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UNIVERSITY OF EDUCATION, WINNEBA

COLLEGE OF TECHNOLOGY EDUCATION, KUMASI

COMPARISON OF COMPUTER BASED TUTORIAL AND TRADITIONAL METHOD OF TEACHING BRICK WALL BONDING

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A dissertation in the Department of Information Technology Education, Faculty of Technology Education, submitted to the school of Graduate Studies in partial fulfilment of the requirements for the award of the degree of Master of Science (Information Technology Education) in the University of Education, Winneba

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DECLARATION

Candidate's Declaration

I hereby declare that this dissertation is the result of my own original research and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature:…… Date:……

Name: Collins Owusu Boateng

Supervisor's Declaration

I hereby declare that the preparation and presentation of the dissertation were supervised in accordance with the guidelines on supervision of dissertation laid down by the University of Education, Winneba.

Supervisor's Signature: …… Date: ……

Name: Dr. Samuel Adu Gyamfi

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DEDICATION

To My Wife and Children

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ACKNOWLEDGEMENTS

An enormous number of people have made contributions, both great and small, to this dissertation and, at the risk of inadvertently omitting someone; I am bound to at least attempt to acknowledge my many debts.

This dissertation reflects the thoughtful guidance of my supervisor, Dr. Samuel Adu Gyamfi I thank him for his many contributions. Much of whatever integrity and quality this dissertation has is a direct result of the contributions of colleagues who reviewed my work during the various stages of writing. Finally, I thank anyone who helped in any way to make this dissertation a success.

University of Education,Winneba http://ir.uew.edu.gh

TABLE OF CONTENTS

CONTENTS **PAGE**

University of Education,Winneba http://ir.uew.edu.gh

University of Education,Winneba http://ir.uew.edu.gh

University of Education,Winneba http://ir.uew.edu.gh

LIST OF TABLES

Table **Page**

.

University of Education,Winneba http://ir.uew.edu.gh

LIST OF FIGURES

University of Education,Winneba http://ir.uew.edu.gh

ABSTRACT

The study compared computer-based tutorial (CBT) and a 'traditional' method of teaching brick wall bonding. The quasi-experimental pretest–posttest non equivalent groups design was used for the study and the experiment was conducted with form two students studying Building Construction at the Armed Force Senior High Technical School and Kumasi Senior High Technical School. In all, 30 students (15 from each school selected by simple random sampling) participated in the study. Computer-Based Tutorial programme for the experiment was developed by me, using interactive tutorial mode of presentation, covering brick wall bonding in Senior High School form two (SHS 2) syllabus. Tutorial was followed by multiple choice and essay test questions with immediate feedback. Hyperlinks were also added to the programme for explanation of the text. The traditional method of teaching consisted of exposition and question and answer. The pre-test was used as the post-test and this was an achievement test comprising ten multiple-choice and four essay test items. The results revealed that the experimental group outperformed the control group in the achievement test in all aspect of the test. Students liked the CBT programme and benefited from it by way of higher achievement. It was recommended that CBT should be incorporated into the teaching of technical subjects at the senior high school level.

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CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

Over the years, teachers in Ghana have used traditional methods of teaching. The Traditional method of teaching consists mainly of giving instructions and expecting students to be cognitively active but physically inactive, except when they are taking down notes. Most students of any age cannot maintain such behaviour for a long period of time (Cangelosi, 2003). Teaching and learning become difficult, because classroom teaching is in abstract. In addition, without the presence of the teacher in the classroom teaching and learning become non-existent. The lecture method of teaching is one of the traditional methods of teaching. The lecture, in its many forms, is the most commonly used method of teaching and learning. There are, however, serious questions regarding the effectiveness of the traditional lecture approach. According to Swanson and Torraco (1995), the lecture method of teaching was established centuries ago as a teaching process that began with a literal reading of important passages from the text by the master, followed by the master's interpretation of the text. Students were expected to sit, listen and take notes.

The Traditional evaluation of students' performance entails in-class-written tests and an occasionally oral presentation. This evaluation does not reflect many aspects of students' improvement in aspects of performance which is not easy to quantify such as attitude, higher order thinking skills, and problem solving (Franklin, 2002). Computer-aided Assessment (also but less commonly referred to as E-assessment), ranging from automated multiple-choice tests to more sophisticated systems is becoming increasingly common. With some systems, feedback can be geared towards a student's specific mistakes or the computer can

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aid the student through a series of questions adapting to what the student appears to have learned or not learned (E-learning, n.d.).

Presently there are many calls to move away from the traditional lecture to interactive computer learning systems that allow students access to information when and where they need it (Edlich, 1993; McIntosh, 1996; Twigg, 1994). CBT, also more popularly known as Computer Assisted Instruction or Tutorials, CBT is a process of learning that is not executed in the traditional manner one would find in the educational environment. Rather than the conventional classroom and instructor setting, CBT, (for example change management tools) involves learning using software applications installed in computers. The student is, in effect, trained by the computer. Oftentimes, this method of learning can be much more effective than the practice of teaching and learning in classrooms because the student, if working alone, can set his or her own speed of learning. (Computer Fundamentals, n.d). In this regard, learning with the computer gives the students the opportunity to learn at their own pace and again gives the students who learn quickly the opportunity to also learn new information.

CBT is especially effective for training people to use computer applications because the CBT programme can be integrated with the applications so that students can practice using the application as they learn (Webopedia, n.d).

Furthermore, CBT is highly effective. People get the information they need, when they need it, no matter where they are located, and they can study at their own pace on their own computer. But creating a CBT programme presents a problem. The material to be taught has to be converted into a computer programme. And in many cases the person who knows the material to be taught is not familiar with computer programming

(Interactive Educational Software, n.d).

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In addition, Electronic learning (or e-Learning or eLearning) is a type of technology supported education/learning (TSL) where the medium of instruction is through computer technology, particularly involving digital technologies. E-learning has been defined as "pedagogy empowered by digital technology". In some instances, no face- to- face interaction takes place. *E-learning* is used interchangeably in a wide variety of contexts. In companies, it refers to the strategies that use the company network to deliver training courses to employees (E-learning, n.d).

Moreover, Computer-supported collaborative learning (CSCL) is one of the most promising innovations to improve teaching and learning with the help of modern information and communication technology. Collaborative or group learning refers to instructional methods whereby students are encouraged or required to work together on learning tasks. It is widely agreed to distinguish collaborative learning from the traditional 'direct transfer' model in which the instructor is assumed to be the distributor of knowledge and skills (E-learning, n.d).

Brick wall is how bricks are arranged to form a fence or to enclose a space. This is termed as bonding. Bonding is the systematic arrangement of bricks or blocks so that one will overlap the other to prevent continuous straight joint.

1.2 Statement of the Problem

Whenever there is no teacher or a teacher is indisposed, teaching and learning come to a halt. Students lose the number of days teachers absent themselves from school. This will go a long way to affect them in their final year examination, because they may not cover the specified syllabus for the examination.

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Again, when students are unable to attend a class, there is no opportunity for them to learn what was taught from the teacher. Also, students do not have the opportunity to learn from the teachers at their own pace. They should tune to the pace of the majority in the class whether the lesson has been understood or not. Computers can make it possible for teachers to give instructions in their absence. Students also are able to learn at any time and at their own pace. These are problems that warrant an investigation into ways in which computers can support learning.

Sticking to the traditional approach to teaching and learning resulted in the students staying home for one whole academic year during the COVID-19 outbreak. Thus, the traditional approach did not give any rooms for individualized learning. It is this reason that compels the researcher to embark on this study, to ascertain whether computerized based tutorial could be a preferred approach.

1.3 Purpose of the Study

In view of the above problem, it has become necessary to compare the effectiveness of traditional method of teaching and learning with the use of computer based tutorial (CBT) for teaching and learning of brick wall bonding in Senior High School form two.

1.4 Hypotheses

The following null hypotheses were used to direct the study**:**

1. There is no significant difference between achievement test score of students selected for Computer Based Tutorial (experimental group) and students selected for Traditional Method of Instruction (control group) before the treatment.

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2. Students instructed by Computer Based Tutorial method will perform the same in terms of achievement test scores as students instructed by Traditional Method of Teaching brick wall bonding.

1.5 Significance of the Study

The study is to give teachers and students an alternative method of teaching and learning in case a teacher or student is not present in class. When a teacher is absent from school and unable to meet students for a lesson, it draws the students back. This study will alert the teachers to prepare a package on the proposed topic to be taught so that the students can learn effectively in the absences of the teacher. The research will give teachers an alternative way of teaching and learners will also gain the opportunity of learning with the computer as an alternate way of learning. Specifically, students who offer building construction in Senior High School form two (2) will learn brick wall bonding from computer based tutorial. This research work comes with an additional learning package that will ease the work of the teachers in the classroom.

The study will enhance the current educational policy which has integrated Information and Communication Technology into the school curriculum. This is because it will encourage students to use the computer to learn their subject areas. Students will be given immediate feedback from the exercises constructed in the computer based tutorial.

The study is useful for both students and teachers of Building Construction. It will indicate how CBT can replace the Traditional Method of Teaching and Learning Brick Wall Bonding.

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1.6 Delimitation of the Study

The study was conducted in two Senior High Schools namely Kumasi Senior High Technical School and Armed Force Senior High Technical School, all in Kumasi. The sample size was thirty (30) with fifteen (15) students from the form two (2) Building Construction class of each of the stated schools above.

Again, the development of computer based tutorial programme and its experiment was delimited to bonding of brickwall and tutorial form of instructional software hence only this form was implied in the preparation of CBT programme. The research focused on limited examples in the intervention only, namely the assessment opportunities, and did not take other examples of learning e.g. class discussion and group work into account.

1.7 Limitations of the Study

Limitations of the study were inherent to the development approach to this research:

1. The population of the experimental group is small; only 15 students were chosen for the study, due to insufficient number of computers in the school computer laboratory and might not represent the majority of the students in the class. Therefore, to generalize the results for larger groups, the study should have involved more participants in the class.
2. I had less control over the independent variable because of the quasi-experimental design used for the study.
3. I was the developer of the intervention (the tutorial), the teacher of the selected topic used for the intervention to teach the control group as well as the researcher, which inherent limitation of subjectivity. In addition, since the assessment of pre-test and post test was conducted by me, it is unavoidable that in the study, certain degree of

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subjectivity can be found. In fact, it would have been sort of objective if it had been decided by two or three examiners.

1.8 Definition of Terms

Computer Based Tutorial/Teaching. Is an interactive instructional technique whereby a computer is used to present the instructional material and monitor the learning that takes place. It allows the student to direct his/her own progress. CBT learning uses a combination of text, graphics, sound and video in the learning process.

Traditional Method of Teaching. It is a prevailing or customary to impart instructions. It is a teacher-oriented lecture method used for presentation of text material with the help of chalkboard.

CCC – Computer Curriculum Cooperation

SME - Expert in the particular subject

1.9 Organisation of the Rest of the study

The dissertation is organized as follows: the first chapter is the introduction to the study. It contains background to the study, statement of the problem, the purpose of the study, the hypotheses, delimitation of the study, limitations of the study and definition of terms. Chapter two reviewed the literature on the following areas: What is traditional teaching?, What methods are used in traditional teaching and learning?, What is Computer Based Teaching (CBT)?, Historic overview of CBT, Characteristics of CBT and Learning Theories, Research works on CBT, Advantages and Disadvantages of CBT and Ways in which CBT can support the teaching and learning of brickwork. Chapter three is about the research methodology. It consists of research design, population, sample and sampling procedure, research instrument,

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data collection procedure and data analysis. Chapter four discusses the findings of the study. The last chapter which is the fifth chapter is about the conclusion, the summary and the recommendation of the study.

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CHAPTER TWO

REVIEW OF RELATED LITERATURE

The review of literature is intended to identify what others have written about this research topic. This chapter reviews the work of other writers and researchers which relate to the study. This includes reviews of existing research, technical papers, books, and other online sources that covers CBT and traditional approach to teaching and learning.

2.1 Traditional Teaching

Traditional teaching is concerned with the teacher being the controller of the learning environment. Power and responsibility are held by the teacher and he plays the role of instructor (in the form of lectures) and decision maker (in regards to curriculum content and specific outcomes). They regard students as having 'knowledge holes' that need to be filled with information. In short, the traditional teacher views that it is the teacher that causes learning to occur (Novak, 1998).

The traditional teaching consists mainly of giving lecture by the instructor. One aspect of the traditional teaching is that it has a tendency to view students as passive learners (Steinhorst & Keeler, 1995) because it does not engage them actively. Again, the traditional teaching methods was predominantly tutor led demonstration with the tutor standing in front of the class and providing handouts which incorporated the material that the learners were required to learn (Napier University, n.d).

2.2 Traditional Methods of Teaching and Learning

The underlisted are some methods used in traditional teaching and learning:

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Role-playing. In this event, a student (or students) takes on the role of a specific individual (a historical person, for example) and acts out the actions of that person as though he were actually that person. The intent is to develop a feeling for and an appreciation of the thoughts and actions of an individual.

(Jabberwocky, n.d; Reece & Walker, 1994). Role-play introduces problem situation dramatically. It provides opportunity for students to assume roles of others and thus appreciate another point of view. It also allows for exploration of solutions and provides opportunity to practice skills. Some students may be too self-conscious and others may feel threatened. In view of all, it is not appropriate for large groups (Adprima, 2011).

Lecture. It is an arrangement in which teachers share information directly with students, with roots going back to the ancient Greeks. Lecture is a familiar form of information-sharing, but it is not without its drawbacks. It has been overused and abused, and it is often the method used when teachers don't know or aren't familiar with other avenues of presentation. Also, many lecturers might not have been the best teacher role models in school (Jabberwocky, n.d; Reece & Walker, 1994). With lecture, there should be a clear introduction and summary. It is necessary for an instructor to pose proficient oral skills. Audience is often passive and learning is difficult to gauge. Communication is one-way which makes it not appropriate for children below grade 4 (Adprima, 2011).

Fire alarm. Often, teachers assume that lecturing is nothing more than speaking to a group of students. Wrong! Good lecturing also demonstrates a respect for the learner, knowledge of the content, and an awareness of the context in which the material is presented.

Good lectures must be built on three basic principles:

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1. Knowing and responding to the background knowledge of the learner is necessary for an effective lecture.
2. Having a clear understanding of the material is valuable in being able to explain it to others.
3. The physical design of the room and the placement of students impact the effectiveness of a lecture.

Lecture is often the method of choice when introducing and explaining new concepts. It can also be used to add insight and expand on previously presented material. Teachers recommend that the number of concepts (within a single lesson) be limited to one or two at the elementary level and three to five at the secondary level (Jabberwocky, n.d).

It is important to keep in mind that lecture need not be a long and drawn-out affair. For example, the 10-2 strategy is an easily used, amazingly effective tool for all grade levels. In this strategy, no more than 10 minutes of lecture should occur before students are allowed 2 minutes for processing. This is also supportive of how the brain learns. During the 2-minute break, you can ask students several open-ended questions, such as the following:

a. "What have you learned so far in this lesson?"
b. "Why is this information important?"
c. "How does this information relate to any information we have learned previously?"
d. "How do you feel about your progress so far?"
e. "How does this data apply to other situations?"

These questions can be answered individually, in small group discussions, or as part of whole class interactions (Jabberwocky, n.d).

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Lectures are information-sharing tools for any classroom teacher. However, it is critically important that you do not use lecture as your one and only tool. You must supplement it with other instructional methods to achieve the highest levels of comprehension and utility for your students (Jabberwocky, n.d).

Reading information. With this method, you assign material from the textbook for students to read independently. You may also choose to have your students read other supplemental materials in addition to the textbook. These may include, but are not limited to children's or adolescent literature, brochures, flyers, pamphlets, and information read directly from a selected website (Jabberwocky, n.d).

Demonstration. In this format, students witness a real or simulated activity in which you use materials from the real world. These materials may include artifacts and objects used by individuals in a specific line of work; for example, microscopes (biologists), barometer (meteorologists), transit (surveyors), or word processing programme (writers) (Jabberwocky, n.d).

Observation. This format allows students to watch an event or occurrence take place firsthand. The only drawback is that sometimes unexpected and unplanned events happen over which you may have little control (Jabberwocky, n.d).

Field trips. With field trips, you are able to take your students out of the classroom and into a new learning environment. This learning environment usually lasts for several hours or an entire school day (Jabberwocky, n.d; Reece & Walker, 1994).

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Round robin. In this setting, each student has an opportunity to share some information or ideas in a small group format. Everyone participates equally and taps into the collective wisdom of the group (Jabberwocky, n.d).

Interviewing. This format may include the personal interview, in which one person talks with another person. It may also involve the group interview, in which several people talk with a single individual (Jabberwocky, n.d).

Brainstorming can be a valuable instructional tool which you can incorporate into almost any lesson. Simply defined, it is the generation of lots of ideas (without regard for quality) about a single topic. This method is particularly appropriate at the start of a lesson to tap into the background knowledge students may or may not have about a topic (Jabberwocky, n.d; Reece & Walker, 1994).

2.2.1 Mental Imagery

Expert opinion. Mental imagery is receiving considerable attention by classroom teachers at all levels and in all subjects because of its proven ability to promote positive learning experiences (Jabberwocky, n.d).

Mental imagery is the creation of pictures in one's mind prior to reading printed material. Mental imagery helps students construct “mind pictures” that aid in comprehension and tie together their background knowledge and textual knowledge. After images are created (and colored by a reader's experiences) they become a permanent part of long-term memory.

Mental imagery works particularly well when the following guidelines are made part of the entire process:

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i. Students need to understand that their images are personal and are affected by their own backgrounds and experiences.

ii. There is no right or wrong image for any single student.

iii. Provide students with sufficient opportunity to create their images prior to any discussion.

iv. Provide adequate time for students to discuss the images they develop.

v. Assist students in image development through a series of open-ended questions ("Tell us more about your image." "Can you add some additional details?") (Jabberwocky, n.d).

Synthesis. One of the objectives of any lesson is to provide opportunities for students to pull together various bits of information to form a new whole or basic understanding of a topic. This process underscores the need for students to actually do something with the information they receive

(Jabberwocky, n.d).

2.2.2 Small Group Discussions

Expert Opinion. Some teachers think small group discussions are nonproductive because no actual teaching takes place. In actuality, though, small groups are highly productive. They allow for the absorption of valuable material, a reflection on different points of view, and an informal means of assessing students' comprehension of material. Here, the class is divided into small groups of two to four students. Each group is assigned a specific task to accomplish. The group works together, and members are responsible for each other (Jabberwocky, n.d).

Discussions are a useful strategy for stimulating thought as well as providing students with opportunities to defend their position(s). Your role in these discussions is that of a moderator.

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You can pose an initial question, supplemental questions when the discussion falters, or review questions for a group to consider at the end of a discussion. It is important that you not take an active role in the discussions, but rather serve as a facilitator (Jabberwocky, n.d).

Experimenting. Through experimenting, ideas are proved or disproved, and predictions confirmed or denied. Experimentation involves manipulating data and assessing the results to discover some scientific principle or truth. Students need to understand that they conduct experiments every day, from watching ice cream melt to deciding on what clothes to wear outside based on the temperature. In the classroom, they need additional opportunities to try out their newly learned knowledge in a wide variety of learning tasks (Jabberwocky, n.d).

Problem-solving activities. In this situation, the class, small groups, or individuals are given a problem or series of problems and are directed to find an appropriate solution. It is important to include problems for which the teacher does not have a preordained answer (Jabberwocky, n.d).

Buzz sessions. In this instance, temporary groups are formed for the purpose of discussing a specific topic. The emphasis is on either the background knowledge students bring to a learning task or a summary discussion of important points in a lesson (Jabberwocky, n.d; Reece & Walker, 1994).

Performance. Having a lot of knowledge is one thing. Being able to pull together bits and pieces of knowledge is another thing. But the crux of a good lesson is the opportunities for students to use their knowledge in productive, hands-on learning tasks (Jabberwocky, n.d).

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Independent practice. This method is one in which each student has an opportunity to use previously learned material on a specific academic task. For example, after learning about how to determine the square root of a number, students might figure out the square roots of a column of numbers from their math textbook (Jabberwocky, n.d).

Debriefing. Usually conducted at the conclusion of a lesson, debriefing allows students to coalesce and condense their knowledge and information as a group or whole class. It is an active thinking process

(Jabberwocky, n.d).

Modeling. In this method, you model the behaviour students are to duplicate within an activity and encourage students to parallel your behaviour in their own activity. Students may model appropriate behaviour for each other, too (Jabberwocky, n.d).

Simulations. Simulations are activities in which students are given real-life problem situations and asked to work through those situations as though they were actually a part of them.

Every simulation has five basic characteristics:

1. They are abstractions of real-life situations. They provide opportunities for you to bring the outside world into the classroom.
2. The emphasis is on decision-making. Students have opportunities to make decisions and follow through on those decisions.
3. Students have roles that parallel those in real life (mother, father, and child).
4. The rules are simple, uncomplicated, and few in numbers.

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5. A simulation has two or more rounds - opportunities to make decisions more than once (Jabberwocky, n.d; Reece & Walker, 1994).

Projects. Students are allowed to create their own original designs, models, or structures to illustrate an important point or content fact. These can take many forms and formats: mobiles, dioramas, shadow boxes, posters, newspapers, brochures, flyers, letters to the editor, collages and three-dimensional models (Jabberwocky, n.d; Reece & Walker, 1994).

Skill practice. Here, you provide students with an opportunity to apply their newly learned skills in a true-to-life experience. The emphasis is on the use of those skills (Jabberwocky, n.d).

Guided practice. In this event, students are allowed to experience all the events of a learning situation. Usually the work is done individually, although it can be done collectively, too. The teacher is a facilitator and a cheerleader (Jabberwocky, n.d).

Reflective inquiry. This method is student-initiated and student-controlled. Individual students are encouraged to select a topic they want to investigate further. In so doing, they pose a series of questions that they want to answer on their own. The questions are typically higher-order questions and emphasize a variety of divergent thinking skills (Jabberwocky, n.d).

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2.3 Computer Based Teaching/Tutoring (CBT)

Computer based tutorial is described as programme providing "some information or clarifies certain concept in addition to providing the student with practice exercises" (Soe, Koki, & Change, 2000, p. 47). The implication is that the computer can begin to take over actual instructional functions, adapted to the student's individual level of accomplishment. Alessi and Trollip (2001) have identified the purpose of computer based tutorials as the presentation of information to learners and the guidance through the initial use of the content. A tutorial (or self-study guide), therefore, comprises the following attributes:

It presents factual information and model skills;

It guides learners through the initial use of information;

Information is queued according to learner's abilities;

It motivates the learner; and

The locus of control should be with the learner (Alessi & Trollip, 2001).

There are two types of structures for computer based tutorials, namely linear tutorials and branches tutorials. The linear is the simplest type of programming in tutorials. The tutorial progresses from one topic or concept to the next, presenting information and asking questions. Although this structure is commonly used, it does not take full advantage of the capabilities of computer based teaching as it does not adapt to individual learners' needs. Computer based tutorial can also be described as the process by which written and visual information is presented in a logical sequence to a learner through a computer. The student learns by reading the text material presented or by observing the graphic information displayed. Some of the programmes provide audio-visual presentation with an option to the student to select audio presentation in addition to the visual media. Each segment of text is

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followed by questions, for student's response feedback on response is indicated immediately (Locatis & Atkinson, 1984; Wang & Sleeman, 1993).

Chauhan (1994) also describes CBT system in terms of its hardware (the machine), its software (the programme), its communication link (the devices which allow learners to use the hardware and software), and the curriculum (teaching materials stored in the computer).
As CBT usually involves a dialogue between one student and a computer programme and student can learn at his own pace and time frame, it is called interactive and individualized learning (Curtis & Howard, 1990).

With the advancement of technology new dimensions of CBT have emerged. Bucholtz (1998) adds new meaning to CBT by using this term for internet based instruction through the use of web pages, web bulletin boards and real audio, graphics and hands-on-applications. Computer Based Tutorial is described and defined by Frenzel (1986) as the process by which written and visual information is presented in a logical sequence to a student by a computer. The computer serves as an audio-visual device. The students learn by reading the text material presented or by observing the graphic information displayed. The primary advantage of the computer over other audio-visual devices is the automatic interaction and feedback that the computer can provide. Multiple paths through the course material can be taken, depending upon the individual student's progress.
Locatis and Atkinson (1984) describe computer based tutorial as a mode of instruction that involves student interaction with the computer directly. Typically, students access programme presented in segments, with each segment including information and questions or problems for students' response. The correctness of each response is indicated immediately and remedial or new information is presented. Sometimes students also have the option of

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requesting help or skipping ahead. Although this tutorial (information-practice-feedback) form of CBT is most typical, there are other forms such as drill and practice exercise, simulations and games.

Steinberg (1991) defined CBT as computer presented instruction that is individualized, interactive and guided. He is of the view that CBT is not a method of instruction. Many methods are implemented in it, including direct and exploratory lesson, drills, games and simulations.

According to Munden (1996) computer based tutorial is an educational medium in which instructional content or activities are delivered by a computer. Students learn by interaction with the computer and appropriate feedback is provided. Poole (1995) defined computer based tutorial as a computer based system designed to help students learn subject matter of all kind. Roblyer and Edwards (2000) defined CBT as software designed to help teach information and/or skills related to a topic; also known as courseware.

All the definitions of computer based tutorial presented above agree that computer plays a role of tutor and imparts instructions either through tutorials or simulations or any other mode of presentation. Computer hardware and specifically designed software is needed to accomplish the specific goals of learning. Software development needs a teacher equipped with best teaching skills and a broad vision.

2.3.1 Types of CBT Programmes

There are many types of Computer Based Teaching/Tutorial Programmes. Each of the CBT programme is appropriate under different instructional circumstances and therefore takes a different pedagogical approach. Although the beginning of CBT was presentation of

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programmed instruction through computer and initial forms of CBT i.e. tutorials, drill and practice, and games were oriented to behaviorist theories of learning. But now no type of CBT is solely associated with a specific learning theory, as sophistication of computer languages has allowed modifying each type of CBT according to any theoretical framework (Bitter & Pierson, 1999; Cox, 1995; Geisert and Futrell, 1995; Maddux, Johnson & Willis, 1997; Poole, 1995). They mentioned and explained the following types of CBT software.

1. Drill and practice
2. Tutorials
3. Instructional games
4. Simulations
5. Microcomputer based laboratories (MBL)
6. Integrated learning system (ILS)
7. Problem solving
8. Reference software

A brief description for each of the types of CBT is given below.

Software for drill practice. Drill and practice programmes are used to provide repetitive exercise for rote skills that have been taught some other way. It is not the function of drill and practice software to impart instructional activities; rather, drill programmes are useful for sustaining, refining, or perfecting performance in some category of behaviour already learned by another method. Usually drill and practice is employed to increase the speed or accuracy of student performance of certain task. Software for Drill practice allows learners to work problems or answer questions and get feedback on correctness. It is an important learning technique for building basic get feedback on correctness. It is an important learning technique for building basic knowledge and basic intellectual skills, such as number manipulation,

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vocabulary, spelling sentence construction etc. These skills are the foundation for higher level intellectual activity. Good drill and practice software provides the user with an enjoyable opportunity for repetitive interaction and immediate feedback on the accuracy of response. Drill and practice software is typically associated with behaviourism, because students are commonly given 'stimuli' (questions), are required to make responses to the stimuli, and then receive some sort of reinforcement (Geisert & Furtell, 1995; Hsu, Chen & Hung; 2000; Maddux, Johnson & Willis 1997; Poole, 1995; Roblyer & Edward, 2000).

Tutorials. Tutorials act like tutors by providing all the information and instructional activities a learner needs to master a topic. All the conceptual or skill based body of knowledge is presented on screen followed by quiz to assess the user's comprehension of the concept or acquisition of the skill. The software monitors progress on the basis of the results of the quiz taking the user on the new material or back over old material. A good tutorial presentation is enjoyable, thorough, and sensitive to the user capabilities; and provides immediate and appropriate feedback. Interactivity is key to user involvement and perseverance (Cox, 1995; Poole, 1995; Roblyer, 1989).

Tutorial software is more associated with the cognitive learning theory, because new knowledge is presented in a systematic way. It is expected that students learn principles and rules, comprehend them and become able to apply the newly acquired knowledge to new situations. A computer based tutorial programme works with an individual student in a very interactive manner and often provides an ideal learning situation for information transmission (Hsu, Chen & Hung, 2000).

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Software for Simulation. Simulations are powerful tools for learning. Simulations model a real or imagined system to show how these systems or similar ones work. They involve the learner in a vicarious experience, of events of processes, a kind of "trial run on reality". As such they marry nicely into a constructivist philosophy of teaching. Students experience life vicariously through the simulation, constructing knowledge about the world from that experience (Poole, 1995; Roblyer & Edwards, 2000).

Simulation software simulates an environment. It allows learner to change the values of parameters in the system, and provides feedback in the form of graphical or diagrammatic display of how the systems' behaviour changes. For example in the simulation based on a model of a pond with three main inhabitants, phytoplankton, herbivore, and fish, the learner may change the number of one or more population and see the effect on the others. Simulations provide a means for learning about an environment that may otherwise not be available to learner to explore, for reasons of safety, time, expanse, or general practicality. A simulation focuses on exploration and discovery learning. It is not an exercise that necessarily has a fixed or correct solution, and the route to the solution may be varied. A computer simulation offers the opportunity for relationships to be explored and exposed by the student's direct manipulation of the variables in the model. Although simulation programmes are usually constructivist, i.e. they allow students to construct their own knowledge, they can have cognitive orientations also (Cox, 1995).

Alessi & Trollip (2001) identify two main types of simulations:

Those that teach about something.

Those that teach how to do something.

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These two main types are further classified into four categories i.e. physical, process, procedural and situational simulations.

Process simulations. These speed up or slow down processes that usually either take so long or long or happen so quickly that students could not ordinarily see the events unfold. For example, courseware may show the effects of changes in demographic variables on population growth or the effects of environmental factors on ecosystems. Biological simulations like those on genetics are popular, since they help students experiment with natural laws like the laws of genetics by pairing animals with given characteristics and showing the resulting offspring (Roblyer & Edwards, 2000).

Procedural simulations. These activities teach the appropriate sequences of steps to perform certain procedures. They include diagnostic programmes, in which students try to identify the sources of medical or mechanical problems, and flight simulators, in which students simulate piloting an airplane or other vehicle (Roblyer & Edwards, 2000).

Situational simulations. These programmes give students hypothetical problem situations and ask them to react. Some simulations allow for various successful strategies such as letting students play the stock market or operate businesses. Others have most desirable and least desirable options such as choices when encountering a potentially volatile classroom situation (Roblyer & Edwards, 2000).

Games. Instructional games are courseware whose function is to increase motivation by adding game rules to learning activities. Instructional games can be similar to drill and practice or simulation courseware but their instructional connotation to the student is different due to entertaining and competitive environment. When students know they are going to play

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a game, they expect a fun and entertaining activity because of the challenge of the competition and the potential for winning (Roblyer & Edwards, 2000).

Cox (1995) mentions that some simulations are designed as games, often including role-playing. In such simulations the programme focuses not only on the underlying model but also on the way in which the learner interacts with the model. Learning may be built up by discovery and conjecture; the simulation encourages learning by inquiry and decision making. According to Hsu, Chen & Hung (2000), instructional games are usually associated with behaviorism because of the variety of reinforcement mechanism inherent in game environments in which students are motivated by competition and game rules to strive to reach to the goal.

Problem Solving. Problem solving software requires students to apply higher-order strategies and synthesize knowledge from multiple curricular areas in order to solve problems. Students can test hypotheses, learn from mistakes and refine skills as they gain mastery of problem solving techniques. Software of this type can provide practice in solving problem by modeling general critical thinking steps, by focusing on specific subject-area issue, or by creating an open environment in which students can discover their own strategies. The problem solving software affords the user more freedom than does drill and practice or tutorial software, but does not necessarily present the real world context that characterizes simulation software (Bitter & Pierson, 1999). Problem solving software teaches directly, through explanation and/or practice, the steps involved in solving problems or help learners acquire problem solving skills by giving them opportunities to solve problems.

Problem solving software is sometimes associated with the cognitivist learning theory because students are explicitly taught specific cognitive strategies. A problem solving

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software is more sophisticated type of learning than that of drill and practice. The computer presents fairly complex problems in which students can learn and improve their problem solving skills. These types of problems cannot be solved by simple memorization; problem solving programmes are designed to promote students' higher order leaning skills such as logic, reasoning pattern recognition and strategies. As they interact with the programme, they gradually move from simple trial and error to more logical and systematic thinking processes (Hsu, Chen & Hung, 2000; Roblyer & Edwards, 2000).

Integrated Learning System (ILS). According to Underwood and Brown (1997), ILS are systems across computer networks that provide a comprehensive, multiyear collection of computer-assisted instruction (CBT) delivered primarily through a model of individual assessment and task assignment and which record and report student achievement. A good ILS includes courseware for broad range of learning experienced, including simulations and on-line vehicles for research. The development of ILS is grounded firmly in the behavioural school of learning theory. ILS have largely addressed mathematical and language material where the body of content is arranged hierarchically. Additionally they are deemed to be identifiably right or wrong answers. The behaviourist approach taken by ILS designer precludes any element of social interaction.

2.3.2 **Software for micro computer-based laboratories**

Recognizing the value of micro computer-based laboratory (MBL) to research, hardware and software systems have been developed. These systems have enabled the students to automate the process of gathering data from experiments, conducting relevant analysis and producing meaningful reports. Scientific experiments are linked to micro-computers in laboratories to automate the process of recording the results of experiments. Complete data sets can be

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stored in secondary memory for further analysis. Summary data are produced as text and in a graphed format (Poole, 1995). Theoretical underlying purpose for MBL is precision in data collection and analysis and hence in conclusion.

Reference software. Reference software can take the form of any traditional reference works, such as dictionaries, encyclopedias, and thesauri on CD-ROM. Other reference software presents extensive collections of information on a focused topic. Electronic reference works can be utilized just as traditional reference material would be. Depending on the particular learning activity, students might refer to software as needed to answer specific questions. They also might openly explore a multimedia references without specific goals to guide their learning. The multimedia components of reference software present information in graphic, audio, video or other alternate formats that allow uniquely unlimited access to students who might not be developmentally able to contend with the text version of the information (Bitter & Pierson, 1999).

2.3.4 Historic Overview of CBT

1951 - Little technology used in schools, primarily TV; baby boom begin with resulting increases in class size; first-generation Univac computer delivered to the US census bureau (Computer Question?, n.d).

1958 - As cold war continues, National Defense Education Act brings some new technology into schools, but primarily in vocational education. Mainframe host computers are not widely accepted in schools that are still using the single classroom, teacher/manager method of delivering information to students (Computer Question?, n.d).

1963 - Vocational Education Act in US supported the use of mainframe and mini computers in universities to train programmers on BASIC i.e a simple high level programming

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language. IBM 360 family of computers was developed; most computers was still using host methods with punched cards as the primary input device; line printers are still the primary output device; the cold war and the competitive space exploration effort continues with President Kennedy's call for the science to be developed that could put a man on the moon (Computer Question?, n.d).

1965 - Elementary and Secondary Education Act brings mainframes and minicomputers into place in some schools, but most are used for administration or for school counseling (database for information about and for students) (Computer Question?, n.d).

1967 - High-level programming languages such as Fortran is being taught in universities. School vocational training programmes begin to include computer maintenance (Computer Question?, n.d).

1970 - Pascal created; the US bombs Cambodia; Kent State antiwar students killed by Army reserve troops; mainframes and minicomputers in use in some schools, but very little use in the delivery of instruction

(Computer Question?, n.d).

1971 - A few software companies begin to develop mainframe and minicomputer-based instructional programmes (Computer Question?, n.d).

1975 - Some Apple 1 PCs are donated to schools; some schools have adopted mainframes and minicomputers and refuse to consider PCs

(Computer Question?, n.d).

1981 - IBM is the first mainframe manufacturer to develop a PC; drill and practice CBT gains acceptance in schools; the cold war continues. The first educational drill and practice programmes are developed for personal computers (Computer Question?, n.d).

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1994 - most US classrooms now have at least one PC available for instructional delivery, but not all teachers have access to a computer for instructional preparation (Computer Question?, n.d).

1997-2007 - Educational software becomes more useful and interesting to students as graphics and video are incorporated. Larger computer storage capacity and the growing prevalence of CD-ROM and DVD drives in personal computers make it easier for educators to store large graphic and video and sound files for educational applications (Computer Question?, n.d).

A multiple choice item scoring machine was invented in 1924 by Sidney Pressy. This teaching machine also allowed for self instruction which could increase the efficiency of instruction. This invention gave birth to the idea of computer based teaching, long before the birth of computers. The first electronic digital computer was invented by John Vincent Atanasoff and Clifford Berry in 1939. It was called The Atanasoff-Berry Computer (ABC). The ABC was followed by another famous early computer called the Electronic Numerical Integrator and Calculator (ENIAC). The ENIAC was commissioned by the U. S Department of Defense and it was completed in 1946. The first documented instructional use of the computer was a computer driven flight simulator used to train pilots at military training institute USA in 1950. The computer was used for the first time in school in 1959. It was the use of International Business Machine 650 (IBM 650) computer to teach binary arithmetic to New York City elementary school children. Then it was found that programmed instruction can be presented through computer more successfully. In the 1960's and most of the 1970's large mainframe computers medium size minicomputers were used for imparting instruction to the students (Bansal, 2002; Poole, 1995; Roblyer & Edwards, 2000).

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Mastery Learning Models were programmed for Learning in Accordance with Need (PLAN), developed at the American Institute for Research and and the Individually Prescribed Instruction (IPI) system at the University of Pittsburgh. These programmes focused on using computer system to support mastery learning models with computer managed instruction systems. IPI focused on diagnosis and development of curriculum materials in reading and arithmetic (Roblyer & Edwards, 2000).

The first microcomputer came into school in 1977 in United States of America and the focus rapidly shifted from mainframes to desktop microcomputer systems (Roblyer & Edwards, 2000). This shift in hardware technology transformed the computer's role in education. Before microcomputers, Courseware came primarily from hardware manufacturers such as IBM and CDC, and software systems companies like CCC. As microcomputer gained popularity, a new software system for education driven primarily by teachers emerged. Computer resources and their instructional applications were no longer controlled by large companies or school district offices. Classroom teachers could decide what they wanted to do with computers (Roblyer & Edward, 2000; Allessi & Trollip, 1991; Campbell, 2000).

2.3.6 Characteristics of CBT

Computer-assisted programmes can be characterized by many attributes suitable to enhance learning. Some of the special characteristics of CBT include:

Individualization. A computer programme can provide multiple instructional paths, tailored to individualized needs (Steinberg, 1991). Students find multiple paths to proceed; every student finds an option to proceed according to his needs i.e. according to his previous knowledge of the subject, ability, interest and intellectual capacity. Game format can add motivation and fantasy and maintain learner's attention. Concept can be presented in tutorials

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with the aid of illustrative animation, dynamically creating illustrations and interspersing verbal explanations. Simulations can provide new insights into relationships, or experiences that would otherwise not be possible.

Flexibility. Flexibility means access to teaching materials at a wide range of time or locations. Computers offer great flexibility in the type of resources available to a students as well as increasing flexibility of access to information. Greater flexibility in education is one strategy for dealing with increased number and diversity of students. Computer programmes can allow the user to choose from a variety of instructional treatments. A student who does not learn with a particular approach can be presented with material using an entirely different and unique approach. Instructional programmes may use a variety of prompts and cues to produce correct student responses (Maler, Barnett, Warren, & Brunner, 1998; Sloane, Gordon, Gunn & Mickelsen, 1989).

Self-pacing. Self-pacing lets students precede at a pace appropriate for their individual learning levels. Students using self-pacing can control the time allowed to solve problem as well as the rate of presentation they can spend several weeks with remedial material or skip entire lesson. When they feel ready to be tested on the specific material, they can choose the testing cycle. Self-pacing can help to individualize instruction for those students who have used the programme before or have prior knowledge of the subject. Self-pacing can be combined with self-placement testing, which directs the student to an appropriate beginning point and to optimal instructional rate (Maler, Barnett, Warren, & Brunner, 1998; Sloane, Gordon, Gunn & Mickelsen, 1989).

Remediation options. The computer can vary instructional treatments and adapt to individual differences after analyzing student responses. Records of the student's past

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performance determine the sequence of instruction. In one type of remedial programme, the instructor uses computer programme to diagnose the student's learning capabilities, achievement level, and cognitive style. On the basis of the diagnosis, the instructor chooses material that is geared to the student. Computer assisted instruction programmes may easily provide remedial treatments by employing branching strategy and/or through incorporating hyperlinks to present text, graphics or any type of material for remediation (Maler, Barnett, Warren, & Brunner, 1998; Sloane, Gordon, Gunn & Mickelsen, 1989).

Graphics and sound. Graphic representation plays an important role instruction. In addition to pictures, computer graphics also include the use of screen formatting features such as arrows, boxes and illustrations to emphasize the concept. This nonverbal mode of instruction helps to building comprehension in areas that are difficult to teach by other instructional techniques. Sound in a programme can prompt, focus, or reinforce students and thus enhance instruction. At a more sophisticated level, some CBT programmes include speech synthesizers that produce words or sentences. Synthesizes are especially applicable with software for the very young or handicapped user. Computer graphics and sound infuse movement, excitement and animation into a programme (Maler, Barnett, Warren, & Brunner, 1998; Sloane, Gordon, Gunn & Mickelsen, 1989).

2.3.7 CBT and Learning Theories

Idea and practice of computer based teaching is grounded in all the predominant learning theories of the twentieth century i.e. behaviourist, cognitive and constructivist. All the learning theories address the questions like: What is learning? How learning takes place?

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How learning can be enhanced? Views about learning can be classified into two broad categories:

2.4 Objectivists/Positivists

Constructivists. The two approaches diverge when they define learning and describe the conditions required to make learning happen and the kinds of problems that interfere most with learning. They disagree because they attend to different philosophies and learning theories (Roblyer & Edwards, 2000). Both of the approaches accept and recognize the potential of Computers to promote and enhance learning. Computer Based teaching software based on both the approaches, ranging from drill and practice to simulations and web based resources are being used.

Objectivists. Objectivists believe that knowledge has a separate, real existence of its own outside the human mind. Learning takes place when knowledge is transmitted to and acquired by the learner. The process of learning is teacher-directed, systematic and structured (Roblyer & Edwards, 2000). Objectivists assert for directed instruction supported by two different theories of learning:

2.5 Behavioural theories

Cognitive theories/Information processing theories

Behavioural Theories. Behaviourism as a theory of psychology and learning became prevalent only in the twentieth century and reached its pinnacle in 1950s and 1960s. The theory has its roots in the work of Ivon Pavlov who presented Classical Conditioning theory as a result of his experiments with the salivation of dogs. Pavlov showed how an animal could be conditioned to salivate (response) at the prompting of an arbitrary stimulus bell

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paired with presentation of food. Pavlov called this process the "conditioned reflex" (Hergenhahn & Olson, 1997).

According to Klein (1996) the work of Edward Thorndike was another important influence on the behaviourist view. He studied the association learning in animals and human beings. He examined how certain types of stimuli affected learning, with a focus on how students might be promoted to learn new material by repeated association with the material they already knew. He also examined methods of shaping learning behaviour through rewards and punishments.

According to Hergenhahn and Olson (1997), and Klein (1996) neither Pavlov nor Thorndike was behaviourist. Each merely described the learning process. The founder of behaviourism was John .B. Watson. It is believed that Watson was the first self proclaimed behaviourist who formulated the principle that only the human behaviour can be studied not the mental state or thought processes.

Behaviourism is the school of psychology that focuses on objective, observable behaviours. Behavioural theorists concentrate on immediately observable consequences. Behavioural learning theories tend to emphasise changes in observable behaviour as indicators of learning. Huffman, Vernoy and Vernoy (1995) mention that behaviourist psychologist and founder of operant conditioning B. F Skinner focused on basic principles of learning. He gathered experimental data to develop his stimulus-response theory. The major principle underlying his learning theory is that behaviours change according to their immediate consequences. Pleasurable consequences strengthen behaviours, while unpleasant consequences weaken them. Skinner modified behaviour by altering external conditions, noting the response to

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those conditions and encouraging or discouraging that response. These three elements of the learning experience are technically called the discrimination stimulus, the response and the reinforcing stimulus. Behavioural principles underlie a teaching strategy known as programmed instruction. Computer based teaching originated with the presentation of programmed instruction through computers. A brief account of programmed instruction is presented in the proceeding section.

Programmed instruction is a technique of self-instruction in which all of the instructional responsibility is carried out by teaching machines or programmed text. It is one of the most direct applications of Skinner's writings. It provides for highly systematic stimulus control and immediate reinforcement (Chauhan, 1994; Hefzallah, 1999; Joyce & Weil, 1996; Robyler, 1998; Sampath, Panneerselvam & Santhanam, 1990).

Cognitive psychology focuses on the mental processing of information. It is concerned with acquisition, storage, retrieval and use of knowledge. Cognitive psychologists study how humans gather, encode and store information from their environment using such mental processes as perception, memory imagery, concept formation problem solving, reasoning, decision making and language (Huffman, Vernoy & Vernoy, 1995).

Klein (1996) considers Edward Tolman as the proponent of cognitive view. Jean Piaget, Edward Tolman, Albert Bandura and Donald A. Norman are listed as cognitive psychologists by Hergenhahn & Olson (1997). Cognitive theorists view people as active processors of information, who seek out information in an attempt to make sense of the world around them.

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Norman (1982) defines learning as the act of deliberate study of a specific body of material, so that the material can be retrieved at will and used with skill. Learning involves purposeful remembering and skillful performance. With this definition, Norman disagrees with those theorists who view learning as an automatic process.

The consequences of actions are also an important component of cognitive learning theories. Instead of proposing the behaviourist view that consequences strengthen actions acting as reinforcers. Cognitive view maintains that consequences serve as feedback. In fact, it provides information to individuals regarding the correctness of their understanding and learning as they actively pursue knowledge and practice skills. Cognitive theorists' conception of how the brain operates, so closely parallels the operation of computers that another label for cognitive theory i.e. information processing theory has emerged. According to this approach, human gather information from the environment and then process it in a series of stages. A certain type of processing is preformed at one level before the information is passed on to another level for a different kind of processing. Thus, cognitive theorists like computer programmers began to think of learning in terms of sensory input, encoding, and retrieval system (Huffman, Vernoy & Vernoy, 1995).

Constructivism. Constructivists believe that what gets into the mind is not transmitted or poured by some external manipulator but has to be constructed by the individual through knowledge discovery or social interaction. Learning takes place when individuals participate in meaningful activities. They construct both mechanism for learning and their own unique version of knowledge, coloured by background experiences and aptitudes. Constructivist perspective emphasizes the active role of the learner in building understanding and making sense of information (Hsu, Chen & Hung, 2000; Roblyer & Edwards, 2000).

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2.6 Research Works on CBT

It is natural to review the educational research literature to find evidence for the effectiveness of the applications of technology, methodology or innovation of any kind. Computer based teaching is in use since 1950s and it is one of the most researched technology applications in education. There is a mix of research findings in favour of or against CBT. Yet there is ample evidence that supports CBT as an effective mode of instruction in various subject areas and at various grade levels. Poole (1995) have exemplified some successful computer assisted instruction programmes and projects and cited findings of research studies as an evidence for the effectiveness of CBT in 'reading', 'writing', 'Arithmetic and problem solving', 'science', and 'social studies'.

Different forms of CBT as supplement to traditional method of instruction have proved their effectiveness to augment student learning. Cotton (2001) reviewed fifty nine research studies exploring effectiveness of CBT and concluded that the single best-supported finding in the research literature is that the CBT as a supplement to the teacher directed instruction produces achievement effects superior to those obtained with traditional instruction alone. This finding holds true for students of different ages and abilities and for learning in different curricular areas. Christmann, Badgett & Lucking (1997) conducted a meta-analysis of the studies comparing CBT, Traditional method of Instruction and Traditional method of instructional plus CBT. It was found that students receiving Traditional method of instruction supplemented with CBT attained higher academic achievement than those receiving only traditional instruction or CBT. Poole (1995) asserts that computer is a tool in the hands of both the student and the teacher. The effectiveness of that tool depends entirely on the skills that the students and teacher bring to the learning process. It can be inferred from this assertion that any research finding regarding the effectiveness of CBT indicate the status of

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the skills employed by teacher the programme designer and students the beneficiaries from that program. However a review of the research findings is presented in this section.

There is a great deal of evidence regarding effectiveness of CBT in the subject area of science. Research findings support CBT at all grade levels i.e. from primary to the university. In the science classroom, students interacting with computers running simulations of experiments enjoyed a more effective learning experience than students watching a demonstration accompanied by teacher-student interaction (Poole, 1995). Roblyer (1988) also found that students who received science instruction through CBT simulations achieved more than those who studied in a conventional learning environment. It was also found that CBT activities are most effective in the areas of science and foreign languages.

Morse (1991) found that although not as conclusive as one might hope, studies do indicate that CBT in science education can improve learning and positively influence student attitude and self-esteem. Helgeson (1988) reviewed studies determining the effectiveness of CBT in science classroom and science laboratories and found evidence in support or CBT, as laboratory activities and simulations and combination or two strategies yielded higher achievement than did conventional instruction. Findings of the studies conducted by Brophy (1999) and Carter (1999) also support effectiveness of CBT in science.

Bayraktar (2000) conducted a study employing meta-analytic research approach. Purposes of this study were to determine whether CBT had an overall positive effect on student achievement in secondary and college level science education when compared with traditional forms of instruction and to determine whether specific study or programme characteristics were related to CBT effectiveness. Forty two studies comparing CBT and traditional instruction in science were included in this meta-analysis. The overall effect size

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was found to be 2.273 standard deviations, suggesting that CBT has a small positive effect on student achievement in science education at the college and secondary level. An average student exposed to CBT exceeded the performance of 62% of the students who were taught by using traditional instruction method i.e. a typical student moved from the 50th percentile to 62nd percentile in science when CBT was used. CBT was most effective in physics education and had little effect on chemistry effect on student achievement in science education but drill and practice was not found effective. Another finding from the study was that experimenter developed software was more effective than commercial and that CBT was found more effective when duration of treatment was shorter than four weeks.

Review of the literature reveals that simulations are the most effective type of CBT in the subject area of science. Microcomputer based laboratories (MBL) are also found to be effective for better learning of sciences concepts. Effectiveness of any computer assisted instruction programme depends upon:

Quality of instructional software

Quality and functioning of hardware.

Researchers have also found that CBT enhances learning rate i.e., students learned the same amount of material in less time than the traditionally instructed students or learned more material given the same amount of time (Cotton, 2001). He continued to say that students receiving CBT also retain their learning better.

Most researchers concluded that the use of CBT leads to more positive student attitudes than the use of conventional instruction. This general finding has emerged from studies of the effects of CBT on student attitudes as cited by Cotton (2001).

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2.7 Advantages and Disadvantages of CBT

There is ample evidence that computer assisted instruction is more effective than the traditional method of instruction. Extra advantages of CBT as identified through the findings of research studies are as below:

High achievement level. A large number of research studies provide evidence for high achievement levels for students of different ages and abilities and for learning in different curricular areas through CBT modes of instruction (Bahr & Reith, 1989; Braun, 1990; Gore, Morrison, Mass, & Anderson, 1989).

Learning rate. In addition to the rise in achievement levels, researchers have also found that CBT enhances learning rate. Student learning rate is faster with CBT than with conventional instruction. In some research studies, the students learned the same amount of material in less time than the traditionally instructed students; in others, they learned more material in the same time. While most researchers don't specify how much faster CBT students learn, the work of Capper and Copple (1985) led them to the conclusion that CBT users sometimes learn as much as 40 percent faster than those receiving traditional, teacher-directed instruction (Capper & Copple, 1985; Kulik 1985; Kulik & Kulik, 1987).

Retention of learning. If students receiving CBT learn better and faster than students receiving conventional instruction alone, do they also retain their learning longer? The answer, according to researchers who have conducted comparative studies of learning retention, is yes. In such researches, students' scores on delayed tests indicate that the retention of content learned using CBT is superior to retention following traditional instruction alone (Capper & Copple 1985; Nash & Ball,. 1983).

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The effects of CBT on other student outcomes have not been as extensively researched as CBT's effects on achievement, learning rate, retention, and attitudes. Some researcher have, however, investigated CBT's influence on other variables and found it to confer benefits on:

Locus of control. Capper and Copple (1985), Kinnaman (1990), and Louie (1985) found that CBT students have more of an internal locus of control/sense of self-efficacy than conventionally instructed students.

Attendance. Capper and Copple (1985) study, demonstrated that students' attendance improved in computer assisted instruction classes as compared with the classes where lecture method was employed.

Motivation/time-on-task. Capper and Copple (1985) found that CBT students (experimental group) had higher rates of time-on-task than traditionally instructed students (control group). Curtis and Howard (1990) hold that CBT incorporates adult learners' need for self-directedness, readiness to learn, time perspective and utilization of past experiences. By using CBT, the learner may work independently without fear of embarrassment. Learning can occur at the learner's own pace and time frame.

Mclean (1996) is of the opinion that CBT provides student with an alternative to classroom settings and frees the instructor from rote processes that are better handled by the computer. Using CBT an instructor can develop or acquire as series of supportive and reinforcing software. Albon (1997) identifies positive outcomes of CBT as a result of his experimentation. It was found that learning is more enjoyable for graduate and under graduate students; students are provided with concise and consistent information in a self paced manner. Other advantages that are associated with CBT are intrinsic in its very design. One obvious advantage of training people on an individual basis is self-paced learning.

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According to Lawson (1999, p. 30) within a self-paced instructional programme, an employee may review specific topics on which he/she needs clarification. Or, if familiar with the topic, the students may quickly complete the course and progress at a faster rate. This is in stark contrast to classroom instruction, in which a group of students is trained based on a predetermined time and are individually expected to master the topic during that time.

Another advantage of self-paced learning is the flexibility of schedules it provides. "Teaching can be taken by most students on a twenty-four hour basis without leaving the work site. Further, it is accessible almost anywhere a computer can be located" (Congram, 1995, p. 52). Also, "the self-pacing learning concept eliminates the need for group instruction and scheduling of activities" (Dhanjal & Calis, 1999, p. 13).

Along with flexibility of schedules comes the cost-effectiveness of using CBT. Since "students can train on-site avoiding the need to travel to training facilities, this results in savings in costs on travel and accommodation costs" (Dhanjal & Calis, 1999, p. 14). Not to mention, "the cost of live on-site instruction has certain fixed costs- instructor wages, classroom expenses, any travel fees, and variable costs, such as student materials" (Blankenhorn, 1999, p. 30). "When the costs are compared, the price of training and retraining drops from possibly hundreds of dollars per student for (live instruction) to thirty dollars or less per employee for computer-based training" (Blankenhorn, 1999, p. 29).

Because training costs include "…the presenter's time and materials, as well as work time lost while students attend lesson," (p. 44) contributing to the lower cost (in some situations) of CBT is reduced training time (Janicak, 1999). One study conducted by Maul and Spots as reported in an article by Lawson showed "the CBT group averaging a thirty-four percent

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decrease in training time when compared with a traditional classroom instruction group" (p. 31).

As stated previously, another advantage of CBT is the increased knowledge retention it affords to students. "Content retention is increased by engaging multiple senses (auditory, visual, and kinesthetic) during the learning process" (Dhanjal & Calis, 1999, p. 13). Well-designed CBT may "incorporate full-colour animation, product simulation and supportive narration to create a professional, yet inviting tone". Also, "CBT offers realistic, on-the-job scenarios to simulate hazardous situations which test a student's skills and responses. It is detailed, high-resolution graphics and animations enhance learning and promote a better understanding and knowledge of the material" (Congram, 1995, p. 53).

Other advantages include **consistency of message**, which cannot be assumed with a live instructor (Dhanjal & Calis, 1999), which can be accomplished using self-check questions, pre-tests and post-tests (Lawson, 1999), and **customization**. "Through customization features, an institution can tailor a genetic programme to match its own policies and procedures" (Lawson, 1999 p. 30). CBT clearly has many advantages over classroom instruction which should be considered by institutions which provide instruction.

Despite the numerous advantages, the CBT has some disadvantages. These are:

Integrity. With the advent of online learning, it is hard to tell if the user actually took the course. A student can have a friend take computer examinations for them, as there is no instructor present to prevent cheating

(Allan, n.d).

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Loss of a Unique Experience. Computer-based training generally relies on teaching masses of people the exact same thing in the exact same way. While this is cost-effective, it lacks versatility. A certain individual might be better taught by speech, another by visuals. Because most online learning systems are purely text-based, a large portion of the population loses out (Allan, n.d).

Low Interactivity. Interactive learning is any kind of education that requires students to respond actively to the study material. For example, computer programmes that teach languages require students to speak in response to phrases and images. Users who interact while learning are more likely to retain information, and many CBT require very little interaction. For example, many online assessments simply require you to check a multiple-choice box as a response (Allan, n.d).

Technical Limitations. If the course is Internet-based, users must have access to the Internet. Only 76 percent of the North American population used the Internet as of 2009. In addition, a person might not have access to a computer if the instructor does not provide it (Allan, n.d).

High Cost of Development. Though computer-based training systems are very cost-effective, the process of development can be very high. Creating a system that teaches well with multimedia elements and interactivity is not a simple process. Extensive e-training programmes can cost millions of dollars to create. The programme must also be maintained and updated at a high recurring cost. This is because of the need to hire programmers and content creators (Allan, n.d).

Other disadvantages of computer-based teaching are that people do not like it as much as they like having an actual person teaching them, according to Prewitt's (1998) article. Along the

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same lines, some people claim that without peer or human interaction, new students in school would not get a "warm introduction" and as a result, "may perceive the institution as faceless and uncaring" (Lawson, 1999, p. 33). A way to combat this problem is to have people greet and get to know new students in a way other than training, perhaps by showing them around, or by working alongside them as they use the CBT to field their questions or simply to make them feel more comfortable.

There are other problems associated with not having a human instructor. The institution believes that "hands-on exercises are essential to provide students the chance to work with equipment and PPE (personal protective equipment), solely reliance on computer-based training cannot achieve these objectives" (Janicak, 1999, p. 35).

It is possible in some instances that CBT may be less cost-effective than a traditional lecture programme as well. Depending on the number of people involved in the training, the cost for a lecture programme could be very economical when compared to the cost of some CBT programmes (Janicak, 1999).

Other disadvantages of CBT include the lack of review and remediation, the absence of feedback, and the inability for an instructor to automatically determine what the student has learned (Prewitt, 1998). All of these instances are indeed problems in instruction, but can be avoided if the CBT is designed effectively to include remediation techniques, feedback, and a post-test which measures how much the students have learned.

Yet another concern about CBT is product quality. Some safety professionals worry that, "developers may understand the programming aspects of formulating a CBT course, yet have

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no real expertise in learning theory" (Lawson, 1999, p. 31). Once again, this is a real problem, yet it can be avoided by making sure that the team developing the CBT has an instructional designer helping to develop the material rather than simply a SME and a programmer.

2.8 Ways in which CBT can Support the Teaching and Learning of Brickwork.

Children used the programmable bricks to build a variety of creative constructions, including an odometer for rollerblades and an automated hamster cage (Martin, Mikhak & Silverman, 2000; Resnick, Martin, Sargent & Silverman, 1996). The learner handouts were uploaded onto a site that was set up as Brickwork VLE to provide links to websites and resources that had interactive exercises with great visual displays. By asking the learners to explore it got them used to finding information and identifying what would be of interest to them. Using the internet in such a way helped the learners realised the wealth of information relevant to their work that they could access and it expanded the scope of resources available to them. This approach also inspired them to take an active interest in their field of work and find out what was happening in the wider sector. The learners were asked to use a Bluetooth connection to upload pictures of what they are building on the construction site onto the computer. These were then put on the interactive whiteboard and the learners were able to have group discussions concerning the work featured. Learners were encouraged to work collaborating with each other as they would have to while working on the construction site. This was beneficial as it gave learners the opportunity to develop social and communication skills (Napier University, n.d).

2.9 Summary of Major Findings of the Literature Review

Traditional teaching is concerned with the teacher being the controller of the learning environment. The methods used in traditional teaching and learning as indicated by Jabberwocky, (n.d) and Adprima, (2011) are role-playing, lecture, fire alarm, reading

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information, demonstration, observation, field trips, round robin, interviewing, brainstorming, expert opinion, experimenting, problem-solving activities, buzz sessions, performance, independent practice, debriefing, modeling, simulations, projects, skill practice, guided practice and reflective inquiry.

Computer based tutorial is a computer programme that enables students to learn on their own and at their own pace. They have the opportunity to interact with the computer. It comprises the following attributes: factual information and model skills, guides learners through the initial use of information, information is queued according to learner's abilities, it motivates the learner, and the locus of control should be with the learner (Alessi & Trollip, 2001).

The types of CBT programmes are drill and practice, tutorials, instructional games, simulations, microcomputer based laboratories (MBL), integrated learning system (ILS), problem solving and reference software. The major concern of this work is on tutorials, it acts like a tutor that provides all the information and instructional activities a learner needs to master on a topic and followed by quiz with immediate feedback after answering. The teaching methods have influence on the design of CBT.

Historic overview of CBT. In 1951 as technology was extended to schools through TV, it increased enrollment in the US schools. In 1977 microcomputer was introduced to schools in USA and teachers had the opportunity to control their instructional applications, instructional applications were no longer controlled by the district offices and companies. In 1997 till now educational software has become more useful and interesting to students as graphics and videos are incorporated.

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Characteristics of CBT. These are some of the characteristic of CBT: Individualization, flexibility, self-pacing, remediation options, graphics and sound. CBT should possess these characteristics to make it friendly and easy to use.

CBT and learning theories. The major theories used are constructivist and objectivist. Both approaches accept and recognize the potential of computers to promote and enhance learning. Researchers had reviewed that CBT as a supplement to the teacher directed instruction produces achievement effects superior to those obtained with traditional instruction alone.

These are some advantages of CBT: High achievement level, learning rate, retention of learning, locus of control, attendance, motivation/time-on-task, independent learning without fear of embarrassment, learning can occur at the learner's own pace and time frame, consistency of message and customization. Despite the numerous advantages, the CBT has some disadvantages. These are: Integrity, loss of a unique experience, low Interactivity, technical limitations and high cost of development.

To wind up, CBT can support the teaching and learning of Brickwork through the visualization of Brickwork on computer screen. This will encourage students since they will see how various brick bonds are built and the description that follows through sound that the computer provides.

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CHAPTER THREE

METHODOLOGY

This research was conducted in order to compare the Computer Based Tutorial approach to teaching with the traditional method of teaching brick bonding in senior high school. The following are discussed in this chapter: research design, population, sample and sampling procedure, instrument(s), data collection procedure and data analysis.

3.1 Research Design

The quasi experimental design was used for this study. To define the experimental type of research, Neuman (2000) states that the experimental method of research builds on the principles of a positivist approach more directly than do the other research techniques. The emphasis is on judging or interpreting rather than on describing. The aim of experimental research is to illustrate three things researchers do in the experiments: begin with a hypothesis, modify something in a situation and compare outcome with and without the modification. Compared to the other social research techniques, experimental research is the strongest for testing causal relationships because the three conditions for causality (temporal order, association, and no alternative explanations) are clearly met in experimental designs.

All 'experimental' designs are variations of the classical 'true' experimental design, which has random assignment, a pre-test and a post test, an experimental group, and a control group. I used the quasi-experiment type by selecting two schools at random but did not assign the students to the control and experimental groups at random. One of the schools (one with the higher mean pretest score) represented the control group and the other represented the experimental group. To ascertain the knowledge level of the two groups, the groups were given a pre-test to determine their knowledge base on the selected topic. The experimental

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group was given a programme (Computer Based Tutorial) designed by me and validated by experts and the students were taught how to use the Computer Based Tutorial to learn brick wall bonding.

3.2 Population

According to Healey (1999) a population is the total collection of all cases in which the researcher is interested in. Examples of possible populations would be all male adults in Ghana, all technical students in Ghana.

Population can theoretically range from inconceivable in size ("all humanity") to quite small (all technical students currently residing in Ashanti Region) but are usually fairly large. In fact, they are almost always too large to be measured. The intended population was all 2 year building construction students in Senior High Technical Schools in Kumasi. Due to the large number the population was from two schools. Samples are, of course, much cheaper to assemble, and if the proper techniques are followed, generalizations based on these samples can be very accurate representations of the population.

3.3 Sample and Sampling Procedure

In order to compare the Computer Based Tutorial and the traditional method of teaching a total of 30 respondents were selected, 15 represented the experimental group and another 15 represented the control group that answered pre-test and a post test questions respectively. To achieve relevant information, certain inclusion criteria were imposed. The participants qualified for sample selection were students from Senior High Technical Schools who offer Building Construction and were in form 2 class. The respondents were selected from two schools in Kumasi metropolis.

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Social researchers frequently want to compare. I used two groups of 15 students each. This would be ideal and compared the group on the basis of a key difference between them (The use of CBT as against lecture method in teaching and learning). When making comparison, I compared cases that do not differ with regard to variables that offer alternative explanations.

Random assignment is a method for assigning cases (eg., individuals, organizations, etc.) to groups for the purpose of making comparisons. It is a way to divide or sort a collection of cases into two or more groups in order to increase one's confidence that the groups do not differ in a systematic way. It is a mechanical method; the assignments on the basis of personal preference or the features of specific cases. Random assignment is random in a statistical or mathematical sense, not in an everyday sense. In everyday speech, random means unplanned, haphazard, or accidental, but it has a specialized meaning in mathematics. In probability theory, random describes a process in which each case has a known chance of being selected. I created a situation or entered into ongoing situation, than modified it. The treatment (or the stimulus or manipulation) is what was modified. In experiments, researchers "measure" independent variables by creating a condition or situation. They measure the independent variable by manipulating conditions so that some subjects feel a lot of fear and others feel little (Neuman, 2000).

I wanted the treatment to have an impact and produce specific reactions, feelings, or behaviours. Diffusion of treatment was a threat that subjects in different groups will communicate with each other and learn about the other's treatment; due to this, two separate schools were used in drawing out the groups. Numbers were written on pieces of paper and drawn from a box; the process was repeated until the sample size of 15 for each school was reached making a total of 30. 15 respondents were chosen for each school due to insufficient

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number of computers in the schools computer laboratory. As mentioned above, the group that had the higher mean score in the pre-test was taken as the control group and the group that had the lower mean score was taken as the experimental group. This was done to test the efficacy of the treatment, albeit at the expense of a Type II error. I felt avoiding a Type I error in the experiment was a higher priority so that any differences in favour of the experimental group could be confidently associated with the treatment.

3.4 Instruments

A CD-ROM prepared by the researcher served as the teaching medium for the experimental group. It is a self-paced and individualized solution with easy step-by-step interactive tutorial courseware for the students.

The traditional method consisted of lectures given by the teacher, recitation, and class activities involving the topics discussed during the lesson. The topics were the same as those given to the experimental group.

The achievement pre-test and the achievement post test were one and the same test. The test was a teacher made test. It was composed of section A 10 multiple choice items and section B, 4 essay test items. The essay test comprised two parts of which one determines how students can differentiate and the other how students can sketch. The questions for the achievement test were based on brick wall bonding as I incorporated in my CBT and the traditional lessons taught to both experimental group and the control group respectively. Because the same test was used for both pre-test and post test, students were asked to answer questions on the question papers and the question papers were collected at the end of the test.

The content validity of the measuring instrument was determined by one graduate researcher.

To determine the reliability of the measuring instrument, the test retest method was

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employed. The test was administered to ten students enrolled in the building construction programme at St. Joseph's Senior High Technical School at Asuoyeboah-Kumai. Two weeks later the same test was administered to the same students. The Pearson product-moment correlation coefficient was calculated to determined the test-retest reliability of the measuring instrument. The reliability coefficient was 0.75, which was considered acceptable according to a thumb rule suggested by Fraenkel and Wallen (1993) that reliability of a test for research purposes should be at least 0.70 and preferably higher.

3.5 Data Collection Procedure

A computer programme on one area of Microsoft PowerPoint in brickwork bonding was developed by the researcher. The computer programme consisted of three parts: self teaching, self testing and assignment. The measuring instrument consisted of two identical forms of a test. A 20-minute achievement pre-test was given on 22nd January, 2010. The test was to assure that both groups had the same knowledge, if any of brick wall bonding. Then the treatments were given for the two groups, the control group was taught using the traditional method of teaching and the experimental group the Computer Based Tutorial. After the treatment a 20-minutes achievement post test was given after two weeks of the treatment.

The sample was randomly selected in each school to form two groups, a control and an experimental group from two Senior High Technical Schools in Kumasi metropolis. The control group consisted of 15 students all of whom went through the following: introduction, pre test, lecture by me, and post test. The experimental group consisted of 15 students all of whom went through the following: introduction, pre test, Computer Based Tutorial, and post test. The sample size was determined by the maximum number of computers in the schools used in the study. Since it was not appropriate to let students work in pairs and groups, it was

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appropriate to use 15 students so that each student would work on his/her own during the experiment.

The effectiveness of the Computer Based Tutorial compared to traditional method was determined by descriptive statistics (Tables and charts) and an independent t-test. An alpha level of 0.05 was used.

3.6 Data Analysis

The data collected in this study were analysed to find a significant difference between the two instructional methods at the 0.05 alpha level. The statistical null hypothesis tested was "students instructed by the Computer Based Tutorial will perform the same in terms of cognitive achievement test scores as students instructed by traditional method".

First the descriptive statistics was used to determine the knowledge level of experimental and control group from the pre-test scores before the treatment, followed by the inferential statistics (t-test). The t-test was applied on the pre-test scores of the students' previous knowledge based on the selected topic.

To compare the achievement of the experimental group and the control group in the post test, descriptive statistics and inferential statistics (t-test) were applied on the post-test scores of the study. The independent t-test was employed to find out the significance of difference between the achievement scores of the experimental and the control groups. This is because the selected students were from two different schools.

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CHAPTER FOUR

RESULTS AND DISCUSSION

The basic purpose of the study was to compare the Computer Based Tutorial and Traditional method of teaching brick wall bonding. An experiment was conducted to compare CBT with traditional method of instruction. Pre-test and Post-test were used on both experimental and control groups.

The pre-test was to ascertain the pervious knowledge level between the experimental and the control group before the treatment. The Post-test was to come out of method which is most appropriate and convenient for both instructors and the learners. Data were collected on one instrument: Achievement Test.

4.1 Analysis of Scores on Achievement Test

The achievement test used as pre-test and post-test in the study was designed and validated to measure achievement in general knowledge, how to differentiate and how to sketch. The number of items for measuring general knowledge, how to differentiate and how to sketch was made up of ten multiple choice, 2 essay test items and 2 sketches. All the items were based on brick wall bonding. These items were used for both the pre-test and the post-test. For the pre-test, the analysis was done to ascertain the previous knowledge of both groups before the treatment on the basis of general knowledge in brick wall bonding. The post-test was to compare both experimental and control groups on the basis of the overall achievement scores, general knowledge, how to differentiate and how to sketch.

Differences between each of the areas in the achievement test scores were determined by descriptive statistics and the independent samples t-test. Descriptive statistics were used to determine the difference in achievement between the experimental and control groups. As

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shown in the table 2, there was no significant difference between the experimental and the control groups on knowledge level of achievement test score before the treatment.

Table 1: Raw Scores on Previous Knowledge of Pre-achievement Test for Experimental and Control Groups

Student Number	Experimental Group Scores (100%)	Control Group Scores (100%)
1	22	25
2	26	14
3	0	28
4	23	12
5	25	24
6	21	0
7	32	27
8	30	25
9	18	19
10	0	21
11	17	16
12	22	34
13	21	33
14	9	22
15	29	29
Total	**295**	**329**
Mean	**19.67**	**21.93**

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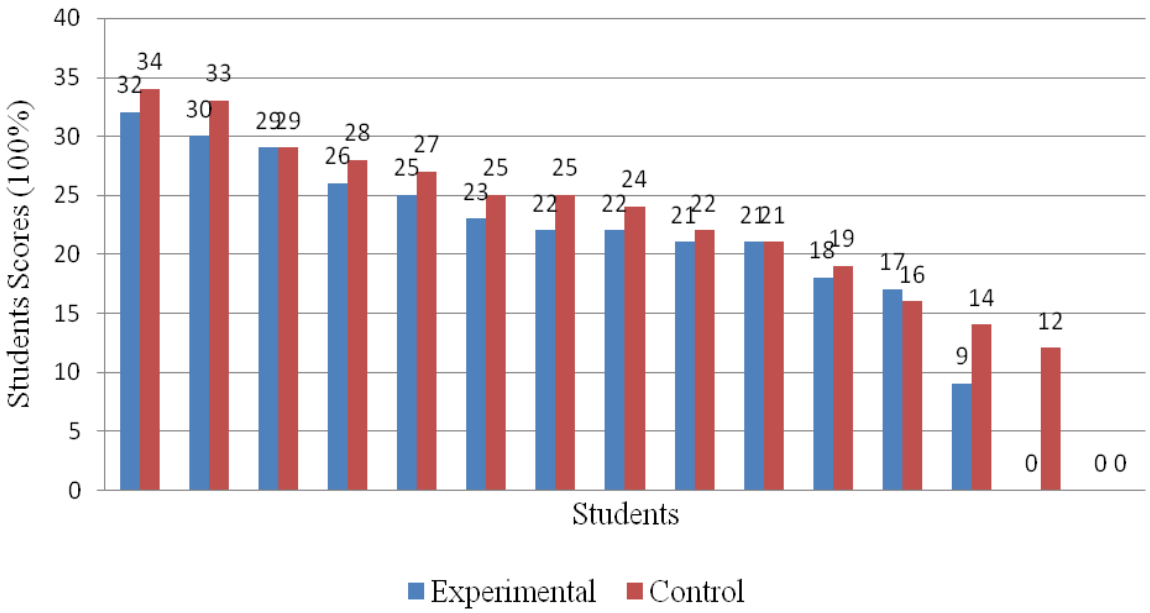

Figure 1. Bar chart that shows pre-test scores of students.

As show in Table 1 and Figure 1, the highest and lowest scores of experimental group were 32 and 0 respectively and the highest and lowest marks of the control group were 34 and 0 respectively. In effect, the ranges were nearly the same. Also, the distribution of the scores was similar in both groups, so on the face of it, there is no significant difference between the two groups.

Table 2 summarizes the results of independent t-test applied to explore the significance of difference between mean scores of the experimental and the control group on knowledge level of achievement test before the treatment.

Because the test scores represented interval data, student's t-test for independent samples was correctly judged to be the appropriate test for this analysis of difference between two groups.

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Table 2: Independent Samples t- test on Groups Mean Scores

Group	Mean	Mean difference	Std. deviation	t-value	p-value
Control	21.93		8.83		
		2.86		-0.67	0.51
Experimental	19.67		8.41		

It is evident from Table 2 that, the null hypothesis is accepted and it can be claimed that there is no difference in pre-test achievement scores between experimental group (students to be instructed by Computer Based Tutorials) and control group (students to be instructed by traditional method of teaching). This is because the p-value is less than the t-value [t-value (-0.67) < p-value (0.51)]. Hence, the treatment was effected and the post test was conducted after the treatment.

The study was to compare Computer Based Tutorial and Traditional Method of Teaching brick wall bonding.

1. One group of students was instructed by Computer Based Tutorial.
2. The other group of students was instructed by Traditional Method of Teaching.

The students, who were all from the senior high school level were from intact classes from two randomly selected schools.

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4.2 Analysis of Overall Achievement Scores

Table 3: Raw Score of Overall Achievement Test by Students Group: Students Instructed by Computer Based Tutorial and Students Taught by Traditional Method of Teaching

Student Number	Experimental Group Scores (100%)	Control Group Scores (100%)
1	70	86
2	81	92
3	70	69
4	83	63
5	76	55
6	82	60
7	90	51
8	91	21
9	76	49
10	79	52
11	78	59
12	96	62
13	90	42
14	86	89
15	96	82
Total	**1244**	**932**
Mean	**82.93**	**62.13**

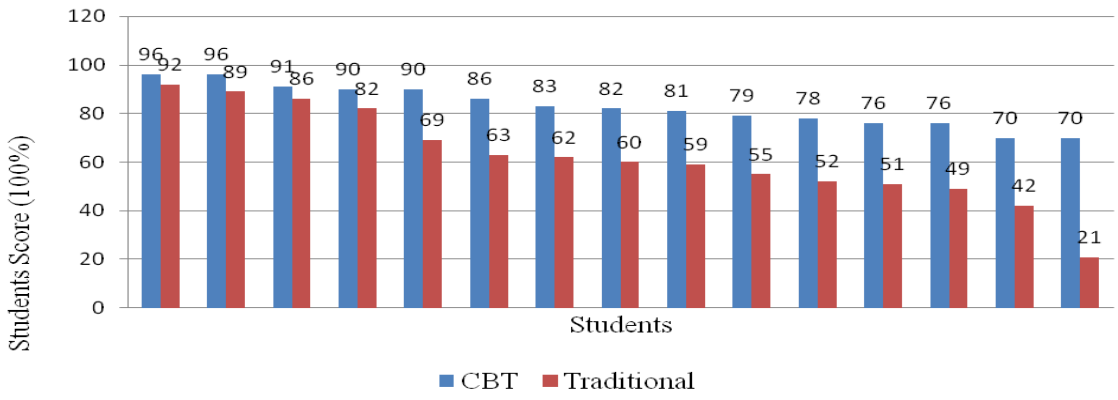

Figure 2. Bar chart that shows students total scores.

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From Table 3 and Figure 2, there is clear evidence that students instructed by CBT performed better then students instructed by the traditional method. Table 3 indicates the highest and lowest scores for both experimental and control groups were 96 and 70 respectively and those for the control group were 92 and 21 respectively. In Figure 2, when scores are compared in both experimental and control group from the highest to the lowest, the columns for experimental group students are higher than the control group students. This indicates that the experimental group students performed better in the overall achievement test scores than the control group students after the treatment.

Test scores for both groups of students are summarized in Table 4.

Table 4: Independent Samples t- test on Groups Mean Scores

Group	Mean	Mean difference	Std. deviation	t-value	p-value
Control	62.13		19.25		
		20.80		3.83	0.001
Experimental	82.93		8.41		

Therefore, the null hypothesis is rejected and it can be claimed that there is a difference in achievement test score between students instructed by Computer Based Tutorial method and students instructed by traditional method of teaching. This is because the absolute value of t-statistic is greater than that of the t-critical value. It means that the student of experimental group who received Computer Based Tutorial performed better on over all scores of brick wall bonding achievement test than those who were taught through Traditional Method of Instruction. Cotton (2001) supported that CBT as a supplement to the teacher directed instruction produces achievement effects superior to those obtained with traditional instruction. A large number of research studies provide evidence for high achievement levels

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for students who are instructed through CBT modes (Bahr & Reith 1998; Braun 1990; Gore, et al. 1989).

4.3 Analysis of Achievement Scores in General Knowledge of Brick Wall Bonding

Table 5, 6 and Figure 3 shows the comparison of achievement scores in the area of achievement in general knowledge of brick wall bonding.

Table 5: Raw Scores of the Experimental and the Control Groups on General Knowledge of Brick Wall Bonding Component of the Achievement Test

Student Number	Experimental Group Scores (50%)	Control Group Scores (50%)
1	30	41
2	46	44
3	28	31
4	43	24
5	27	25
6	49	30
7	50	25
8	50	10
9	27	20
10	41	31
11	42	32
12	48	23
13	42	19
14	41	43
15	46	45
Total	**610**	**443**
Mean	**40.67**	**29.53**

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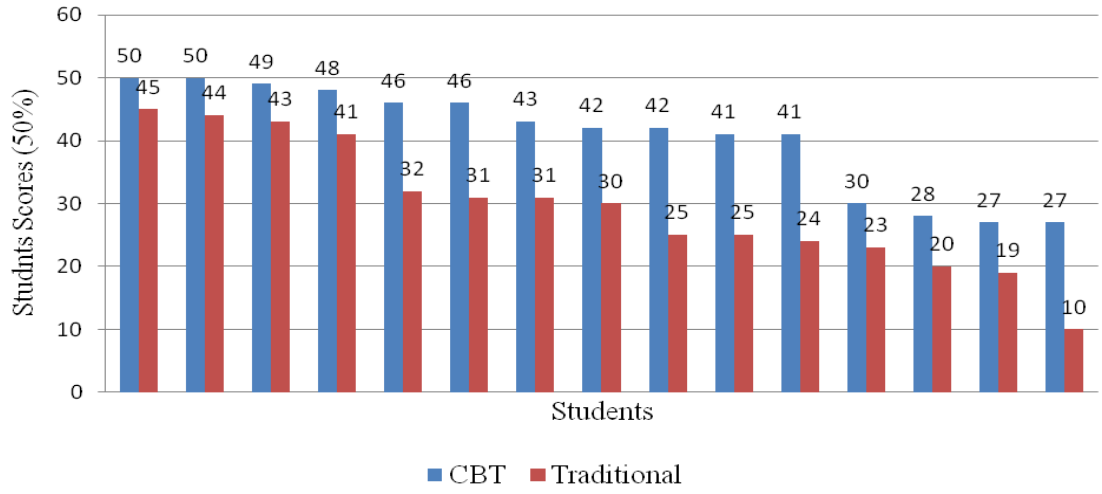

Figure 3. Bar chart that shows the achievement scores of students general knowlege on brick wall bonding.

From Table 5, the highest and lowest scores of experimental group is 50 and 27 respectively while the control group is 45 and 10 respectively. When the scores are compared throughout Table 5, the experimental group performed better than the control group.

Figure 3 also depicts scores in terms of column height, the experimental group columns are higher than the control group columns when compared from the highest to the lowest in both groups. This indicates that the experimental group performed better in general knowledge on brick wall bonding than the control group.

Table 6 summarizes the results of independent t-test on scores for achievement in general knowledge of brick wall bonding by experiment and the control groups.

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Table 6: Independent Samples t- test on Groups Mean Scores

Group	Mean	Mean difference	Std. deviation	t-value	p-value
Control	29.53		10.25		
		11.14		3.24	0.003
Experimental	40.67		8.50		

Independent t-test applied on scores of the experiment and the control group students on general knowledge of brick wall bonding of achievement test reveal that the t-value is greater than the p-value. Hence the hypothesis stating that students instructed by Computer Based Tutorial method will perform the same in terms of achievement test scores as students instructed by traditional method of teaching brick wall bonding is rejected. Rejection of hypothesis leads to the conclusion that CBT in this experiment proved more effective in general knowledge of brick wall bonding among the students than the traditional method of teaching. Hsu, Chen and Hung (2000) inferred that CBT tutorial programme works with an individual student in a very interactive manner and often provides an ideal learning situation for information transmission. Bayraktar (2000) supported the idea that CBT is found more effective when duration of treatment is shorter than four weeks. Finding of the studies conducted by Brohpy (1999) and Carter (1999) also support effectiveness of CBT over traditional method of teaching.

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4.4 Analysis of Achievement Scores on Differences between Types of Brick Wall Bonding

Table 7, 8 and Figure 4 shows comparison of achievement scores in the area of achievement on the differences between Types of Brick Wall bonding.

Table 7: Raw Scores of Experimental and the Control Groups on how to Differentiate between Types of Brick Wall Bonding

Student Number	Experimental Group Scores (30%)	Control Group Scores (30%)
1	25	20
2	17	28
3	22	26
4	23	23
5	22	15
6	20	30
7	26	14
8	25	6
9	30	10
10	20	12
11	20	12
12	28	22
13	29	13
14	28	27
15	30	22
Total	**365**	**280**
Mean	**24.33**	**18.67**

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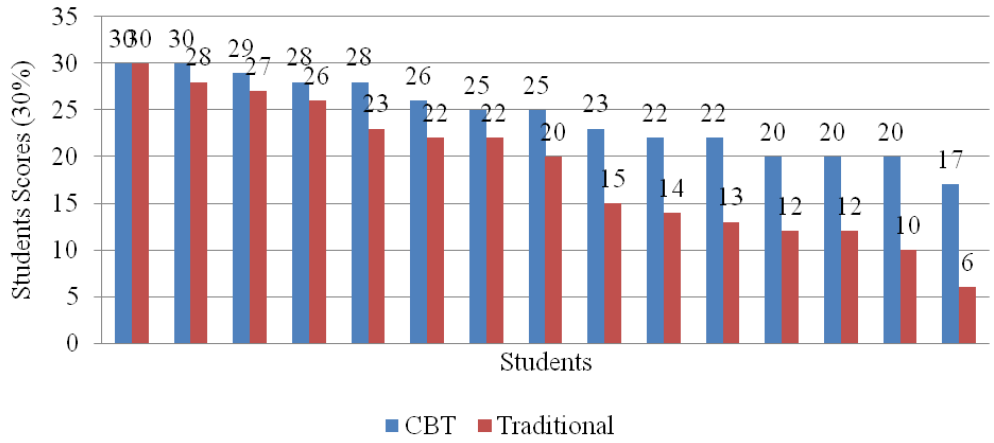

Figure 4. Bar chart that shows how students can differentiate between brick wall bonding

As shown in Table 7, two students instructed by CBT scored 30 out 30 while one student instructed by traditional method scored 30 out 30. When compared throughout the Table 7 majority of the students instructed by the CBT performed better than those instructed by the traditional method.

Figure 4 shows the scores in terms of column height, when compared from the highest to the lowest column students instructed by CBT attained the highest columns as against that of students instructed by the traditional method. Based on the questions that should ascertain students understanding on how to differentiate between types of bonding, experimental group students performed better than the control group students.

Table 8 summarizes the independent t-test employ to find out if students instructed by Computer Based Tutorial method will perform the same in terms of achievement test score as students instructed by traditional method based on how to differentiate between types of bonding.

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Table 8: Independent Samples t- test on Groups Mean Scores

Group	Mean	Mean difference	Std. deviation	t-value	p-value
Control	18.67		7.43		
		5.67		2.58	0.017
Experimental	24.33		4.13		

Results of the Independent t-test as summarized in the Table 8 reveals that students instructed by Computer Based Tutorial method performed differently in terms of achievement test scores to that of students instructed by traditional method of teaching brick wall bonding. Therefore the null hypothesis, stating that students instructed by CBT method will perform the same as students instructed by traditional method of teaching brick wall bonding is rejected. Hence CBT in the present experiment proved more effective in how to differentiate between types of brick wall bonding than the traditional method of instruction. Capper & Copple (1985) and Nash & Ball (1983) revealed to back the finding that retention of content learned using CBT is superior to retention following traditional instruction alone. Poole (1995) supported that CBT helps students learn subject matter of all kind. In effect students performed better in achievement test than that of students instructed by traditional method.

4.5 Analysis of Achievement Scores on Sketches of Brick Wall Bonding

Table 9, 10 and Figure 5 shows comparison of achievement scores in the area of achievement on sketches of Brick Wall bonding.

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Table 9: Raw Scores of the Experimental and the Control Groups on Sketches Component of the Achievement test

Student Number	Experimental Group Scores (20%)	Control Group Scores (20%)
1	15	15
2	18	20
3	10	12
4	17	17
5	17	15
6	13	10
7	14	12
8	16	5
9	19	9
10	18	9
11	16	10
12	20	17
13	19	10
14	17	19
15	20	15
Total	**249**	**195**
Mean	**16.60**	**13.00**

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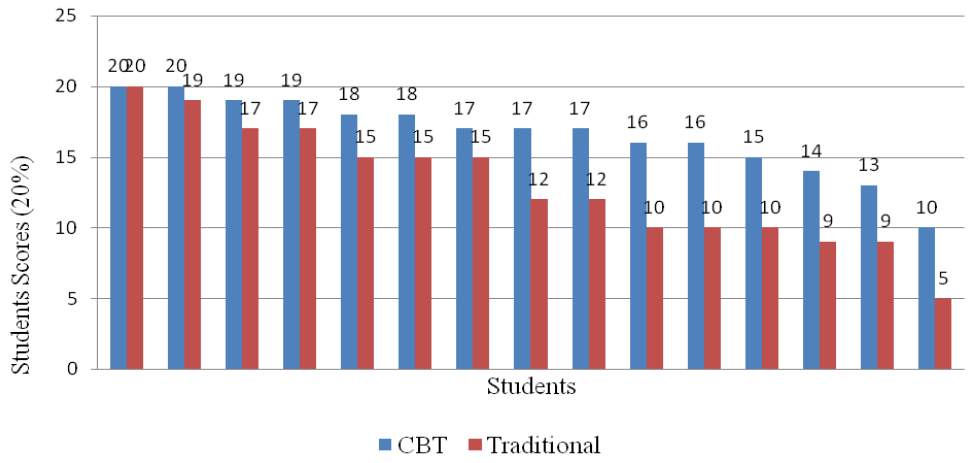

Figure 5. Bar chart that shows students ability in sketches of brick wall bonding.

Table 9 shows the results of students' ability to sketch. The scores revealed that students instructed by CBT performed better than those instructed by traditional method. Two students scored 20 each for experimental group while one student scored 20 for control group. Generally, the experimental group scores were higher than the control group scores throughout the experiment as seen from the Table 9.

From Figure 5, columns are used to represent the students' scores. To compare students instructed by CBT as against those instructed by Traditional method from the highest to lowest column. Beside the first columns for both groups which were equal, all the remaining columns, the experimental group had the highest as compared to the control group. This indicates that the CBT is the best option to teach sketches of brick wall bonding than the traditional method.

Table 10 summarizes the results of independent t-test on achievement scores by the experimental group and the control group in the area of sketches.

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Table 10: Independent Samples t- test on Groups Mean Scores

Group	Mean	Mean difference	Std. deviation	t-value	p-value
Control	13		4.26		
		3.6		2.75	0.011
Experimental	16.6		2.75		

Significant value of 't' at 0.05 level of significance reveals that mean achievement scores of the experimental and the control groups are significantly different. Therefore, the null hypothesis, stating that Students instructed by Computer Based Tutorial method will perform the same in terms of achievement test scores as students instructed by traditional method of teaching brick wall bonding in the area of sketches is rejected. It is concluded that the students of experimental group who received CBT showed significantly better achievement than those of control group students who received instructions in traditional manner. Computer graphics and sound infuse movement, excitement and animation into a programme, have enhanced students ability in sketches (Maler, Barnett, Warren, & Brunner, 1998; Sloane, Gordon, Gunn & Mickelsen, 1989).

The results of the present study are in consonance with the results of many of the experimental studies demonstrating effectiveness of CBT for better student achievement in science such as (Bayraktar, 2000; Brophy, 1999; Carter, 1999). Review of studies determining the effectiveness of computer based tutorial by Helgeson (1998) found precedents in support of CBT for science. Meta analysis of researches regarding effectiveness of CBT by Roblyer (1989) revealed that effectiveness of computer based tutorial depends upon the quality of utilization of CBT software.

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In addition, Spotts and Bowman (1995) inferred that colleges that are behind in incorporating technology into curricula will soon not be able to compete for students as well as schools which have stronger technology programmes. Again, they noted that attitude change because of the use of electronic media in the classroom since the use of electronic media generates interest, and interest leads to learning.

In conclusion as it was indicated by the following researchers: Poole, (1995); Helgeson, (1988) and Roblyer, (1988) that, in the science classroom, students interacting with computers running simulations of experiments enjoyed a more effective learning experience than students watching a demonstration accompanied by teacher-student interaction. The use of CBT in the present study has influenced students learning ability more than the use of the traditional method of teaching as indicated by the results of the study and in line with existing relevant literature.

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CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

The present study was conducted to assess the effectiveness of computer based tutorial programme as compared with traditional method of teaching in brick wall bonding of Senior High School Form 2. The purpose of the study was to compare the effectiveness of traditional method of teaching and learning with the use of computer based tutorial (CBT) for teaching and learning of brick wall bonding in Senior High School Form 2.

Comparison of CBT and traditional method of instruction is not only a comparison of two modes of instruction but of two theoretical paradigms. Traditional method represents a paradigm whereby knowledge is transmitted from teacher to student. Knowledge is 'poured' into learner's brain and as such, the leaner becomes a passive recipient of knowledge. The teacher plays an active part in the mode of instruction. Consequently, when the teacher absents from school, teaching and learning come to a halt. In any case, when a student is absent from school he/she loses the lesson for good. There would not be any opportunity to get the particular lesson.

CBT, on the other hand, represents a paradigm where knowledge is constructed and sought by the learner. The learner plays an active role in learning process because learning in individualized, self-pace and results from 'hands on' experience.

The present study was completed in two phases, during the first phase a computer based tutorial programme was developed by me. The second phase of the study was experimentation with CBT programme to determine its effectiveness in terms of student

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learning. I also constructed one instrument to be used in the study. The instrument was an achievement test used as pre-test and post-test.

5.2 Development of CBT Programme

A review of the related literature revealed that the computer based tutorial was most feasible to be adopted for the present study. Hence a computer based tutorial programme was developed.

This programme covered a text and a graphics content of all brick wall bonding types. The text material was designed with graphics, was followed by multiple choice questions, written, and sketches questions to assess and enhance student learning. Explanations for terms and concepts in the text were presented through hyperlinks.

An experiment was conducted to determine the effectiveness of CBT programme. The sample for the study was made up of thirty students out of total ninety SHS 2 of Building Construction class from two different schools. Sample of the study was selected on the basis of simple random sampling in the two schools from intact classes. Only 15 students were selected from each school because there was a maximum of 15 computers in the schools used in the study. A pre-test was done to determine the knowledge level of the participants on the selected topic.

The experimental group was given a treatment in the form of computer based tutorial in the computer laboratory of their school. I supervised the experimental group and taught the control group on the same topic in the different schools. Both groups were told that their achievement would be tested after completion of treatments.

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Achievement test was the instrument used in the present study. The test comprising ten multiple choice items, two written and two sketches were developed by me. This test was designed to measure the general knowledge, ability to differentiate and sketch. Necessary procedure for test development i.e. preparation of chart of specifications, item construction, test-retest validity and revision was followed.

The achievement test was administered to both the experimental and the control groups in both the pre-test and the post-test. Achievement scores of students in both the groups were used to compare the student learning through computer based tutorial and traditional method of teaching i.e. for the post-test. However, the pre-test achievement scores indicated no significant differences between the two groups in terms of their achievement before the test.

The data were analysed through computer programme Microsoft Excel (Ms Excel) version 2007. Descriptive statistics and independent t-test were applied to ascertain the knowledge level of students before the post-test. Again, descriptive statistics and Independent t-test were applied to compare the achievements of the experimental and the control groups. Each of the areas tested was analysed and the findings were supported with relevant related literature.

5.3 Key Findings

Results of the present study demonstrated that computer based tutorial was an affective mode for learning brick wall bonding. Specifically, the study found the following:

1. Students instructed by CBT performed better than those instructed by traditional method on the differentiation between types of brick wall bonding.
2. Students instructed by CBT performed better than those instructed by traditional method on sketches.

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3. Students instructed by CBT performed better than those instructed by traditional method on general knowledge on brick wall bonding.
4. The use of CBT in the present study has influenced students learning ability more than the use of the traditional method of teaching as indicated by the results of the study.

5.4 Conclusions

The findings of this experimental study lead to the following conclusions: Computer based tutorial is a better method of instruction for Senior High School Building Construction Form 2 class as compared to the traditional method of instruction. Computer based tutorial proved more effective method as compared with traditional method of teaching to enhance student learning in the following area: general knowledge in bonding, ability to differentiate and sketch of brick wall bonding.

Students benefited from the individualization, self-pacing and interactive nature of the CBT programme. Interactive, self-paced and individualized modes of presentation as used in the present study are better strategies to enhance student learning than the traditional method of teaching. Incorporation of questions and feed back in instructional process has a better impact on student learning. Learners' active participation in instructional process results in better student achievement. Computer assisted instruction is a powerful, useful and interesting mode of instruction.

5.5 Recommendations

Experimentation with computer based tutorial and findings of the study have lead to the following recommendations.

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Recommendations for Government

1. Government should establish a computer based tutorial promotion department under the ministry of education to plan, organize and coordinate efforts to utilize computer based tutorial. Development of computer based tutorial software, administration and control regarding hardware in educational institutions may be major tasks of these departments.
2. Government should also establish computer based tutorial departments in various institutions such as Ghana Education Service, ICT in Education Planning Unit, Curriculum Research and Development Centres and Education Universities. These departments may conduct research studies and make efforts to develop computer based tutorial software.
3. Widespread use of computer based tutorial requires a very high number of computers. Availability of such number of computers and adequate software is not possible in near future. Government should take steps to lower the prices of hardware either by encouraging indigenous hardware manufacturing industry or by offering incentives to hardware importers.
4. Government should offer incentives for teachers who increase their proficiency in computer studies and contribute to enhance computer based tutorial.
5. Much can be learnt through the experiences of the others. Selected experts in the field of computer based tutorial can be sent to those countries which are utilizing this mode of teaching successfully; Government support is needed in this regard.

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5.6 Recommendations for Teacher Education

1. Personnel with expertise in pedagogy and computer programming are needed if students are to benefit from computer based tutorial. Hence teacher education institutions should introduce courses to prepare teachers equipped with pedagogy and computer programming skills.
2. Teacher education institutions can start new programmes to produce computer programmers, engineers and analysts equipped with pedagogic skills.
3. Teachers should be given computer literacy training through refresher courses. It is necessary to develop a culture for better utilization of computer in teaching learning process.

5.7 Recommendations for Further Research

1. Future researchers should undertake researches to determine the efficacy of various types of computer based tutorial for various subject areas and at different levels of education.
2. Large scale research efforts necessary for the utilization of computer based tutorial invite government support due to the following reasons.

a. Research at student level just to fulfill the course requirements may not be sufficient to meet the required level of research.

b. Research in the field of computer based tutorial is too costly to afford personally by a research scholar.

c. One researcher alone cannot seek the required cooperation from the concerned parties - i.e. departments, organizations, educational institutions, etc.

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APPENDICES

APPENDIX A

ACHIEVEMENT PRE-TEST

This test is to enable the researcher gather his data on knowledge level of students before the treatment. Please be assured that any information obtain would be treated with utmost confidentiality.

SHS TWO BUILDING CONSTRUCTION

Please circle the correct answer from the option A - D

STUDENT NO.: …….

1. When no vertical joint in any one course is directly above or below a vertical joint in the adjoining course is termed as
   A. Bounding
   B. Bending
   C. Bonding
   D. Banding

2. Stretcher bonds are used for the following except:
   A. Cavity walls
   B. Half-brick walls
   C. Half-brick skins of hollow walls
   D. Half load bearing wall

3. Brick wall that consists of alternate stretchers and headers in each course is
   A. Header bond
   B. Stretcher bond
   C. English bond
   D. Flemish bond

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4. What name is given to a combination of English and Flemish bond?
   A. Single Flemish bond
   B. Double Flemish Bond
   C. Single English Bond
   D. Double English Bond

5. Why do closer place next to the quoin header?
   A. To increase the strength of the wall
   B. To avoid vertical continuous joint
   C. To give good appearance to a wall
   D. To prevent straight joint

6. A brick wall that consist of three-five courses of stretcher to one course of header is
   A. English garden-wall bond
   B. Flemish garden-wall bond
   C. English stretcher wall bond
   D. Flemish stretch wall bond

7. What other name is used to describe Sussex bond?
   A. English garden-wall bond
   B. Flemish garden-wall bond
   C. English stretcher wall bond
   D. Flemish stretch wall bond

8. A brick-on-edge bond with hollow at the middle of the wall is termed as
   A. Rat-trap bond
   B. Monk bond
   C. Dutch bond
   D. Miscellaneous bond

9. The height of a wall in relation to its width is known as
   A. Strength ratio
   B. Width ratio

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C. Height ratio

D. Slenderness ratio

10. ……. usually consists of two stretchers to one header in each course.

A. Monk bond

B. Dutch bond

C. Rat-trap bond

D. Miscellaneous bond

SECTION B

PART I

1. State two between differences between English bond and Flemish bond.

2. Outline two between differences between stretcher bond and header bond.

PART II

3. Sketch the following bonds:

i. Quetta bond

ii. Rat-trap bond

4. Make a freehand sketch of English garden-wall bond in isometric.

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APPENDIX B
ACHIEVEMENT POST TEST

This test is to enable the researcher gather his data for his research work after the treatment. Please be assured that any information obtain would be treated with utmost confidentiality.

SHS TWO BUILDING CONSTRUCTION

Please circle the correct answer from the option A - D

STUDENT NO.: 00…….

2. When no vertical joint in any one course is directly above or below a vertical joint in the adjoining course is termed as

E. Bounding
F. Bending
G. Bonding
H. Banding

2. Stretcher bonds are used for the following except:

A. Cavity walls
B. Half-brick walls
C. Half-brick skins of hollow walls
D. Half load bearing wall

3. Brick wall that consists of alternate stretchers and headers in each course is

A. Header bond
B. Stretcher bond
C. English bond
D. Flemish bond

4. What name is given to a combination of English and Flemish bond?

A. Single Flemish bond

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B. Double Flemish Bond

C. Single English Bond

D. Double English Bond

5. Why do closer place next to the quoin header?

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B. To avoid vertical continuous joint

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7. What other name is used to describe Sussex bond?

A. English garden-wall bond

B. Flemish garden-wall bond

C. English stretcher wall bond

D. Flemish stretch wall bond

8. A brick-on-edge bond with hollow at the middle of the wall is termed as

A. Rat-trap bond

B. Monk bond

C. Dutch bond

D. Miscellaneous bond

9. The height of a wall in relation to its width is known as

A. Strength ratio

B. Width ratio

C. Height ratio

D. Slenderness ratio

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10. ……. usually consists of two stretchers to one header in each course.

A. Monk bond

B. Dutch bond

C. Rat-trap bond

D. Miscellaneous bond

SECTION B

PART I

1. State two between differences between English bond and Flemish bond.
2. Outline two between differences between stretcher bond and header bond.

PART II

3. Sketch the following bonds:

iii. Quetta bond

iv. Rat-trap bond

4. Make a freehand sketch of English garden-wall bond in isometric.