1. Students taught basic electronics with Computer Tutorial and Drill had a higher mean achievement score than those students taught using the conventional teaching method in the achievement test. The mean was found significant.

2. Students taught basic electronics with Computer Tutorial and Drill had a higher mean interest score than those students taught using the conventional teaching method in the interest inventory items. The mean was found significant.

3. Students taught basic electronics with Computer Tutorial and Drill had a higher mean score than those students taught using the conventional teaching method in the test for retention of learning. The mean was found significant.
4. The study revealed that boys taught basic electronics with Computer Tutorial and Drill had a higher mean achievement score than girls taught with the same Computer Tutorial and Drill in the Achievement test. But the mean was not found to be significant

5. The study revealed that boys taught basic electronics with Computer Tutorial and Drill had a higher mean interest score than girls taught with the same Computer Tutorial and Drill in the interest inventory items. However, the mean was not found to be significant

6. Boys taught basic electronics with Computer Tutorial and Drill performed better than girls taught basic electronics with the same Computer Tutorial and Drill in the test for retention of learning. But the mean was not found to be significant

7. There was no significant interaction effect of treatment given to students and their gender with respect to their mean scores in the Achievement Test

8. There was no significant interaction effect of treatment given to students and their gender with respect to their mean scores in the Interest Inventory Items.

**Implications of the Findings**

The findings of this study have implications for the Technical teachers of basic electronics, government and administrators of secondary schools, curriculum planners and the society. The findings of this study revealed that Computer Tutorial and Drill improved students’ achievement, retention and interest in basic electronics than the conventional methods. The implication of these findings is that students studying basic electronics will learn better, develop much interest and retain their learning better when Computer Tutorial and Drill is used for teaching basic electronics by the teachers. Also, technical teachers have to adopt the use of Computer Tutorial and Drill to create student-centred classroom in the teaching of basic electronics at the secondary schools in Lagos state.
The adoption of the Computer Tutorial and Drill in the teaching of basic electronics requires development of software and well equipped computer laboratory for its effective implementation. This implies that school administrators and the government need to constantly make provision for employment of computer programmers who will be working with the teacher as well as computer set, and consumables that will provide the teachers and students the opportunity of using Computer Tutorial and Drill for basic electronics teaching and learning in the secondary schools in Lagos State.

The findings of this study also have implication to the curriculum planners of secondary schools curriculum and the society at large.

**Conclusions**

Application of computer technology to all aspects of human endeavour coupled with the need to create student-centred classroom to engage learners in their leaning tasks, improve learners’ interest and consequently achievement in the school subjects has necessitated the use of computer in teaching. This study has found out that Computer Tutorial and Drill improved students’ achievement, retention and interest in basic electronics than the conventional teaching methods. Also, the study found out no significant interaction effect of treatments given to students and their gender in the basic electronics achievement and interest. This simply means that the effectiveness of Computer Tutorial and Drill on students’ achievement and interest in basic electronics does not depend on gender. Hence, irrespective of gender, students studying basic electronics will record improved performance in their achievement and interest in basic electronics when Computer Tutorial and Drill is used for teaching. These results therefore revealed that Computer Tutorial and Drill is a viable alternative to the conventional teaching methods in teaching basic electronics. Moreover, Computer Tutorial and Drill provides powerful tools to support the shift to student-centred learning and is
capable of creating a more interactive and engaging learning environment for teachers and learners.

**Recommendations**

Based on the findings of this study, the following recommendations are made;

1. More attention should be accorded computer literacy and operation in the secondary schools and relevant computer assisted instructional packages should be developed for use within the Nigerian school systems. In addition, Nigerian public schools should be equipped with necessary ICT facilities to leverage the potentials of ICT in Nigerian schools.

2. Technical teachers of basic electronics in Lagos State should adopt the use of the Computer Tutorial and Drill to teach basic electronics.

3. Further empirical studies should be carried out on the use of computer for instructional purposes, on different subjects and at different levels to provide sound basis for the integration of computer in Nigerian schools.

4. Curriculum planners such as Nigerian Educational Research and Development Council (NERDC) should consider review of curriculum for basic electronic for secondary schools with a view to incorporating the Computer Tutorial and Drill.

5. Since the findings of this study showed that students who worked on the Computer Tutorial and Drill performed better than those who worked on the conventional teaching method, students should be encouraged to develop interest in the use of computer.

6. Lagos State Government should provide relevant equipment for teaching Basic Electronics in all the secondary schools.
7. Lagos State Ministry of Education and principals of Lagos State Senior Secondary Schools should organize seminars, conferences and workshops to sensitize technical teachers on the use of Computer Tutorial and Drill.

Suggestions for Further Research

The following are suggested for further research.

1. This study should be replicated in other geo-political zones in Nigeria
2. Effects of Computer Tutorial and Drill in other areas of vocational subjects such as metal work, wood work, building, agriculture and home economics should be studied in order to find out whether there is any difference in CTD effectiveness.
3. Further empirical study should be carried out on the use of Computer Tutorial and Drill for instructional purposes on different subjects and at different levels.
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