UNIVERSITY OF CAPE COAST

IMPACT OF COMPUTER BASED INSTRUCTION (CBI) ON STUDENTS' PERFORMANCE IN MATHEMATICS: A CASE STUDY OF PUBLIC BASIC SCHOOLS IN KASOA

ERIC ATTA

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BY

ERIC ATTA

Dissertation submitted to the College of Distance Education of the Faculty of Education, University of Cape Coast in partial fulfilment of the requirements for award of Masters of Education Degree in Information Technology

MAY 2015

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: Eric Atta

Supervisor's Declaration

I hereby declare that the preparation and presentation of this dissertation was supervised in accordance with the guidelines on supervision of dissertation laid down by the University of Cape Coast.

Supervisor's Signature:…… Date:……...

Name: Dr.S. Baafi - Frimpong

ABSTRACT

The main purpose of this study was to ascertain the differences existing between the use of Computer Based Instruction (CB1) and the traditional method of teaching mathematics. The study was conducted in two basic schools in Kasoa. The schools were St. Martha's Basic school and Emmanuel Presby basic school all in Kasoa. The survey was conducted by using questionnaire and achievement test items. Items in the Questionnaire and the text items were of relevance to the purpose of the survey they were administered in two basic schools. The data was collected, organized and analyzed using frequency, percentage and t-test. It came to light that students attitude towards CBI in Ghana was positive.

Again, the study revealed that students in the basic schools who were taught with CBI scored higher marks than those who received traditional method of teaching. Also, there was significant difference in the academic achievement of students taught with CBI and those taught with Traditional method. Conclusions drawn from the study were that, since the students had positive attitude towards CBI they are likely to embrace instructions using CBI. Again, if CBI is adopted by all schools it is likely to improve academic performance. Based on the findings it was recommended that Government and the Ghana Education Service should equip the basic schools with enough computers and educational software that can facilitate the use of CBI.

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ACKNOWLEDGMENTS

I wish to acknowledge the help that Dr. S. Baafi - Frimpong accorded to me throughout this research work.

DEDICATION

To my family

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LIST OF ACRONYMS

BECE	Basic Education Certificate Examination
CBI	Computer Based Instruction
CBIP	Computer Based Instruction Package
CAI	Computer Assisted Instruction
ICT	Information and Communication Technology
UNESCO	United Nations Education and Cultural Organization

CHAPTER ONE

INTRODUCTION

Background to the Study

The ongoing unprecedented growth of ICT, coupled with the globalization of the economy, has created a huge challenge for education (Cheng & Townsend, 2000). The implementation of ICT is in the forefront of education reform. ICT has become an important subject in the syllabus of the first cycle schools in Ghana. It is now examinable at Basic Education Certificate Examination (BECE).

ICT has become an important medium for communication and work in a variety of areas. (Teaching Syllabus for Information and Communications Technologies for JHS, 2007**)**. This is an indication that the Ghana government recognizes the importance of ICT in education. To exploit the full benefit of ICT, technology has to be integrated in the lessons taught in the classroom.

The use of technology in education provides students with more suitable environment to learn, serves to create interest and a learning centered-atmosphere, and helps increase the students' motivation. The use of technology in this way plays an important role in the teaching and learning process (İşman, Baytekin, Balkan, Horzum, & Kıyıcı, 2002).

In parallel with the technological advances, technological devices, particularly computers began to be used in educational environments to develop audiovisual materials such as animation and simulation, which has resulted in the development of the computer-based instruction techniques. The best example of the integration of mathematics and technology is the Computer-Based Instruction

technique. Thus, the use of computers in the teaching and learning activities (Brophy, 1999).

CBI enables the students to learn by self-evaluating and reflecting on their learning process. CBI motivates children to learn better by providing them with the immediate feedback, reinforcement by creating an exciting and interesting game-like atmosphere. Studies in the field reveal that students' achievement increase when the CBI technique is provided as a supplement to the classroom instruction.

CBI is more effective on less successful children. The reason for this is that the computer-based instruction enables the children to progress at their own pace and provide them with appropriate alternative ways of learning by individualizing the learning process (Senemoğlu, 2003).

The most familiar function of mathematics education was to teach the children the mathematics concepts in a meaningful way and enable them to learn how they could make use of these concepts in their daily lives (Çepni, Taş, & Köse, 2006). The computer based teaching has had an impact on the development of educational technology to a great extent in the 21st Century and this has resulted in the production of software for the computer-based instruction.

The primary purpose of the educational software is to solve the learning problems in the mathematics courses encountered by the primary school students, to increase their motivation and achievements and to protect them against the negative effects of the rote-memory based educational system. There are

software-supporting educational products designed to be used in the computer-based and computer supported teaching practices.

These are the products that the teachers used as complementary materials for taking notes about their students through observations, making tables, developing materials, doing calculations, and preparing simple educational software. The educational software is used as a teaching material in the teaching of part of a subject or the whole subject (Alkan, Deryakulu, & Şimşek, 1995; İşman, 2005). According to Alessi and Trollip (2005), educational software can be divided into five different types.

These are tutorial, drill and practice, simulation, educational games and hypermedia type. For effective and productive teaching, these techniques should be used with some classroom activities like presentation, demonstration, practice and evaluation of learning (Özmen, 2004). The use of computer technology enables learners to be active in the learning process, to construct knowledge, to develop problem solving skills and to discover alternative solutions (Özmen, 2008).

The presentation of teaching materials by means of the computer technology help students to process and develop information, to find alternative solutions, to take an active part in the learning process and to develop their problem solving skills.

Most of the scientific and technological advances are realized by the people whose problem solving skills have been developed. In addition, these advances give rise to positive changes in the lives of people owing to the ways

and techniques developed by means of the power of the problem solving skills. The use of the problem solving skills is inevitable at every stage of our daily lives.

As a result of the advances in today's technology and computer devices, it is getting indispensable to use this new technology in the solution of educational problems. Education and technology play important role in the education of humans. Although education and technology are different concepts, the use of both resulted in the emergence of a new discipline, educational technology.

Owing to educational technology, teaching and learning activities become enjoyable. Students learn willingly, by playing and enjoying during these activities (İşman, 2005). Among the primary and secondary school students, girls use computer 5 hours a week for playing purpose whereas boys spend 13 hours a week for the same purpose (Christakis, Ebel, Rivara, & Zimmerman, 2004).

The use of computer in teaching and learning environments is very important as the children like it very much and could continue playing with it without ever getting bored. Nowadays, it is evident that visual materials such as TV and computer are utilized in every field. And it is also evident that computer attract students very much.

The use of audio-visual devices and animations with instructional materials results in the enjoyable and productive learning process (Kulik & kulik 1991). In this way, the learning process can become enjoyable and interesting for students as a result of abolishing traditional classroom learning activities. Technological developments give rise to new teaching and learning facilities.

These days, human beings keep on searching to find out how to use computer in educational activities in a more productive way rather than searching to reveal whether the use of computer in teaching and learning activities is effective (Kara & Yakar, 2008).

Educational technologies, especially computers play an important role in concretizing abstract concepts, which are difficult for children to learn, by means of animations (Akpınar, 2005). Computer-based instruction makes teaching techniques far more effective than those of the traditional teaching methods as it is used for presenting information, testing and evaluation and providing feedback. It makes a contribution to the individualization of education. It motivates students and gets them to take an active part in the learning process. It helps to develop creativity and problem solving skills, identity and self-reliance in learners. CBI provides drawings, graphics, animation, music and plenty materials for the students to proceed at their own pace and in line with their individual differences.

It serves to control lots of variables having an impact on learning, which cannot be controlled by means of traditional educational techniques (Kaşlı, 2000; Chang, 2002). Liao (2007) found out that CBI had a positive effect on individuals by comparing 52 research studies carried out in Taiwan in his meta-analysis study. Senteni (2004) also found out that CBI enabled the students to increase their motivation and achievements and to develop positive attitudes.

According to research studies in literature, the use of computer-based education increases students' attitudes and achievements significantly (Berger,

Lu, Belzer, & Voss, 1994). There is a lot of research on CBI. Different results have been arrived at in different studies. Some of these studies revealed that CBI serves to establish more effective learning situations than traditional teaching methods which involve teacher presentation, question and answer techniques, and discussions etc (Crook, 1994; Brophy, 1999, Li & Edmonds, 2005; Brooks, 2005; Çepni, Taş, &Köse, 2006; Chang, Sung & Lin, 2006; Liao, 2007; Ragasa, 2008; Lin, 2009).

It has been found out that CBI serves to develop meta-cognitive skills in students and helps them to learn in a meaningful way instead of rote-memory learning as well as enables them to increase their achievements (Renshaw & Taylor, 2000).

According to some studies there is no significant difference between the CBI and traditional teaching methods (Bayraktar, 2001). This study, which aims to test the impact of the use of the CBI, was thought to be important as it would contributed to the wide use of educational software which triggers active participation and enables students to make their own meaning.

With the use of computers in education, a lot of terms have come into and gone out of use in education (Owusu, Monney, Appiah, & Wilmot, 2010). The overlapping terms related to the uses of computer and associated technologies in science education are categorized into three by Poewll, and Trowbridge (2008) as follows: Learning about computers, learning with computers and learning through computers. This could also be used to categorize mathematics education as;

1. Learning about computers involves the knowledge of computers at various levels such as knowing the uses of the computer and the names of the various parts, knowing how to use the keyboard and computer packages (Owusu et al., 2010). According to Tabassum (2004), the knowledge of computers may be thought of as a continuum which ranges from skills in and awareness of computers at a lower level to programming at a higher level.
2. Learning with computers, students use computers as a tool in data collection, analysis, communication with other people, information retrieval and myriad other ways (Owusu et al., 2010). Learners use computers to get information and do their homework.
3. The term 'learning through computers' involves the use of computer as an aid for the teacher to do his/her presentations, and/or to get the learners to practice and drill. Computers are used to enhance interactive activities, to provide immediate feedback, to facilitate the retention and to enable the learners at diverse levels to work at their own pace.

This study involves mainly learning through computer as well as learning about computer. The study makes use of the operant conditioning – deriving from the practices of Skinner's behaviourism. The process had received immediate feedback and work at their own pace. Usage of computers at the elementary level enables students gain an in-depth understanding of working with different software applications. There are instances of elementary school teachers giving examples of their students creating music on computer.

There is also the example of Skyline Elementary School where students prepare their reports using multimedia software, incorporating sounds and visual effects. This practical knowledge of how different software applications work lays a lasting foundation for their future technical endeavors as they move into the career phase. The applications they learn may become outdated but exposure to the skills at an early age gives them confidence to handle new software applications.

Computer-Based Instruction or CBI increases student performance reveals a 1991 report by Kulik and Kulik, based on data obtained from at least 240 studies spanning students across all levels, from elementary to adult. These studies, most of which centered on K-12 students, had 81 percent of them saying that students receiving CBI scored better than their counterparts in traditional learning settings without computers.

A student in a typical CBI setting showed 62 percent performance in examination whereas a student learning with conventional methods showed only 50 percent performances on the same examination. In addition, one CBI student did better than 62 percent of students in traditional learning classes.

As students gain knowledge and experience in computer usage, they explore different ways of presenting their information through text, videos or sound and think of the ones that can most accurately convey their thoughts. An elementary school teacher shares the example of how students think of using different font styles and formatting for information they consider significant.

CBI also makes students sensitive to audience needs and their way of thinking, as they look for reaction from their peers to their presentation of information. Acquisition of technical skills gives students more avenues to express themselves; for example, a student can explain his understanding of a lesson through a multimedia presentation. This way, he is more closely involved in learning than in traditional instruction methods.

There is an increase in confidence and self-esteem of students as a result of this improved learning. As their involvement in learning activities increases, a change in their perception of their school ensues, leading to lower absenteeism rates. Instead of information being passed unilaterally from teacher to student, computers enable a bilateral flow of information between students and teachers (Kulik & Kulik 1991).

Students can now assume an active role in their learning, rather than a passive one, and computers can act as a supplementary resource to the teacher's instruction. Students can search for information on their own and make active decisions about how to use it. With computers in classrooms, students have greater flexibility in many areas: deadlines, formatting of assignments, and communication with teachers and peers.

Many students are more willing to take initiative and thus can accomplish more while they enjoy the experience of learning. In response to computers, teachers have changed their methods of student assessment and learning indicators. For students, assignments can feel easier or harder depending on the amount of access to information and support they have. For teachers, computers

may sometimes make it more difficult to adequately measure learning, as the Internet provides such a large database of easily available information that students may access or use without fully understanding (Kulik 1986)

Programs for computer-based instruction (CBI) have come a long way in the last two decades. They are available today in a variety of sophisticated shapes and sizes, and show few traces of their origin in B.F Skinner's modest, fill in the blanks teaching machines. The programs tutor and drill diagnose learning difficulties, prescribe remedies for problems. Keep records of students' progress, and present materials in print and diagram form.

Pioneers in CBI believed from the start that the computer would bring students great benefit, such as better, more comfortable and faster learning; opportunities to work with vastly richer materials and more sophisticated problems; personalized tutoring and automatic measurement of progress. Benefits for teachers were to include less drudgery and repetition, greater ease in updating instructional materials, more accurate appraisal and documentation of students' program and more time for meaningful contact with learners.

Soon after its introduction, educational researchers started to design evaluation studies to determine whether CBI actually produced such benefits. Although this evaluation studies yielded potentially valuable information about the effects of computer based teaching the message from the studies was not immediately clear. One problem was that each evaluation was published separately, making the total picture difficult to see. Another more serious problem was that studies were never exact replications of one another. They differed in

experimental designs setting, and in the types of computer application they investigated.

The first systematic reviews designed to integrate finding from the various evaluation studies concluded that, CBI is effective in raising student achievement, especially when it is used to supplement regular instruction in elementary schools. Vinsonhaler and Bass's review (1972) for example, reported that results from ten independent studies showed a substantial advantage for computer augmented instruction. Elementary school children who received computer-supported drill and practice generally showed performance gains of one to eight months over children who received only traditional instruction.

Edwards el al (1975) reviewed studies of CBI at various educational levels and in various subjects and they also reached positive conclusion about its effectiveness in raising achievement test scores. These reviewers noted that CBI reduced the time it took student to learn. Later reviewers have used meta-analysis to integrate evaluation findings on CBI (Glass, McGaw, and Smith, 1981).

Statement of the Problem

There is no doubt that, ICT has become a driving force of educational reforms and it is an integral part of national education policies and plans. During the last decade, the Ghana Government in collaboration with the Ghana Education Service has invested heavily in Information and Communication Technology (ICT). ICT has had a major impact in educational context, in organization and in teaching and learning methods. Having been a mathematics tutor for years, I have

envisaged that the use of ICT in mathematics can promote teaching and learning of the subject.

Candidates who wrote Basic Education Certificate examination (BECE) in April 2011 performed poorly in mathematics. This is because most candidates couldn't answer questions on topics such as natural numbers, drawing a Venn diagram and inserting the element in them. They also found it difficult to solve word problems.

Candidates were not able to translate the problem into mathematical language and use mathematical symbols to enable them solve the problem. They couldn't recognize a linear relation and plot point to draw the corresponding straight line. They showed weakness on geometric figures and perimeter. This could be attributed to the fact that most teachers use the traditional method in teaching mathematics.

This method of teaching is very boring and makes mathematics very difficult for most students to enjoy and understand. It is therefore important for teacher to change their methodology and strive to make students understand concepts properly using improved teaching and learning materials to enhance students' understanding (Chief Examiners Report April, 2011).

It is believed the solution to the problem lies in the use of computer based instruction (CBI). Unfortunately, it appears not much research have been conducted to ascertain the effectiveness of CBI at least not in Kasoa basic schools. This research therefore, aims at looking at how the use of Computer based instruction (CBI) in the teaching and learning of mathematics can improve

students' performance. The study will compare traditional method of teaching and Computer based method of instruction in teaching mathematics in Kasoa basic schools.

Purpose of the Study

The researcher sought to find out if the use of computer based instruction in the form of tutorials, drills and practices, simulation and games could help improve student performance in mathematics in the basic schools in Kasoa. Again, he would like to find out the attitude of students toward computer based instruction.

Research Questions

The study was guided by the following research questions:

1. What is the attitude of students toward computer based instruction?
2. What differences existed between the use of the traditional teaching method and computer based teaching method in terms of students' performance

Research Hypotheses

Ho: There is no significant difference between the traditional methods of teaching Mathematics and Computer based instruction with regard to students' achievement

H1: There is significant difference between the traditional methods of teaching Mathematics and Computer based instruction with regard to students' achievement.

Significance of the Study

Despite increasing research on the use of Computer Based Instructional strategies in mathematics education, there is no clear theoretical base that guides the integration of computers into mathematics education (Crocco, 2001).This research would assist teachers to understand the potential impact of using computer aided instruction in teaching. Policy makers would use the findings of the research as a working document to justify any policy they may implement as far as ICT is concerned.

The findings of the study would provide new empirical evidence on the introduction of ICT and its potential impact to researchers who wanted to make further studies in the area of ICT. Additionally, the findings of this study may provide guidance for further research to investigate particular aspects of specific instructional strategies more deeply.

Delimitation of the Study

The study sought to find out the potential impact of CBI on students' performance in mathematics. However the research is limited to Ewutu Senya Education directorate of the Ghana Education Service (G E S). Although there are more than one thousand (1000) basic schools in the municipality. Only public schools in Kasoa circuit would be selected for the study. The study was also delimited to the impacts of CBI on student performance and problem solving skills in mathematics.

Limitations of the Study

The following limitations were observed regarding this study. First, the study was designed to focus on learning of mathematics by junior high school students drawn from Schools in the Central region of Ghana. Thus, the findings may not be generalized to private schools and other public schools. Secondly, the study did not examine other alternative means like Internet for delivering the course content. Thirdly, the curriculum content was limited to one topic of the entire mathematics curriculum. Despite these limitations, it is expected that the findings will be relevant, particularly to the use of CBI in teaching mathematics in Ghanaian school system.

Organization of the Rest of the Study

The study was organized into five chapters. The second chapter deal with the review of the literature related to the study. Chapter Three entails a detailed description of the methodology used for the study. The fourth chapter outlines the presentation and analyses of the collected data, based on the research objectives and discussion of the findings. Chapter Five presents the summary, conclusions, recommendations and suggestions made with regards to the study.

CHAPTER TWO

LITERATURE REVIEW

Introduction

In this chapter the researcher reviews literature on the theoretical basis of the research. Three learning theories namely; Behaviourist, Cognitive and Constructivist theories are discussed. The researcher's conceptual view of the study will also be discussed. Thirdly, empirical studies related to the study are reviewed.

Theoretical Framework of the Study

Theories are constructed in order to explain, predict, and master phenomena. A theory makes generalizations about observations and consists of an interrelated, coherent set of ideas and models. The theoretical framework of the study is the structure that holds or supports the basis of the research work.

It represents the theory which explains why the problem under study existed. It serves as the basis for conducting the research. Three major theories of teaching and learning would be discussed and their importance to teaching and learning would be put forth. Their relationship to teacher education would be highlighted. The theories would also be linked to the use of technology.

Behaviourism

Behaviourism is a theory of animal and human learning that only focuses on objectively observable behaviours and discounts mental activities. Behaviour

theorists define learning as nothing more than the acquisition of new behaviour (Philips, & Soltis, 1998). Behaviourists believe that we can understand human behaviour by a meticulous study of particular behavior (Ozman, & Carver, 1992).

Behaviourists are psychologists who think that whatever a person thinks is what he exhibits in his behaviour. They are not interested in whatever the person is thinking which does not manifest in his behaviour. They measure human thoughts by studying his outward behaviour by word or deed.

Behaviourist hold fast to 3 claims: (Stanford Encyclopedia of Philosophy)

1. They claim that psychology is the science of behaviour and not of the science of mind.
2. They think that behaviour can be described and explained without making reference to mental events or internal processes. They argue that the sources of behaviour are external (in the environment), not internal (in the mind or the head).
3. They think that, in the event of developing a behaviourist theory in psychology, all mental terms and concepts that are used in describing or explaining behaviour should be eliminated and replaced by behavioural terms or they should be translated or paraphrased into behavioural concepts.

Behaviourist techniques have been employed in education to promote desirable behaviour in learners and discourage undesirable ones. Some of the methods that have been adopted by educationists and applied in the classroom

include contracts, consequences, reinforcement, extinction, modeling, cueing shaping, and behaviour modification (Philips & Soltis 1998).

1. Contract is when the educator or parent enters agreement with the learner that the learner will learn a task within a given time. The contract method of behaviour change can be used in school and at home. It is helpful because the educator or parent together with the learner ensure that the contract is fulfilled.
2. Reinforcement is the presentation of a stimulus that increases the probability of a behaviour/response re-occurring. This occurs frequently in the classroom. A remark, a clap or any kind of approval or disapproval is enough to encourage the learner to want to repeat behaviour or to discontinue in that direction.
3. Consequence is a reaction in the form of reinforcement by a teacher or educator to behaviour of a learner. Consequence occurs immediately after the behaviour. It may show approval or disapproval of that behaviour or response.
4. Extinction is when unfavorable reinforcement is received after a behaviour which makes the one who elicited that behaviour to find it unrewarding. The habit reduces gradually until it dies completely.
5. Modeling is observational learning. The learner observes behaviour and also behaves in that way.

6. Cueing is when a student is encouraged to give the right response to a question/behaviour by providing him or her with hints that will lead him or her to the response/behaviour.
7. Shaping is the process of gradually changing the quality of a behaviour/ response. The desired behaviour is broken down into small units such that each can be accomplished within a given time. Each of the units should be reinforced as it progresses towards the overall behavioural goal.
8. Behaviour Modification is a method of eliciting better classroom performance from reluctant students.

Behaviourism has been adopted as a teaching and learning theory. It is taught in schools of education. Behaviourist techniques of teaching are used in technology to help in teaching and learning. The machine is able to use both visual and audio cues to help learners form right behaviours (Philips & Soltis 1998). Desired behaviours are rewarded while undesirable ones are discouraged by the computer. Instructions are broken into smaller frames and this helps learners to learn the better.

It helps learners to master each frame before progressing to the next. This is the technique of shaping. Computer Based Instruction (CBI) is able to show approval of responses by applause and audible remarks. They can be programmed to show visual and verbal cues to encourage learners. Feedback of exercises is immediate to prevent learners from repeating responses. Behaviourist techniques of teaching are supported by CBI.

Cognitive Theory

Cognitive theorists recognize that much learning involves associations established through contiguity and repetition. They also acknowledge the importance of reinforcement, although they stress its role in providing feedback about the correctness of responses over its role as a motivator, cognitive theorists view learning as involving the acquisition or reorganization of the cognitive structures through which humans process and store information (Good, & Brophy,1990).

Cognitive psychologists believe that the human mind is an active and important factor in learning. They focus on how people think, how people understand and how people know. They think that learning involves the transformation of information in the environment into knowledge that is stored in the mind. They believe that learning occurs when new knowledge is acquired or existing knowledge is modified. Two prominent cognitive psychologists are Jean Piaget (1896-1980) and Lev Vygotsky (1896-1934).

Some principles of cognitive psychology are those put forward by the gestalt psychologists, Max Wertheimer (1880-1943), Wolfgang Kohler (1887-1967) and Kurt Koffka (1886-1941) and others. They think that human perception makes meaning when things are seen as a whole. Gestalt psychologists are of the view that the brain is holistic, parallel and analogue. They said that the whole is different from the sum of its parts.

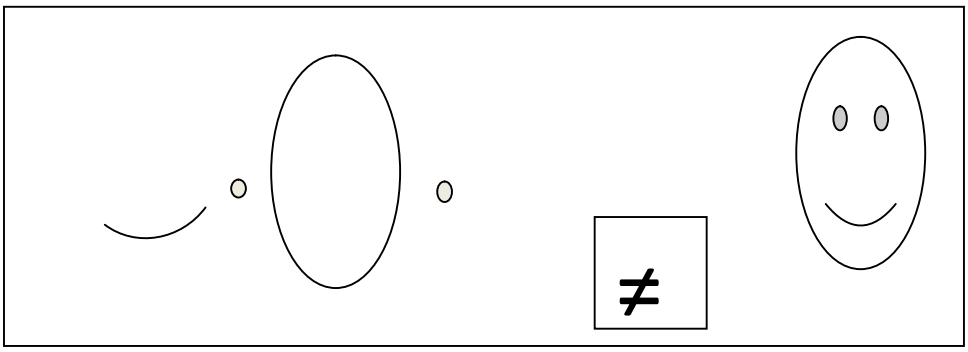


Fig.1. Illustration of the Gestalt claim that the whole is different from the sum of its parts.

(Chang, Dooley, & Tuovinen, 2002)

The gestalt theorists believe that the cognitive learning theory can best be explained with the laws of perception. Boring (1942) stated that, in 1933, Helson extracted 144 laws of Gestalten. Some of those laws are discussed here.

The Law of Good Form

Gestalt means "form" or "shape". Gestalt psychologists are of the view that psychological organization will always be as good as prevailing conditions allow. For Gestalt psychologists, form is the primitive unit of perception. When we perceive we always pick out form. Our perceptions are influenced by past experiences. This principle is also called Pragnanz Law (Tan OonSeng, Parson, Hinson, & Sardo-Brown, 2003).

The Law of Figure-Ground Discrimination

Viewers will perceive an object (figure) and surface (ground) even if shapes are grouped together (Ehrenstein, 2004). We do not simply see black and white shapes; we also see faces and vases. This explains the point that things are viewed holistically and not as parts. It also shows that the background to every

visual or verbal presentation is important. If the background is not properly laid it leads to confusion.

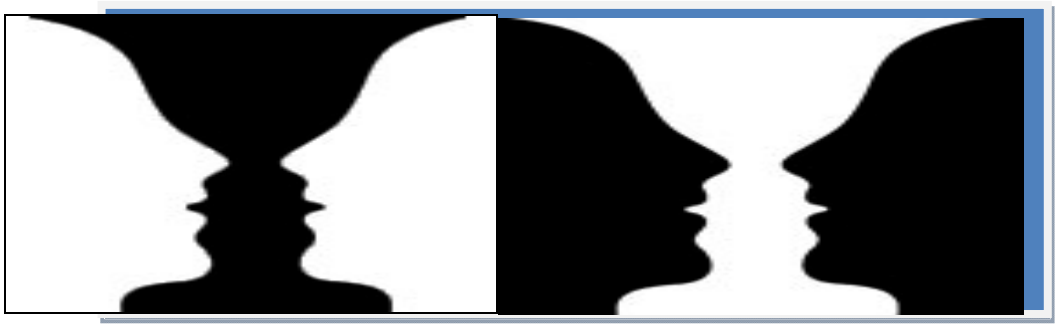


Figure 2. Law of Figure–Ground

(Chang , Dooley,& Tuovine , 2002)

The Law of Proximity

The closer objects are to each other, the more likely they are to be perceived as a group (Ehrenstein, 2004) objects and concepts which are close together in space or time tend to be perceived as grouped together. They perceive those that are far apart as unrelated. In that case if you want ideas or objects to be seen as associated, then they must be presented in close proximity. This law refers to both space and time.

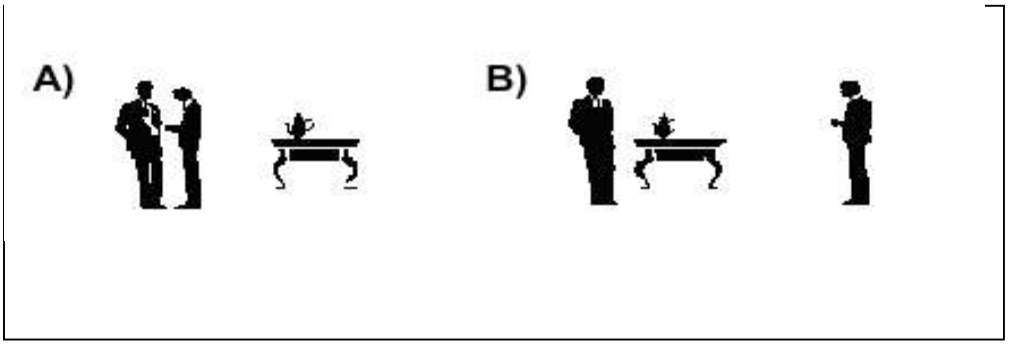


Figure 3. Two men and the table.

(Chang, Dooley, & Tuovinen, 2002)

A) The picture is perceived as (a man +a man) +a table.

B) The picture is perceived as (a man +a table) +a man.

The Law of Similarity

Objects that are similar, with like components or attributes are more likely to be organized together. (Schamber, 1986). Things that are similar are likely to form a group. They are likely to be considered as together and counted as a unit.

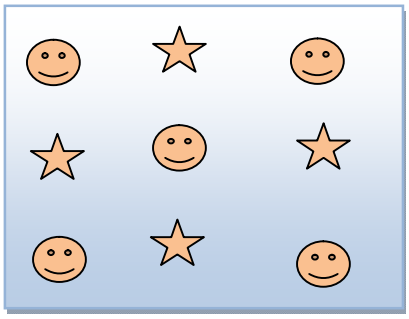
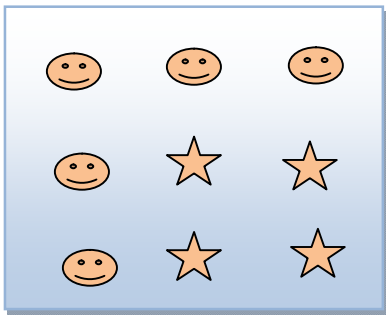
A  B 

Figure 4. Groupings of shapes

(Chang, Dooley, & Tuovinen 2002)

Things that are similar are likely to form "Gestalten" groups. In picture (A) you might quite easily perceive an X of faces against a background of stars. In picture (B) you might observe a square of stars partly surrounded by faces. This is an example of similar grouping emphasizing good form or Pragnanz.

The Law of Closure

In perception there is the tendency to complete unfinished or partially objects (Ehrenstein, 2004). The human mind completes the uncompleted parts into a whole. Kanisza's triangle is one of the most recognizable example of this (Wikipedia, 2008).

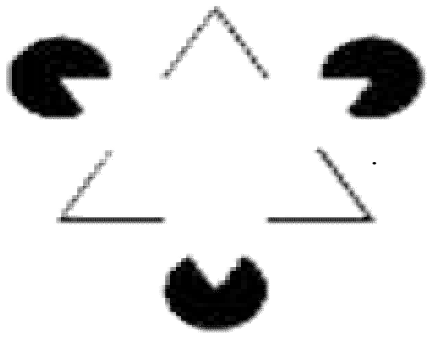


Figure 5. Figures that are not complete

(Wikipedia, 2008)

The Law of Continuity

Objects will be grouped as a whole if they are co-linear, or follow a direction (Chang, Dooley, & Tuovinen, 2002). The eye and mind are likely to follow the direction that has continued for some time even though flow might have stopped.

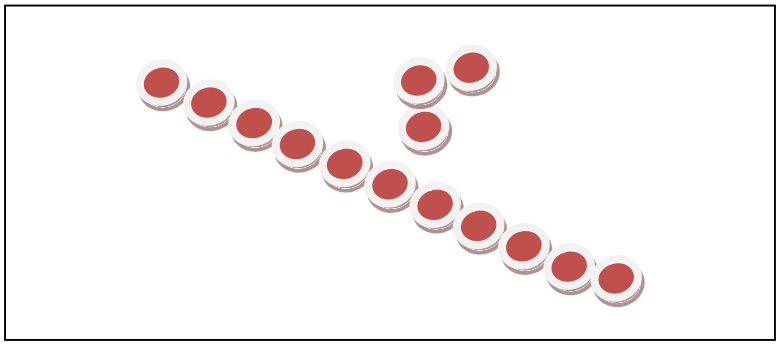


Figure 6.Illustration of the Law of Continuity

(Chang, Dooley, & Tuovinen 2002)

The Law of Focal Point

The idea is that a point of interest, something emphasized or different will catch and hold viewers' attention. (Chang, Dooley, & Tuovinen, 2002). Too many focal points are likely to confuse the learners and diffuse their learning interest.

Lauer (1979) said that when everything is emphasized, nothing is emphasized. Important issues should be singled out and emphasized to help learners note them.

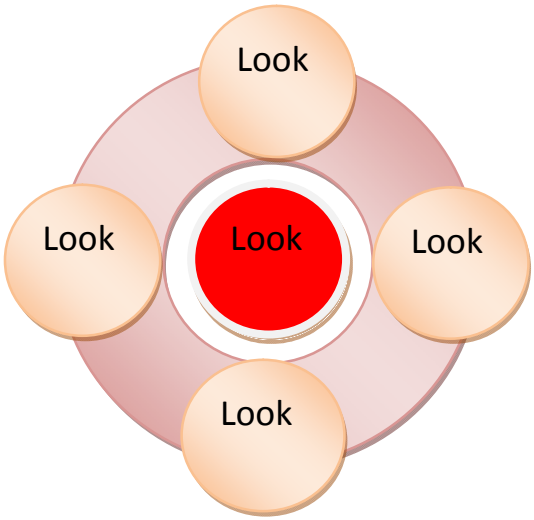


Figure 7.Illustration of the Law of Focal Point.

(Chang, Dooley, & Tuovinen 2002)

Law of Unity

This law has to do with arrangement of things where the elements and structures have a visual connection and look like they belong together, in unity. This law can be used to make visual presentations or to make learners visualize a concept. Lauer (1979) states that unity implies that a congruity or arrangement exists among the elements in a design; they look as though they belong together, as though there is some visual connection beyond mere chance that has caused them to come together. If related elements or concepts do not appear within the same form they are considered as separate and unrelated to the main concept and may lead to confusion. The first group of letters below may be perceived as unrelated, while the second group may be seen as related.

Figure 8: Illustration of law of unity

(Chang, Dooley, and Tuovinen 2002)

Law of Simplicity

This is the law that states that people will visualise according to the simplest way of grouping items – and the effort to simplify complex items is unconscious (Chang, Dooley, and Tuovinen 2002).

This law applies to objects and concepts. It is always easy for people to find simple concept to relate to more complex ones in order to make better appreciation of the complex ones.

This works well when learners are presented with a graphical message which is well organised and uncluttered, and yet complex and ambiguous. The simplification process may lead to unintended conclusions. Fisher and Souch (1998) have it that when learners are presented with visuals, then there is an unconscious effort to simplify what is perceived into what the viewer can understand. The closer objects are to each other, the more likely they are to be perceived as a group (Ehrenstein, 2004). The gestalt laws have been accepted as aspects of the cognitive learning theory. They form part of the tried and tested

ideas and models that are taught in institutions of education. By their nature they help explain concepts visually.

These cognitive laws of learning have direct implication for CBI. They can be illustrated in computer instruction to give their best effect in teaching and learning.

Information Processing Model (IPM) Theory

The information Processing Theory approach to learning evolved out of the cognitive theory in America. Here the human mind is likened to the computer. The theorists think that the mind is like the computer in its compliance with logical rules and strategies. They think that the mind has a limited capacity in the amount and nature of the information it can process.

Information Processing emphasizes "the significance of 'encoding' (input) of information, the 'storage' of information, and the 'retrieval' (access) of information. The language and the metaphor often used in one of the minds of computer is IPM theorist. U. Neisser, maintains that the correlation between cognition and computers is a powerful one Benjafeld (as cited in Tan, 2003).

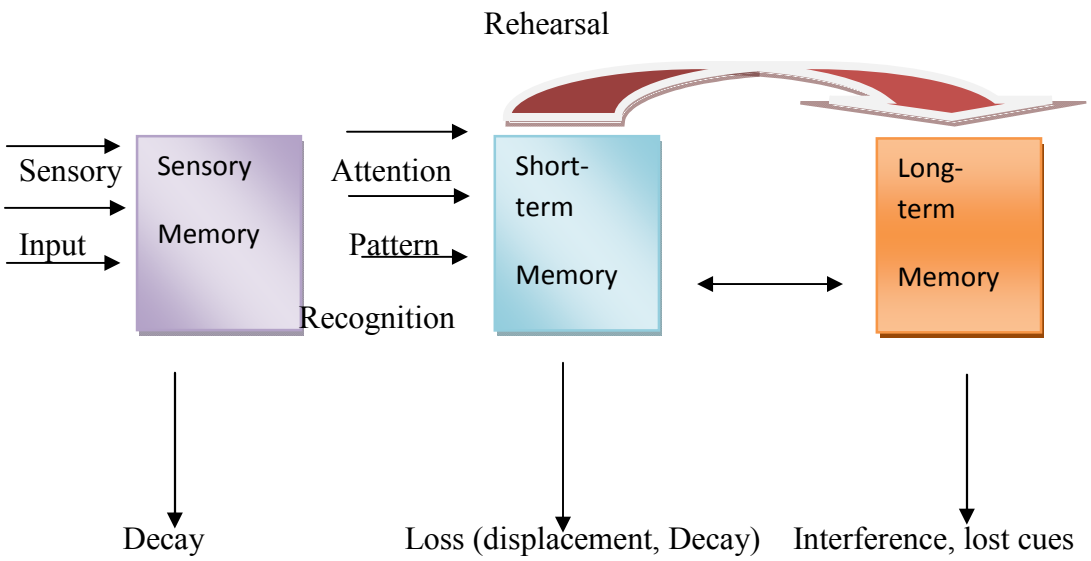


Figure 9. Information processing model

(Tan, 2003).

Also, just as it is possible to improve the processing power of computers by upgrading its hardware and software (programming), we can as well help children to be better thinkers by the training we give them. The diagram above shows a model of the human mind as proposed by the information processing model. The theorists believe that the human mind comprises of sensory memory, short-term memory and long-term memory.

They think that information is received from the environment through our sensory organs. They believe that the sensory memory is affiliated with transudation of energy. They put forth that the environment makes available information through light, sound, heat, smell, cold etc. But that the brain only understands electrical energy. It is also believed that the body has cells that receive the information which they call transducers. They believe that in the process of transudation memory is created. It is believed that this memory is very

short. In the case of vision it lasts for about half of a second, and in the case of hearing it lasts for about three seconds. The visual system has iconic memory stimuli which elicits in shape, size, colour and location but not meaning. Hearing system has echoic memory for auditory stimuli.

Besner & Coltheart (1974) state that the momentary freezing of visual input allows us to select which aspect of the input should go on to further memory processing. Short-term memory is relatively longer memory system information storage than the sensory memory. It is also called working and relates to what we are thinking about at any point in time.

This is a conscious memory and is created by paying attention to an external stimulus or an internal thought or both conditions. This lasts 15 to 20 seconds. It can be repeated. This repetition is known as maintenance rehearsal, after which it will last for 20 minutes. One more means by which short-term memory can be expanded is chunking. This is the means by which we group small bits of information into a larger and meaningful unit.

Long-term memory is the third stage of memory. This is more lasting memory. It lasts from minutes to lifetime. Its capacity to retain information appears to be limitless. Contemporary psychologists agree that long-term can be divided into subtypes of declarative and procedural memory (Santrock, 2008).

Diagram Illustrating Long-Term Memory

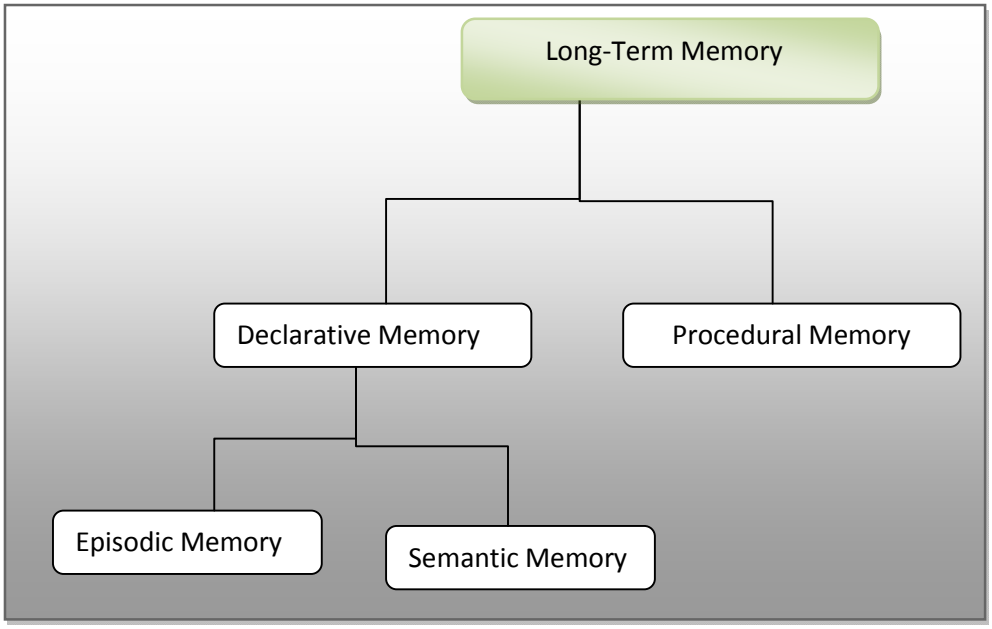


Figure 10. Illustration of long term memory

(Strantrock 2008)

This sort of memory is non-declarative knowledge. They are difficult to describe or narrate. They are in the form of skills and cognitive operation. They cannot be consciously recollected in the form of specific facts. They are sometimes referred to as "Knowing How" or "Implicit Memory". Example is the exhibition of dancing skills.

Declarative Memory

This type of memory is information that can be recollected consciously. They are specific facts or events that can be verbally recounted or communicated. They can also be called "Know that" or "Explicit Memory". They are exhibited when we explain a basic mathematical principle.

Episodic Memory

These are memories that we have of place and time. Example is My First Day at School. This kind of information is encoded in the form of images.

Semantic Memories

Semantic memories are general facts and concepts. They are those facts that are learned in school. We can call them instructional content.

Constructivism

Constructivism is a philosophy of learning founded on the premise that, by reflecting on our experiences, we construct our own understanding of the world we live in (Brooks, & Books, 1999). It is based on the type of learning in which the learner forms, or constructs, much of what he learns or comprehends (Cashman, Gunter, & Gunter, 2005).

Constructivists assume that learners are not empty vessels to be filled with knowledge. They believe that learners are actively attempting to create meaning. Learners often select and pursue their own learning. They believe that real-life learning may be messy and complex. They think that education should be whole.

It should be mental, social and physical and not just dispensation of facts and information. They believe that learners construct meaning for themselves individually and socially as they learn. Constructivists believe that while the learners are constructing meaning they are really learning and that there is no other learning besides the constructing of meaning. The implication of this notion is that the learner should be the focal point when considering learning. It should

not be the subject or the lesson. Also there is no other knowledge besides the meaning that the individual learner or the community of learners make.

Principles of Constructivist learning

The theory of constructivism is based on 9 major principles (Vygotsky's, 1978):

1. Learning is an active process in which the learner uses sensory inputs to construct meaning out of it. The learner plays an active part in the construction of meaning. He is therefore an active participant and not a passive one.
2. People learn to learn as they learn. The learner constructs meaning and also a system. In that case he learns two things at the same time. An example is in research. The researcher learns to conduct research and at the same time learns more about the topic he is conducting the research on.
3. Learning involves language. This means that the language that we use influences our learning. Vygotsky's (1978) believes that language and learning are intertwined.
4. The crucial action of constructing meaning is mental and it happens in the mind. In some learning, physical activity may be required, but ultimately the mind is actively involved.
5. Learning is a social activity. The people around us influence our learning. These people may include our teachers, peers and family.

6. Learning is conceptual. Learners relate what they learn to what they already know, what they believe, their fears and the like. We can then say that learning is not only active but that it is also a social activity. We cannot separate what we learn from our lives.
7. Learning takes time, it is gradual not instantaneous. We always have to go back to the ideas that we are learning, ponder them, try them out, play with them and use them. We need to repeat them a lot of times to master them.
8. Motivation is an important ingredient of learning. Motivation helps learners to learn what they are learning. If learners know the importance of what they are learning, that is even a bigger motivation.
9. One needs knowledge to learn. To learn, the learner needs a previous build-up of knowledge to build.

Conceptual Framework of the Study

The conceptual framework of the research presents the researcher's position on the use of CBI in the classroom.Feldhusen and Szabo (1969) drew the conservative conclusion that CBI is at least as effective as live teaching, and it may also result in substantial savings of student time. A more recent traditional review by Helson (1979) is even more positive.

Helson reported that achievement gains over other methods are the norm, that improved attitudes toward computers and subject matter were generally reported, and that many CBI students gained mastery status in a shortened period of time. Conceptions of the role that the computer can play in instruction have

broadened. CBI designers no longer think of the computer effectiveness of computer-based instruction as an efficient machine for drilling students. They think of it as a device that could be used in a variety of ways, in a variety of subjects, for a variety of goals.

Earlier reviews of CBI need to be updated. We need to know whether the record of effectiveness of CBI has changed with the development of new software in recent years. At least one earlier review (Kulik, 1981) found evidence of a time trend in the record of effectiveness of CBI, and we need to know whether this trend has held up. Cuban (1986) asserted that technology in education is over hyped.

Technology in Education

Technology is known to be contributing to the advancement of education. If well integrated ICT is known to possess many positive contributions to teaching and learning. But if history is anything to go by then we have to consider the faith we have already put in computers. The history of failures of electronics in education is too many to overlook.

The Repetitive Cycle of Technology in Education

Technology is not new in education. Over the centuries there have been efforts to introduce technology into education. Many of them were successful but some of the recent attempts were met with failures. It, therefore, suggests that technology could have positive impact in education. It also means that there could be failures. Electronics have not been particularly successful in education. The expected results have not been achieved. Failures of electronics in education are

thought to be due to hype, investment considerations, poor integration and lack of educational outcomes. Each new technology reinitiates the cycle.

Movies were considered to have the potential to revolutionize our educational system. This was the general view as was expressed by Thomas Edison in 1922. Radio was another electronic device that was considered to have the potential of making great contribution in the classroom around 1945. The popular idea was that portable radios should be introduced in the classroom and be "integrated into school life" alongside blackboards.

In the 1960s efforts were made by way of investment by the US government in getting TV sets in the classroom. But Lyndon Johnson who was one of the presidents that invested in getting the TV sets in the classroom was able to foresee the failure of the project. All these technologies which were seen to have wonderful potential of making great contributions to education had to be abandoned because they could not serve the purpose they were planned for.

The question to ask is "what makes the computer different? In 1964 Wilbur Schramm who is regarded as the father of communication suggested that what if the full power and vividness of television teaching were to be used to help the schools develop a country's new educational pattern. He was referring to the power of the television which he thought function of the teacher which technology does not have. Computers are, undoubtedly, different from other electronic devices because of its ability to offer interaction. They have the capability for promoting interaction among its users and so has an added advantage over electronic devices like the radio and television and film. With the

advantage of interaction the computer is able to moderate interaction among learner and to do a lot to help learners to learn yet it fall short of the presence of a presence of the live teacher.

One single factor that the live teacher alone could offer to learners is the motivation to learn. The learner needs motivation from the teacher. This motivation helps the learner to put in the needed effort to learn. There is also the need for ongoing guidance and encouragement. There should also be "caring supervision" of the learner's work. These are very important ingredients for learning. Without them learning will not be complete. Unfortunately the computer is not known to be good at them.

Cost of Technology

Cost of technology is very high. There is the cost of acquisition and cost of maintenance. The cost of acquiring the equipment and maintaining them to be functional is so high in schools that, unless the well-funded, a lot of its resources will be used to fund the technology.

Funds that could have been spent on interventions which can accrue obvious academic benefits would be used to fund the introduction of the technology and that intervention abandoned or postponed. Interventions like a meal for the pupils at school and de-worming of school pupils which have shown proven success of keeping the pupils in school might have to be abandoned (Oppenheimer, 2003).

Myths of Technology in Education

The mention of technology sets people thinking that it is capable of solving all problems. The myths of technology in education are who educators and learners should be conscious of. One of these common myths is the belief that the skills that the 21st century youth needs can only be acquired through the new technology of the 21st century.

There may be many of those skills that their acquisition can be facilitated by the use of the new technology. This could be because the educators of this century have decided to use them for their instruction or better still they are made to use them in that direction (Oppenheimer, 2003). CBI is constructivist and student centred.

The problem we have to solve is the number of teachers that are needed in the classroom. As reported by UNESCO in its 2015 data the world needs about 50 million new teachers to add to the present number to be able to take up all teaching positions. The same report states that we will need up to 400,000 teacher trainers to be able to produce that number of new teacher (UNESCO, 2015). The world cannot afford that number of teacher trainers; neither can it obtain that large number of trainees for the job.

When we consider the amount of money governments spend on acquisition of books, the most likely conclusion that one arrives at is the integration of ICT in schools. With its dynamic educational features ICT can help solve the problem of lack of teachers since distance learning can be encouraged at places where there may not be the required compliment of teachers.

The distant instructor is recommended where there are no teachers. And where there are teachers ICT can still be used to supplement or enhance the teachers' work (UNESCO, 2015). EBook readers are recommended where the desktop and laptop computers may be inappropriate since they are easier to handle and use less power. The teacher should, therefore, be trained in the various pedagogies and how they can be relevant in computer based instruction.

Empirical Framework of the Study

During the past decades, computers have been used as learning tools in education. Computer Assisted Instruction (CAI) provided a better learning environment in education (Chang, Sung, & Lin, 2006; Crook, 1994; Liao, 2007; Lin, 2008; Ragasa, 2008). At present, the dynamic and interactive Web sites related to mathematics teaching and learning can be easily reached through the Internet. In England, the National Curriculum for England (2008) encouraged teaching mathematics by using information and communication technology.

In the USA, the National Council of Teachers of Mathematics' (NCTM, 2000) encouraged teachers to use computers in the classroom and stated, "Computers are essential tools for teaching, learning, and doing mathematics. They furnish visual images of mathematical ideas, they facilitate, organizing and analyzing data, and they compute efficiently and accurately" (p. 24).

Despite the National Curriculum for England and the NCTM standards' support for using computers in the classroom, the empirical research conducted on the comparative efficiency of Web-Based Instruction (WBI) and traditional instruction in mathematics teacher education is limited.

However, studies of how CAI programs compare to other methods of teaching have been conducted since the 1980s. Mevarech and Rich (1985) compared the effects of CAI and traditional instruction on the mathematics achievement and attitudes of disadvantaged Israeli students in grades 3, 4, and 5.

The results indicated that students in the CAI group scored higher on achievement. In addition, their attitudes toward school and toward themselves as mathematics learners were more positive. Ganguli (1992) investigated the effect on students' attitudes of the computer as a teaching aid. Fifty-one students participated in an experimental group that involved a computer as an aid in teaching mathematical concepts. Fifty-nine students in a control group were taught using traditional methods.

The results indicated a significant treatment effect on students' attitudes, favouring the use of a computer as a teaching aid. Tilidetzke (1992) investigated differences in achievement for control groups learning college algebra using traditional classroom instruction methods, compared to experimental groups using computer algebra tutorials for three pre-calculus topics.

The results indicated no significant difference in mean scores on a posttest or a delayed posttest between CAI and traditional instruction in a college algebra course when studying three topics of course material with 2 hours of computer lab time. Ragasa (2008) compared the effects of 38 sophomore college students in the basic statistics taught with the use of CAI and 15 students with the use of the traditional method on the basic statistics achievement. The results indicated a significant treatment effect on students' achievement posttest.

Research on the importance of CAI on PK-12 students has examined the effectiveness of CAI on student achievement (Chen & Liu, 2007; Liao, 2007), including drill-and-practice (Fuchs, Fuchs, Hamlet, & Powell, 2006), tutorial (Donovan & Nakhleh, 2007; Hannafin, Burruss, & Little, 2001), and simulation (Schorr &Goldin, 2008). The findings of the effectiveness of CAI on achievement suggest that CAI is more effective than traditional instruction. They show that CAI improved student mathematics performance and attitude (Chen & Liu, 2007; Liao, 2007).

Research has shown that effective use of multimedia or interactive Web-based modules can increase student learning (Aberson, Berger, Healy, & Romero, 2003; Bliwise, 2005; Fletcher-Flinn & Gravatt, 1995). Aberson et al. (2003) evaluated a Web-based interactive tutorial used to present hypothesis testing concepts. The results indicated that students who used the tutorial performed better on a quiz than students who completed the standard laboratory, supporting the effectiveness of this freely available online tutorial.

Similarly, Bliwise (2005) suggested that a Web-based tutorial improved student learning on statistics. (Darling-Hammond, 1999; Hill, Rowan, & Ball, 2005**;** Hill, Schilling, & Ball, 2004). In addition, research has demonstrated a connection between teachers' pedagogical knowledge and students' performance (Carpenter, Fennema, Peterson, & Carey, 1988; Rowan, Chiang, & Miller, 1997; Staub & Stern, 2002). Therefore, in order to teach effectively in an elementary school, a teacher needs not only a strong background in mathematics but also a thorough understanding of pedagogy.

A competent teacher should have a solid foundation of both procedural knowledge and conceptual knowledge. This type of knowledge is known as knowledge of mathematics for teaching (Ball, 1990; Hill et al., 2005) and as profound understanding of fundamental mathematics (Ma, 1999). That is, teachers need a deeper, more profound understanding of fundamental mathematics.

Resistance to Change and Negative Attitudes

Much research into the barriers to the integration of CBI introduction found that teachers' attitude and an inherent resistance to change was a significant barrier (Shoepp, 2005). Teachers who are not using new technologies such as computers in the classroom are still of the opinion that the use of CBI has no benefits or unclear benefits (Empirica, 2006).

Some teachers resist change because they do not see the need for changing the way things are done. They think that the new order must be a tried and tested one. Changing from the traditional way of teaching to the use of CBI is not acceptable.

The argument some of them put across is that CBI has not proven to make any educational gains where it has been introduced. They quickly point to Larry Cuban's argument that CBI is not what contributes to gains where gains were thought to have been made with CBI but that was due to better administration and dedicated teachers. They think more attention should be given to the supply of better facilities to the schools rather than expensive CBI gadgets.

A significant number of researchers identified time limitations and the difficulty in scheduling enough computer time for class as a barrier to teachers

use of CBI in their teaching(Al-Alwani, 2005) to plan technology lessons, explore the different internet sites, or look at various aspects of educational software's (Sicilia, 2005).

Lack of Effective Training

One of the three barriers of teachers' use of CBI in teaching students was lack of training (Beggs, 2000).The issue of training is certainly complex because it is important to consider several components to ensure the effectiveness of the training (Becta, 2004).One of the teachers' complained was about how difficult it was to always have access to computers (Sicilia, 2005).There is the need for colleges of education to integrate preparation of CBI into their training. If the teachers are given effective training to be able to incorporate CBI in their lesson, it will be easy for them to practice it on the field.

Availability and Accessibility

Computers had to be booked in advance. If they forgot to book for the use for the use of the computers, they would have to forgo the use of the computers several periods in a row when they wanted to work on several projects with the students (Sicilia, 2005).

Studies have found out that, lack of access as a major barrier to the use of CBI in schools. In some cases the computers are not available in schools and/ or home. Old, slow and non-functional computers can be identifying as reasons for CBI not being used in schools. Inaccessibility of CBI is not always merely due to non-availability of computers within the school. It may be the result of a number

of factors such as poor organization of resources, poor quality hardware, inappropriate software, and lack of personal access for teachers (Becta, 2004).

Besides the availability and accessibility of computers, there is also the need to keep them functional. Broken down computers have to be serviced. Some of these can be done by a technician that can be offering support to the teachers.Practioners of CBI view from 26 countries on what were sought on what were the main obstacles to the implementation of CBI in schools.

They concluded that four of the top ten barriers were related to the accessibility of CBI. The barriers are insufficient number of computers, insufficient peripherals, insufficient number of copies of software's, and insufficient simultaneous internet access (Pelgrum, 2001).

Effect of Computer Based Instruction in Teaching and Learning

It has been argued by Heineck et al. (1999) that if one defines student learning as the retention of basic skills and content information, as reflected in standard test, then evidence suggested that there is a positive relationship between computer based learning and standardized test.

According to Hawkridge (1990), computers as pedagogical tools in computer based instruction offer advantages over other methods of teaching and have revolutionized education in advanced countries. Teasley (1995) concur with Hawkridge (1990) that computers are useful tools for pupils' drills and practice tutorial activities, guided discovery building, intellectual structures, data retrieval and manipulation.

Numerous studies have been conducted on the effects of computer use on student achievement, attitudes, learning rates, and other variables. Meta-analyses, reviews of literature, and individual studies generally indicate that computer-assisted instruction has a positive effect on student learning. A meta-analysis combines the results of numerous studies that were conducted in different settings, at different times, and under different conditions and therefore can give a better indication of the effects of a treatment than an individual study can.

A series of meta-analyses by James Kulik and his associates at the University of Michigan compared the achievement levels of students using computer based instruction with students who received traditional instruction. They reported significant effect sizes in elementary (0.47), secondary (0.26), and college instruction (0.36) in a variety of courses (Bangert-Drowns,Kulik, Kulik,& Morgan,1991; Kulik, Kulik, & Bangert-Drowns, 1985).

In a study of 123 colleges and universities, the use of the computer as a tutor to supplement traditional instruction was associated with more learning in less time, slightly higher grades on post-tests, and improved attitudes toward learning (Kulik & Kulik, 1984).

An updated meta-analysis of 254 studies comparing outcomes in computer instructed and traditional instructed classes was consistent with the earlier studies (Kulik & Kulik, 1991). The study included students of all ages, kindergarten through adult, who used computer-based instruction (CBI) in mathematics, social studies, science, reading and language, and vocational training.

The computers were used for drill and practice, tutoring, and programming. Overall there were small positive changes in student attitudes toward computers and learning, a reduction in the amount of time needed for instruction, and an increase in exam scores of 0.3 standard deviations. It should be noted that the results were not consistently and overwhelmingly in favor of CBI. In 81% of the studies, the CBI classes had the higher average on end-of-course examinations, and in 19% the traditionally taught classes had the higher average.

The effect sizes in mathematics were higher for precollege (0.37) than postsecondary (0.14). This suggests that developers of CBI programs may be more successful at creating programs to teach elementary skills and basic knowledge than higher order skills. All the studies included in this meta-analysis were published before 1984.

Computer software has changed rapidly in recent years so it is important to examine more recent studies on the effectiveness of computer-assisted instruction to determine if the positive effects indicated by earlier studies have persisted. Studies have revealed that, the impact of computer-assisted instruction in mathematics in elementary and middle schools found that all had at least slightly higher test scores and for nine of the studies the increase was statistically significant (Kulik, 1986).

The median effect size was 0.38 which is consistent with the studies from the 1960s through 1990. Evaluation of computer tutorials in science courses had even stronger positive results. A more recent meta-analysis of 52 studies of 5000 subjects in Taiwan from first grade through college in English, physics,

chemistry, statistics, mathematics, and business found that computer-assisted instruction had moderately positive effects on students' achievement over traditional instruction (Liao, 2007). The 45 overall grand mean effect size was 0.552, the mean effect size for mathematics was 0.291, and the mean effect size for college was 0.823.

Results of literature reviews have been consistent with these meta-analyses in concluding that computer-Assisted Instruction (CAI) does produce higher achievement for students of different ages and in different subject areas, especially when CAI is combined with traditional instruction.

In a review of research on computers used for drill-and practice, problem solving, simulation, and tutorials, all studies showed that computer assisted instruction as a supplement to traditional instruction was more effective than traditional instruction alone (Edwards, Norton, Taylor, Weiss, & Dusseldorp, 1975).

Summary of Literature Review

In this chapter the researcher discussed the theoretical framework of the study. The study draws its frame from three learning theories, the behaviorist, cognitive and constructive theories. The conceptual frame of the research was also put forth. Finally, empirical findings of the related literature were also discussed.

CHAPTER THREE

METHODOLOGY

Overview

This chapter deals with the process through which the research was conducted. It describes the research design, population, sample and sampling techniques, instrumentation, and administration of the instrument as well as data analysis procedure.

Research Design

Burns and Grove (2003: 195) defined a research design as "a blueprint for conducting a study with maximum control over factors that may interfere with the validity of the findings." Parahoo (1997: 142) described a research design as "a plan that describes how, when and where data are to be collected and analysed".

The study focused on the impact of computer based instruction on pupil's performance in mathematics. The study was therefore to help improve immediate classroom practice. Experimental and action research designs were chosen for the study after a careful consideration of the topic.

Action research is a process in which participants examine their own educational practice systematically and carefully, using the techniques of research. Action research is an interactive inquiry process that balances problem solving actions implemented in a collaborative context with data-driven

collaborative analysis or research to understand underlying causes enabling future predictions about personal and organizational change (Reason & Bradbury, 2002).

The researcher also employed the experimental design to be able to manipulate those variables he deemed necessary and to control those he wished to get the best effect. This is in accordance with the belief of Campbell and Stanley (1963) as they contended that experimental research is the kind in which variables are manipulated and the effects of the manipulation upon the variables are observed.

The choice of the action and experimental design helped the researcher to analyze the attitudes of the respondents' quite accurately. It also helped him to be able to manipulate the two respondent groups which allowed him to study the effects of the treatment given to each of the groups.

The nature of the study points to the need for action and experimental survey approach to be used to gather data with the view to analyzing the impact of computer base instruction on pupil's performance in mathematics. The study looked at the students' and teachers' attitude towards the use of CBI in learning mathematics.

The researcher also used the traditional method of teaching and computer base instructional method of teaching to find out the one that would have better impact on pupil's performance in mathematics. The researcher thus examined the effects of computer-based mathematics instruction and traditional instruction on students' achievement.

Population

Population is a group of individual or items that share one or more characteristics from which data can be gathered and analyzed. A research population is also described as a well-defined collection of individuals or objects known to have similar characteristics. Research population is generally a large collection of individuals or objects that is the main focus of a scientific query. It is for the benefit of the population that researches are done.

The population for this study was all the teachers and pupils of public basic schools in Kasoa. The accessible population was however, two public basic schools in Kasoa, namely St. Martha's Catholic Basic school and Emmanuel Presbyterian Basic School. These public basic schools were chosen for the research because of the following reasons:

1. The poor performance of mathematics by pupils in the schools.
2. The Chief Examiner's report of 2011which indicated that Candidates who wrote the Basic Education Certificate Examination (BECE) in April 2011 performed poorly in mathematics.

This is because most candidates could not answer questions on topics such as natural numbers, drawing a Venn diagram and inserting the element in them. They also found it difficult to solve word problems. Candidates were not able to translate the problem into mathematical language and use mathematical symbols to enable them solve a problem. They couldn't recognize a linear relation and plot point to draw the corresponding straight line. They showed weakness in geometric figures and perimeter.

It is only through constant drills, simulations, games, tutorials, and practices that students can acquire the skills required in solving mathematical problems. Teachers should therefore change their teaching methodology and strive to make students understand concepts properly using improved teaching and learning materials.

Sample and Sampling Procedure

The sample for the study consisted of 40 pupils from each of the two junior high schools involved in the study. The students selected were in JHS one. The researcher adopted a probability sampling procedure for the study based on the fact that, it is highly reliable and more accurate.

It has a higher degree of representation that is suitable for very large numbers, and it is also possible to evaluate the relative efficiency of various sampling designs when conducted. Specifically, the researcher used a random probability sampling procedure so as not to be bias. Through random sampling the two schools in the Awutu Senya East District in Kasoa were chosen for the study.

They were the Emmanuel Presby Basic School and St Marth's Catholic Basic School. St. Marth's Basic (Group One) experimental group received CBI while Emmanuel Presby Basic (Group Two) control group received the traditional method of teaching. Questionnaires on their demographic information and attitude towards CBI were prepared and administered to both groups. Achievements test was also prepared for both schools. St Martha's Basic School (Experimental group) answered the achievement test using CBI whiles Emmanuel Presby Basic

School (Control group) answered it using the traditional method. No particular attention was paid to gender, however mixed gender was used.

Instrumentation

The instruments that were used for the study were questionnaires and achievement test. The questionnaires were used to elicit responses regarding demographic and attitudinal data. It was made up of 18 items presented in 2 sections. Section one of the instruments was made up of 5 items regarding the demographic data. Section two of the questionnaire had18 items. It was used to collect information about the attitudes of the students towards CBI.

Achievement test was also administered to students in both categories (experimental and control groups) to ascertain the differences that existed between the two groups. Those in the control group received direct instruction from the researcher. Direct instruction usually included the presentation of material, thinking aloud by the teacher, guided practice, correction and feedback, and modeling by the teacher (Kinney and Robertson, 2003). The teacher played the role of the expert imparting knowledge. The teacher decides what, when, and how students should learn (Brown, 2003; Kinney and Robertson). All students studied the same topic at the same time.

The experimental group received computer based instruction with no assistance from the researcher. They were allowed to interact with the software on the computer to deduce their own meaning. At the end of it all achievements test was conducted for both groups to find out which of the two methods (traditional method and CBI) was more effective.

Students learning with CBI could learn at their own pace. This is because the CBI software is always on the computer therefore students could learn at any time they wish. But the traditional method of teaching requires the presence of a teacher; therefore if the teacher is not available no teaching and learning could take place

Again Computer based instruction motivates children to learn better by providing them with the immediate feedback, reinforcement by creating an exciting and interesting game-like atmosphere, but that of the traditional based does not provide the students with immediate feedback therefore learning becomes boring. Students learning with CBI assume an active role in the learning process rather than a passive one, since they interact with the CBI to deduce their own understanding

Based on the results of the achievement test, the effectiveness of computer based mathematics instruction on student achievement and the differences that existed between the use of the traditional teaching method and computer based teaching method were analysed

Data Collection Procedure

Administration of the instrument was executed by the researcher in person during normal school hours to ensure adequate co-operation from respondents. To facilitate administration of the instrument, a letter of introduction was sent to the Head teachers of the schools. In the letter the purpose of the study, the need for the study and its importance to the individual respondent were explained. After establishing communication with the Heads of schools visited, the researcher

obtained permission to conduct the study. A total of 80 students' attitude questionnaires and 20 achievements test each regarding CBI and Traditional methods were administered in each of the two basic schools selected. St Martha's basic school (Experimental group) received the test items as CBI whiles Emmanuel Presby Basic School (control group) received it in the traditional form (hard copy).

The attitude towards computer based mathematics instruction on student and the differences existed between the use of the traditional teaching method and computer based teaching method was analyzed

Data Analysis

Data from the questionnaire was analyzed using descriptive statistics which generated results of frequencies and percentages on demographic information and attitudes towards CBI. To find whether there were differences between the two methods T-Test was used. The data was entered into the SPSS. It was appropriately coded which gave a p-Value of 0.000 at an alpha value of 0.05. This indicated that there was a significant difference between the two methods of teaching.

CHAPTER FOUR

RESULTS AND DISCUSSION

Overview

This chapter deals with the presentation and analysis of the data collected. This is followed by the discussion of the findings. Descriptive statistics such as frequencies and percentages were used in analyzing the results. The results are presented and analyzed in relation to the demographic information of the respondents and the research questions.

Demographic Information of Students

This section takes a critical look at the demographic data of the student respondents from the two basic schools. The basic schools surveyed were the St Martha's Basic School in Kasoa and Emmanuel Presby Basic School also in Kasoa. Forty first year students were randomly sampled from each of the schools making a total of 80 respondents in all. Table 1 presents the distribution of respondents by school.

Table 1: Distribution of Respondents by School

School	No.	%
St. Martins Basic	40	50
Emmanuel Presby Basic	40	50
Total	**80**	**100**

Source: Field Survey, 2012

Table 1 shows that 80 respondents were surveyed in the two schools, namely: St Martha's and Emmanuel Presby. Forty (50%) respondents were sampled from each school.

Age Profile of Student

The sampled students varied in age. Table 2 presents the age distribution of the sample. The numbers and percentages of the age group are given.

Table 2: Age Distribution of Respondents

Age	No	%
10-12	3	3.8
13- 14	51	63.8
15- 16	25	31.2
17 and above	1	1.2
Total	**80**	**100**

Source: Field Survey, 2012

Table 2 shows the age profile of the respondents in the survey. Out of the 80 respondents, majority of them (51, representing 63.8%), were between the ages of 13 and 14 while 31.2% were between the ages of 15 and 16. It is not surprising that majority of the respondents fell within the 13-14 age bracket since ideally, a student in JHS 1 is supposed to be 13 years old if he/she started school at the right time. Table 3 presents the sex distribution of respondents.

Table 3: Sex Distribution of Respondents

Sex	No	%
Male	32	40
Female	48	60
Total	**80**	**100**

Source: Field Survey, 2012

Table 3 shows the sex profile of the students. There were 80 respondents in all. Thirty two (40%) of the respondents were males whiles 48 (60%) of the respondents were females. The results imply that more females than males were enrolled in the basic schools in Kasoa. The number of female students was more than that of male.

Time One Spends on the Computer

Time one spends on the computer daily has an impact on one's ability and attitude to CBI. Responses with regard to the time the respondents spend on the computer every day is presented in Table 4.

Table 4: Time Spent on the Computer Daily

Time	No	%
Less than 1 hour	11	13.8
1 hour-2 hours	57	85.0
3 hours and above	12	15.0
Total	**80**	**100**

Source: Field Survey, 2012

Table 4 shows the length of time (in hours) each respondents spend on the computer each day. Out of the 80 respondents 11 (13.8%) of them spent less than an hour each day, 57(85.0%) of the respondents spent 1-2 hours each day on the computer while 2 (15.0%) of the respondents spent 3 hours and above on the computer daily. The responses with regard to the number of students who had computers are presented in Table 5.

Table 5: The Number of People who have Computer at Home

Statement	No	%
Yes	70	87.5
No	10	12.5
Total	**80**	**100**

Source: Field Survey, 2012

Table 5 shows that out of the80 respondents, 70 (87.5%) of them had computers at home. Only 10 (12.5%) of them did not have computers at home. The fact that many students had computers at home is an indication that they were familiar with the use of computers and were likely to be interested in CBI programs.

Research Question 1

What is the attitude of students toward computer based instruction?

Students' attitude helps to shape the perception they have towards the use of CBI in their learning. Eighteen items in the form of statements were used to determine their attitude toward CBI. The responses are presented in Table 6.

Table 6: Students' Attitude toward CBI

Statement	A		U		D		TOTAL	
	No.	%	No.	%	No.	%	No	%
I do not have enough Skill to use CBI.	31	38.75	5	6.25	44	55	80	100
I want to do my studies using the CBI.	71	88.75	1	1.25	8	10.0	80	100
Engaging with computer makes me angry.	10	12.5	5	6.25	65	81.25	80	100
It is not interesting to solve problems with CBI.	16	20.0	8	10.0	56	70.0	80	100
I believe that I can do all my work with the help of CBI.	64	80.0	7	8.75	9	11.25	80	100
I believe that I will not be a good user of CBI.	8	10.0	6	7.5	66	82.5	80	100
I get nervous when I think of studying with CBI.	10	12.5	9	11.25	61	76.25	80	100
I become confused operating with CBI.	20	25.0	10	12.5	50	62.5	80	100
It is enjoyable for me to learn new things in CBI courses.	66	82.5	6	7.5	8	10.0	80	100
Studying with CBI require good emotions.	66	82.5	6	7.5	8	10.0	80	100
I'm not able to solve problems using CBI.	16	20.0	13	16.25	51	63.75	80	100
I do not believe CBI can help me in my daily life	15	18.75	9	11.25	56	70.0	80	100
It is difficult to use the Computer.	10	12.5	6	7.5	64	80.0	80	100
CBI makes my course more interesting.	64	80.0	3	3.75	13	16.25	80	100
CBI increase the probability of finding Jobs.	68	85.0	4	5.0	8	10.0	80	100

Source: Field Survey 2012

Table 6 shows the results of the attitude of students towards CBI. Out of a total of 80 respondents 71 (88.7 5%) of them strongly agreed that, they were not afraid to engage with CBI. This shows that students had access to CBI and so it

had a positive effect on them. This is in line with the findings of (Sicilia, 2005), which stated that availability and accessibility of computers have an effect on student attitude towards computer. When computers are available and accessible students' attitude towards it is positive. Six (7.5%) of them also strongly disagreed that they were afraid to engage with CBI.

The second item in table 6 sought to find out from the respondents if they had enough skills to use CBI. Out of 80 respondents 31 (38.75%) of them strongly agreed they did not have enough skills to use CBI. Forty four (55%) of them disagreed that they did not have enough skills to use CBI

The next item in table 6 sought to find out from the respondents if they wanted to do their studies using CBI. Out of 80 respondents 71 (88.75%) of them agreed that they wanted to do their studies using CBI. This is due to availability and accessibility of computers in the schools. It agrees with the findings of (Becta, 2005).

Only eight (10%) disagreed that they wanted to do their studies using CBI. On the issue of students becoming angry when engaging with CBI, majority of the respondents (81.25%) disagreed while only (16.5%) agreed.

Similarly, with the item that sought responses as to whether the students found it interesting to solve problems with the help of CBI, only (20.0%) of the respondents disagreed whiles majority (70.0%) agreed. Also the result of item that sought responses as to whether the students believed they would not be good users of CBI, found that out of 80 respondents 8 (10.0%) of them agreed they

would not be good users of CBI. Sixty-six (82.5%) of the respondents thought they would be good users of CBI.

From the analysis, generally, it could be said that the students had positive attitude towards CBI. This is possibly because majority of the students had computers at home. This further suggests that the use of CBI can be encouraged in the schools to improve the quality of teaching and learning. According to research studies found in the literature, the use of computer-based instruction increases students' attitudes and academic achievements significantly (Berger, Lu, Belzer, & Voss, 1994; Geban, 1995).

Research Question 2

What differences exist between the use of the traditional teaching method and computer based teaching?

It was important to find out if differences existed between the use of CBI and the traditional method as regards students' academic achievement. The difference between the two methods would enable the researcher recommend the best method of teaching to the basic schools in Ghana to improve performance.

To found out whether differences existed between the two the methods, students of St Martha's basic school were taught using CBI whiles students of Emmanuel Presby basic school were taught using traditional method. After the use of the two methods in teaching a post test was conducted and the mean score for the two groups are presented in Table7.

Table 7: Mean Scores for CBI and Traditional Method of Teaching

Name of school	No	Mean	SD.
St. Marthas Basic Sch (CBI)	40	17.38	1.764
Emmanuel Presby Basic (Trd met)	40	8.90	2.023
Total	**80**		

Source: Field Survey, 2012

From Table 7 it is clear that St Martha's basic school which was taught with CBI (treatment group) obtained a higher mean score of 17.38 and standard deviation of 1.764.On the other hand students of Emmanuel Presby Basic School which was taught using the traditional method (control group) obtained a mean score of 8.90 and standard deviation of 2.023.The result indicated differences existed between the two methods in terms of students achievements. This agrees with the findings of Hawkridge (1990), which stated that computers as pedagogical tools in CBI offer advantages over other methods of teaching.

The mean score of students from St Martha's Basic (treatment group) was higher than that of Emmanuel Presby Basic School (control group) .The standard deviation for St Martha's Basic School (17.38) was lower than that of Emmanuel Presby Basic School (2.023) .This shows that achievements score in St Martha's Basic School were more homogeneous than those of Emmanuel Presby Basic School.

Hypothesis Testing

It was hypothesized that there is differences between CBI and traditional method of teaching. To test the hypothesis, the independent sample t test was performed comparing the mean score for CBI (M = 17.38, SD = 1.764) with that of Traditional Method of Teaching (M= 8.90, SD = 2.023). With alpha set at .05,

the test was shown to be statistically significant, t (19.97) = 78, p < .05.The results are presented in Table 8.

Table 8: T-test Output on CBI and Traditional Method of Teaching

Description	St. Martin's Basic Sch.	Emmanuel Presby Basic
Population	40	40
Mean score	17.38	8.90
Standard Dev.	1.764	2.023
p-value	0.000	
t-value	19.97	
df	78	

Source: Field Survey, 2012

The results from the t-test shows that t = (19.97), df = (78), sig (p) = (0.000). This shows that we are 95% sure that lesson delivered by CBI give better outcomes than lesson delivered by traditional teaching methods. Liao (2007) found out that CBI had a positive effect on individuals than traditional method.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Overview

This chapter deals with the summary of the study in general. It gives the summary of the findings that emerged from the data collected. Conclusions are then drawn from the findings. Recommendations are made on the basis of the findings and conclusions. It also gives suggestions for further research in the area of study.

Summary

The purpose of the study was to find out if the use of computer based instruction in the form of tutorials, drills and practices, simulation and games could help improve student performance in mathematics in the basic schools in Kasoa. The population of interest in this research was students in basic schools. Two public basic schools were surveyed. St Martha's basic school and Emmanuel Presby basic school all in Kasoa were surveyed. Forty first year students in each school were randomly selected.

Thus, the sample size was 80. Questionnaire, CBI and Traditional method of teaching were used as instruments for the study. The questionnaire was used to seek responses concerning the attitude of students towards CBI. CBI and the traditional methods of teaching were also used to ascertain which of the two methods were more effective in teaching.

Summary of Key Findings

The main findings of the study were that:

1. Students in the basic school had positive attitude towards CBI
2. Students who were taught with CBI scored higher marks than those who received traditional method of teaching. Also there was significant difference in the academic achievement of students taught with CBI than those taught with Traditional method.

Conclusions

Conclusions drawn from the study were that, since the students had positive attitude towards CBI they are likely to embrace instructions using CBI. Again, if CBI is adopted by all schools it is likely to improve academic performance. Students who study with CBI showed better academic gains than those who were taught with the traditional method. I therefore recommend that CBI should be adopted by all schools to increase academic performance of students.

Recommendations

The situation in the basic schools regarding the impact of CBI on their performance needs decisive action to encourage it use. To this end the following recommendations were made:

1. Government and the Ghana Education Service should equip the basic schools with enough computers and educational software that can facilitate the use of CBI.

2. Teachers should be encouraged to use CBI in their lesson delivery by educating them on the benefits of the use of CBI and giving them the necessary orientation, therefore more computers should be provided in schools by the government and with the support of the public so that students who do not have their own computers would be encouraged to engage with computers.

Suggestions for Further Research

The researchers' further work and findings were limited to only mathematics. It is therefore suggested other researchers who are interested in this area of research should research on the effect of CBI and traditional method of teaching on students in other subject area.

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APPENDICES

APPENDIX A

UNIVERSITY OF CAPE COAST

QUESTIONNAIRE FOR STUDENTS

Introduction

I am an M.Ed (Information and Communication Technology) student of the Centre for Continuing Education, University of Cape Coast. I am conducting a study into the impact of computer based instruction (CBI) on students' performance in mathematics in Kasoa schools.

The purpose of the study is to find out if the use of computer based instruction in the form of tutorials, drills and practices, simulation and games could help improve student performance in mathematics in the basic schools in Kasoa. The study is based on a sample so your participation is critical. The information you supply will be given the utmost confidentiality. You are therefore not to write your name anywhere in the questionnaire. In responding to the items on the questionnaire, please be as honest as possible.

Thank you.

SECTION A

DEMOGRAPHIC DATA

Please kindly read carefully and indicate by ticking **[ ] what** is in the square bracket. Information provided will be treated confidentially.

1. Name of the School……
2. Gender Male[ ] Female [ ]

3. Age 10 – 12 years [ ] 13 -15 years [ ]

16 -18 years [ ] 20 years and above [ ]

4. Do you have computer at home? Yes [ ] No [ ]

Other specify…….

5. How long do you use the computer each day? Less than hour [ ]

1hour – 2 hours [ ] 2 hours and above [ ]

SECTION B

Students' attitude towards CBI

Indicate [ ] the extent to which you agree or disagree with the following statements

	Statement	Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree
1	I am not afraid to engage with CBI					
2	I do not have enough skills to use CBI					
3	I want to do my studies using the CBI					
4	Engaging with CBI make me angry					
5	It is not interesting to solve problems with CBI					
6	I believe that I can do all my studies with the help of CBI					
7	I believe that I will not be a good user of CBI					

8	I get nervous when I think of studying with CBI					
9	I become confused operating a CBI					
10	It is enjoyable for me to learn new things in CBI courses					
11	Studying with CBI requires good emotions					
12	I'm not able to solve problems using CBI					
13	I do not believe CBI can help me in my daily life					
14	It is difficult to use CBI					
15	I do not want to solve problems with CBI when there are other means.					
16	CBI makes my course more interesting.					
17	I learn more using CBI than I do from books.					
18	CBI increase probability of finding jobs					

Others, please, specify…….....

……

APPENDIX B

SECTION C

Students Achievement test

Simplify the following integers

1. 7 + (-8)

   a. 1

   b. -1

   c. 15

2. 8 + 13

   a. -5

   b. 5

   c.21

3. -10 + (-15)

   a.5

   b. 25

   c. -25

4. 6 + (-8 + 5)

   a. -3

   b.3

   c. 19

5. 8 + (-5 + 6)

   a. -9

   b. 9

c. 18

6. What must be added to -15 to give -8?

a. 7

b. -7

c. 8

7. What must be subtracted from -7 to give -9?

a.-2

b. 2

c. 3

8. The temperature of a body falls from -3 degree Celsius to 11 degree Celsius.

By how many degrees does it fall?

a.8

b.-8

c. 9

9. What is the absolute value of 9?

a. -9

b. 9

c .0

10. The absolute value of -9 is 11

a. -9

b. 9

c. 0

State whether the following integers are true or false

11.-6 > -2

a. True

b. False

12. 6 > -3

a. True

b. False

13.-5 < -2

a. True

b. False

14. 0 > -1

a. True

b. False

15. -1 < 0

a. True

b. False

Simplify the following without using calculator

16.-8 – (- 13)

a. -5

b. 5

c. 21

17. 5 – (- 10)

a. 15

b. – 15

c. 5

18. – 15 – 10

a. 25

b. -25

c. -5

19.125 – (-75)

a. -200

b. 200

c. 70

20. 0 – (-18)

a. 18

b. 0

c. -18