UNIVERSITY OF EDUCATION, WINNEBA

EFFECTS OF COMPUTER-BASED LEARNING IN PHYSICS AMONG PURE SCIENCE STUDENTS OF AGONA NYAKROM SENIOR HIGH TECHNICAL SCHOOL

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A DISSERTATIONIN THE DEPARTMENT OF SCIENCE EDUCATION, FACULTY OF SCIENCE EDUCATION, SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES, UNIVERSITY OF EDUCATION, WINNEBA IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR AWARD OF THE MASTER OF SCIENCE EDUCATION (PEDAGOGY OPTION)

2014

DECLARATION

Student's Declaration

I, Bright Jebusimiham, declare that this Thesis, with the exception of quotations and references contained in published works which have all being identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole for another degree elsewhere.

SIGNATURE: .....

DATE: .....

Supervisor's Declaration

I, Dr. E. K. Oppong, hereby declare that the preparation and presentation of this Dissertation was supervised by me in accordance with the guidelines for the supervision of Thesis laid down by the University of Education, Winneba.

SIGNATURE: .....

DATE: .....

DEDICATION

This dissertation is dedicated to the Almighty God for helping me to fulfill my promise and to my mother, Mrs. Rita Bright.

ACKNOWLEDGEMENT

I wish to first of all, express my deepest appreciation to the Almighty God, who has been my source of strength and direction in all my endeavours.

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ABSTRACT

This study investigated the comparative efficiency of computer-based instruction (CBI) and traditional teaching method in physics among pure science students of Agona Nyakrom Senior High Technical School.The experimental design was used for this study. The research population for this study comprised of teachers and students of Agona Nyakrom Senior Technical High School .Purposive and simple random sampling techniques were used to select a sample of 62 respondents for the study. Both descriptive and inferential statistics were used in analyzing data. The findings indicated that Computer- Based Instruction improves the performance of the students as against the traditional approach. Majority of the students expressed an opinion that traditional method of teaching be replaced completely with the CBI method rather than only supplementary. They therefore recommended that the use of the CBI method in teaching and learning other subjects as well. The study concluded that dependence on school teachers' self-initiative for acquisition of computer skills, high levels of anxiety in using computers, lack of computer resources, focus on 'learning about the computer' instead of 'learning through computers', were the predominant barriers. Among the recommendations made were barriers that have and are still hindering the integration of ICT in the curriculum should be tackled by policy implementers. In this regard, as teachers are unwilling to change from the traditional methods of teaching to using information and communication technologies, they should be encouraged by policy makers and sensitized from time to time to understand the good side of technology.

CHAPTER ONE

INTRODUCTION

1.1 Overview.

This chapter deals with background of the study, statement of the problem, objectives of the study, research questions, significant of the study, limitations of the study and organization of the study.

1.2 Background to the Study

The 21st century can best be described as the ‗era of technology'. Information and Communications Technology (ICT) has enhanced most activities in the world. As observed by Pelgrum and Plomp (2004), the western economies especially can be described as ‗knowledge' economies because more manual and some cognitive activities have been taken over by computers and other ICT applications. Technological innovations especially in ICT have become part and parcel of the citizenry of the industrialized countries.

According to Kankaanranta (2005) ―the rapid development of technology has challenged learning environments also to adopt ICT to support learning and teaching and in guiding children to become its diversified users". Opoku (2008) also notes that it has now become clear that ICT as a modern tool has an important role to play in the quest to accelerate the rapid development of the education sector of every society. Any society that ignores the importance and usefulness of ICT in its development and most especially in its educational delivery would be doing so at the peril of the quality development of its human resources needed to facilitate development (Opoku, 2008).

Ghana, like most developing countries, not wanting to be left behind in the use of technological innovations, has acknowledged the importance of ICT in its development

agenda. The Government of Ghana has therefore placed strong emphasis on the role of ICT in contributing to the country's economy and education. The country seeks to promote an improved educational system within which ICT is widely deployed to facilitate the delivery of educational services at all levels of the educational system (Republic of Ghana, 2003). The use of ICT as a means of reaching out to the poor in Ghana has been captured in the country's development agenda like the Ghana Poverty Reduction Strategy Paper (GPRS I & II) and the Education Strategic Plan 2003-2015 as noted by Mangesi (2007). Upon the basis of the importance of ICT in the nation's socio-economic agenda, the Government of Ghana with the help of the Government of India has established the Kofi Annan Centre of Excellence in Information Technology (Ministry of Education, Youth and Sports (2004).

Unfortunately, earlier attempts in Ghana to integrate ICT into the educational system were not centrally planned. These attempts were left to Parent Teacher Associations (PTAs), old students' associations and Non Governmental Organizations (NGOs). In Ghana the PTAs form part of the school management committee and therefore they may help in the proper management of the schools. The PTAs help in the provision of various equipment and facilities to the schools. In Ghana, there is competition among old students of the various secondary schools. These old students associations try to outdo each other in the provision of facilities to their respective alma mater. Moreover, there are various NGOs in the country whose scope of interest cuts across the entire socio-economic divide. Therefore, these bodies tried to provide computers and other equipment to schools of their wards, their alma mater and schools that fitted into the scheme of things of the organizations. However, it was few schools that had rich old students, vibrant PTA as well as those that were lucky to have the support of NGOs that had ICT facilities in their schools. There was no centrally planned policy regarding the teaching and learning of ICT in the schools. Schools, colleges and individuals did things in their own manner which were not aligned

with any planned national agenda. In the teaching and learning activities in the schools, teachers used the conventional approach of teaching and hardly did they use computers in their teaching. These approaches included demonstrations, lecture, discussion, or any of the various teaching techniques as deemed appropriate to deliver the subject matter.

However, it has been realized in Ghana that ICT should be integrated into the educational system of the nation. The Government of Ghana seeks to develop and restructure the relevant ICT curricula for all levels of educational system (Republic of Ghana, 2003). The teaching and learning of ICT has therefore been formally enshrined in the educational system. The new education reform has placed emphasis on the teaching and learning of ICT. The Ghana government's _white paper' issued on the reform acknowledged the importance of ICT (2004). Syllabuses on ICT have therefore been designed for pre-tertiary levels of the nation's educational system. This indicates that ICT will be taught at all the pre-tertiary levels of the educational system which comprises the basic, junior high schools and the senior high schools. This indicates that right from the kindergarten to the final year of the senior high school students will be instructed in ICT. Again, at the senior high school level, ICT has been made an examinable subject. Aside the syllabuses, schools have been assigned ICT coordinators. The coordinators have gone through in-service training to be equipped to train their colleague teachers in their schools. The teachers are expected to use ICT in their teaching and the preparation of lesson notes. It is the programme's eventual expectation that ICT would not only be present as a subject in the curriculum but teachers will apply ICT in the teaching and learning of all other subjects such as Integrated Science and Social Studies. This expectation is in line with the emergence and widespread use of technology as noted by Karper (2005). They observed that a different atmosphere has been created in the classroom and that educators are required to incorporate new methods of teaching in the classroom in order to properly challenge and stimulate students. Ghana is therefore envisaging an era in which teachers

will make use of technology such as projectors, computers and other equipment while students on the other hand are expected to acquire basic ICT literacy, develop interest and use ICT for learning other subjects (Curriculum Research Development Division (2007).

Application of ICT in various ways is particularly pertinent in science education. One major technological device affecting the classroom in general and science classroom in particular is the computer. As noted Imhanlahimi andImhanlahimi, (2008), the use of computer in science instruction has a lot of advantages including providing the opportunity for individual learning. Moreover, the use of computers in science classrooms is believed to provide students with immediate feedback on their performance and therefore the use of computers should be invaluable in the science classroom. Computers play an important role in contemporary teaching and learning of science concepts as noted by Chang (2000). Imhanlahimi and Imhanlahimi (2008) indicate that a lot of studies in education in various countries of the world have revealed the importance of computer in science education. Therefore, the role of computers in science instruction cannot be overemphasized.

The use of ICT facilities especially computers in the science classroom will therefore provide the Ghanaian student with current opportunities and technologies that will enable him or her to become a fully developed person capable of competing with their peers elsewhere.

However, it is worth noting that in the developing countries, laudable policies suffer implementation impediments although it is the hope of many an educator that the laudable ideas would be implemented. To aid the implementation of the ICT educational policy it is important that the benefits and various usages of computers are explored.

1.3 Statement of the Problem

In the case of traditional methods in physics teaching, it is obvious that physics concepts are usually being taught by using abstract examples and words. This way of teaching, which needs highly cognitive skills to assimilate the taught subjects, creates a high pressure on the students, leading them to lose their self confidence and lower their use of capacities. Lecturing and questioning are the most common teaching methods in most of the traditional physics classrooms. Especially in middle and high school, students are exposed mainly to subject matters and they generally cannot understand why they learn those subjects, when they are not interested in them, or when they know that this knowledge will never be of any use to them throughout their life (George, 2006).

According to Cankoy and Tut (2002), school system has become so much more subject matter centered than experience centered. In this transition from experience based to symbol based education, students have been facing the problem of formal education that is _abstract‘, _artificial‘, and _bookish‘. After several decades, the education system in Ghana still contains highly controversial examples, applications and practices. Similarly, in Ghana, most of the physics contents in the senior high schools are provided in a traditional manner. Thus the students encounter many difficulties in acquiring what is taught, and more importantly, causing them to memorise most of the concepts without understanding (Cankoy& Tut, 2002).

Constructivist models of instruction propose to create environments in which learners actively construct their own knowledge, rather than receiving the teacher‘s explanation of the world. Increasing technological developments highly influence educational activities such as cognitive tools, teaching machines, computers, and calculators. The constructive learning environments can be created with the help of some cognitive computer-based tools such as databases, spreadsheets, and multimedia construction software where

learners can participate in active, mindful, and purposeful interpretation and the reflection of the external world (Bungum, 2006).

Computer-based instruction is one of the earliest applications of computers in education. Drill and practice, tutorial, problem-solving, and simulation are the kinds of CBI. Some computer based instruction types provide learning environments that engage students in creative tasks and problem solving mostly reflects the real-world assumption. Besides, CBI could be used as a supplemental to traditional instruction or as replacement for traditional instruction (Butler &Sellbom, 2002).

The evolution of the information technologies causes the rapid changes in societies. As we consider the inadequacy of conventional teaching methods to overwhelm the obstructions in the instruction process, one of the best solutions is the use of information technology.

1.4 The purpose of the Study

The general objective of this study is to examine the effects of computer based instruction on performance of students in physics in some selected senior high schools in Agona West Municipality. The sought to find out the influence the use of educational software has on students‘ academic performance in senior high schools. There is the need to examine whether the use of computer based instruction has had positive impacts on academic performance of students or not. This study therefore intends to examine the effects of computer based instruction on performance of students in physics in senior high schools in Ghana.

1.5 Research Hypothesis/ Questions

Questions

The study was guided by the following null hypotheses and research questions:

To achieve the set objectives, the following research questions would be addressed:

1. What are the current computer-based instructional materials in the school?
2. How do the various computer-based instructional materials help in improving students‘ academic performance?
3. What is the level of satisfaction of the students with the use of computer-based instruction in the teaching and learning process?
4. What factors serve as barriers to the use of computer-based instruction in the school?

Hypothesis

H_o: There is no significant difference between the academic achievements of students instructed by CBL and those taught by the traditional method.

H_i: There is no significant difference between the academic achievements of students instructed by CBL and those taught by the traditional method

1.6 Significance of the Study

By using the computer software as a tool for modeling, conjecturing, analysing and generalising, students are enabled to learn conceptually, visually and meaningfully in physics lessons (Ball, 1990). In spite of the research on the significance of technology in schools, numerous educational institutions are limited by the charge of latest technologies.

For the reason of the high cost of the purchasing and execution of these technologies, it is essential to check the readiness of technology accomplishment in the classroom environment and to decide what effect this would have on student achievement. When this issue is solved, teachers would then have the needed knowledge and research to conclude the cost- benefit of technology acquisitions.

For this rationale, the utilisation of computers in all schools in Ghana should be thoroughly investigated. In this regard, this study provides a preliminary basis for the feasibility analyses, which is particularly focused on the use of computers in senior high school physics education. The study is supposed to reflect valuable results that will, in turn, encourage the administrators, principals and educators to focus on the use of computer-based instruction techniques not only in physics but in any field of education in schools in the country. It will also add to existing body of knowledge.

1.7 Delimitation

The study confines itself to pure science students andteachers of AgonaNyakromSenior High Technical School.

1.8 Limitation to the Study.

Due to financial, logistic and time constraint, the sample chosen for the study was small in relation to the entire selected high schools in Agona West Municipality. Thus, the results obtained will not be used as representative of the entire working population of teachers and students. Such a generalization could be misleading as it may not present the facts as they pertain to all senior high school in the Ghana. This could lead to the reliability of the study being compromised.

1.9Organisation of the Study

The study is divided into five chapters. Chapter one which is the introduction comprises the background to the study, statement of the problem, objectives of the study, research questions, significance of the study, scope and limitation of the study, and the organisation of the study. Chapter two deals with review of the literature on the following sub topics: brief history of computer education, computer-based education, effects of computer-based education, barriers to the use of computer-based education and theories on learning. Chapter three outlines the research method adopted which include the study area, research design, population, sample and sampling procedure, research instrument, pilot study, ethical issues, data collection procedure and procedure for the data analysis. Chapter four composes of a presentation, analysis and interpretation of available data. The last chapter, which is the fifth chapter, summarises the findings, draws conclusions and makes suggestions and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This chapter focuses on the history of computers in education, computer-based instruction, effects of computer based instruction, barriers to the use of CBI and learning theories,

2.2 History of computers in education

Computers and related technologies are now in most of the schools in all around the world. Advancements in technology are inevitably reflected in educational systems. In most of the developed countries education has been penetrated by information technologies (IT); schools have computers, a large numbers of teachers use computers and new technologies while teaching, and more over textbooks have some parts devoted to new technologies. New technologies are integrated into disciplines and more disciplines are being influenced by the new technologies in an integrated way. Most of the educators and researchers try to use technologies in various subject matters, and this integration changes the nature, concepts and methods of work in each subject. For example, in science education, the way of teaching and learning, the roles and functions of the most concepts have changed with the use of technology (Debela, 2004).

Although the wide-spread interest in computers as an instructional tool did not occur until the 1980s, computers were first used in education and training at a much earlier date. Much of the early work which computers introduced in education was done in the 1950s by researchers at IBM, who developed the first Computer Assisted Instruction (CAI) author language and designed one of the first CAI programmes to be used in public schools. Students followed the commands on the computer screen receiving rewards for correct answers within the framework of behaviourist approaches. In 1959, PLATO, the

first large-scale project for the use of computers in education was implemented by Donald Bitier at the University of Illinois (Carter, 2004). By the early 1980s many educators were attracted to microcomputers because they were relatively inexpensive, compact enough for desktop use, and could perform many of the functions performed by the large computers that had preceded them.

The dominant use of computer-based instruction in the 1980s was typified by the employ of ―behavioural-based branching" software that based greatly on drill and practice to teach programmed content and/or skills. The educational software that ran on the computers of the early 1980s were at first based on Skinner's ―methods of branching": first separating into small sections, rewarding combined responses, and teaching disconnected facts. Although the learning is passive where learners do not work together with problems and content, research studies indicate that learner did advantage from the technology when the learning objectives were behavioural (Carter, 2004).

During the 1990s, computers eventually started to have a major impact on instructional practices in schools. With the help of advances in technology and learning, science researchers consider learning with technology as means for constructing problem-solving skills and for achieving learner independence. The cognitive approach to instructional technology emphasised ―looking at how we know rather than how we respond, and analysing how we plan and strategise our thinking, remembering, understanding, and communicating" (Saettler, 1990). Besides, students would also learn through playing games and simple simulations with the help of cognitive school of thought. The worth of using a word processor has been discovered by writing teachers and almost immediately students were using the advantages of word processor by writing, deleting, formatting and revising with effortlessness. Other subject matter teachers perceived the importance of the computer in creating a rich learning environment by using databases, spreadsheets, presentation, and research tools.

Since 1995, rapid advances in computer and other digital technology, as well as the internet, have led to a rapidly increasing interest in and use of these media for instructional purposes (Reiser, 2001). Swiftly there was a volume of information obtainable to students with a network of people all through the world that improved communication and the exchange of thoughts. Additionally, distance education courses are offered and in this way students in geographically isolated schools have extended learning opportunities in a diversity of subject areas. For example in United Nations, Kalu (2006) states that the proportion of instructional rooms with internet access increased from 51 percent in 1998 to 93 percent in 2003. Theoretical explanations could now be demonstrated and manipulated with the help of technology innovations. A complete innovative learning environment became possible.

Since the advent of the personal computers in the mid 1980s, computers have rapidly become one of the key instructional technologies used in both formal and informal education. The computer‘s role has changed because of two factors: first, it can provide rich learning experiences for students and secondly, computer giving students the power to manipulate depth and way of their learning. Furthermore, teachers can use the computer as an aid to manage classroom activities; it has a multitude of roles to play in the curriculum which can range from tutor to student tools (Eugene, 2006).

In the domain of computer instruction, there are four broad classes of computer applications: as an object of instruction, as a tool, as an instructional device, and as a means of teaching logical thinking. The computer may itself be the object of instruction such as in computer literacy course students can learn about how computers are used in society and in computer programming course they can learn how to construct a programme by using programming languages. In its role as a tool, the computer assists both teachers and students, such as calculator, typewriter, and presentation aid. Students can use computers to solve complex mathematical calculations as a pocket calculator or

students can use word processing programmes to complete term papers and assignments. Both teachers and students can use data presentation software which incorporates with computers to present the content of the subject-matters. In addition to this, students can use a database for inquiry of specific information (Guha, 2001).

Levin and Wadmany (2006) defined the terminologies used by educators and researchers –ecomputer-assisted instruction, computer-based education, computer-based instruction, computer-enriched instruction, computer-managed instruction" that can easily become puzzled by educators. The following definitions are a combination of those offered by the literature represent commonly accepted (although surely not the only) definitions of these terms: Computer-based education (CBE) and computer-based instruction (CBI) are the broadest terms and can refer to virtually any kind of computer use in educational settings, including drill and practice, tutorials, simulations, instructional management, supplementary exercises, programming, database development, writing using word processors, and other applications. These terms may refer either to standalone computer learning activities or to computer activities which reinforce material introduced and taught by teachers.

Computer-assisted instruction (CAI) is a narrower term and most often refers to drill and practice, tutorial, or simulation activities offered either by themselves or as supplements to traditional, teacher directed instruction. In a traditional approach one can say that computer assisted instruction is an expression of any subject matter by using computers, or in general sense it is an acquisition of knowledge in a more simple way to the student by the learning-teaching activities with the help of computers (Levin and Wadmany,2006).

Computer-managed instruction (CMI) can refer either to the use of computers by school staff to organise student data and make instructional decisions or activities in which the computer evaluates students' test performance, guides them to appropriate instructional

resources, and keeps records of their progress. Computer-enriched instruction (CEI) is defined as learning activities in which computers generate data at the students' request to illustrate relationships in models of social or physical reality, execute programmes developed by the students, or provide general enrichment in relatively unstructured exercises designed to stimulate and motivate students. After providing a short reminding of the applications of computers, there is a need to mention the computer assisted instruction and the utilisation of CAI methods (Timucin, 2006).

2.3. Computer-based instruction

Computer-based instruction (CBI) is an educational medium in which a computer delivers instructional content or activities. The Association for Educational Communications and Technology defined computer-based instruction as a method of instruction in which the computer is used to instruct the student and contains the instruction designed to teach, guide, and test the student until a desired level of proficiency is attained (Association for Educational Communications and Technology, 1977). The level that the computer assists the learning process varies among programmes. Students learn by interacting with the computer while using computer-based instruction (Parr, 2003). The computer analyses the students‘ responses and supplies proper feedback to the students. More advanced software packages adjust the level and direction of the instruction to best suit the individual user‘s needs.

According to Fletcher-Flinn and Gravatt (1995), the general belief is that computer technology allows educators more options for communicating, facilitating the lesson, and enhancing the teaching and learning. Proponents claim that computer technology makes learning easier, more efficient, and more motivating. These beliefs are supported by research that has found that learning with computer-based instruction added to the traditional teaching methods produces a higher level of academic achievement than

traditional teaching methods only (Fletcher-Flinn& Gravatt, 1995). Traynor (2003) suggests that computer-based instruction affects cognitive processes and increases motivation by the following ways: personalising information, animating objects on the screen, providing practice activities that incorporate challenges and curiosity, providing a fantasy context and providing a learner with choice over his/her own learning.

The act of personalising information allows computer-based instruction to increase learner interest in the given tasks. Another benefit is that new information can be more easily integrated into existing learning if a student‘s name or other familiar contexts appear in a problem. The cognitive load on the learner‘s memory is decreased by the animation of objects thus increasing learning thereby allowing the learner to perform search and recognition processes and to make more informational relationships (Smith, 2001).

One of the simplest ways a computer aids in the learning process is that the computer makes it easy to provide challenges and increase curiosity. These activities are found to increase personal satisfaction and promote a positive perspective on lifelong learning (Wang, 2002). Wernet, Olliges and Delicath (2000) found that a fantasy context such as computer programmes that produce an action-packed game environment instead of simple rote recitation of facts increased learning by placing the learner in a situation that was intrinsically motivating. Finally, providing students with a choice over their own learning provides learner with controlled instruction that contributes to motivation (Traynor, 2003).

According to Nti (2008), the old approach to teaching is teacher-centred which implies that teacher does all the talking, and the learners do all the listening. The traditional or the conventional instruction method is characterised by: unspecified or vague objectives, emphasis on instructor behaviour rather than student behaviour, use of lectures to provide critical information, a constant instruction – set pace for all students, evaluation which is infrequent over large sections of materials, and for the purpose of assigning relative, standing rather than for remediation, delayed feedback to student about his performance,

minimal responses of students to the instructional materials and few faculty/student or teacher/student interactions.

Simonsson (2004) noted that under the traditional system of instruction, the student is motivated primarily by the fear of receiving a poor grade, of losing a course credit or of being forced to leave the college (droping out) for academic failure. However, the new approach is learner-centred; the learner is not treated as an empty vessel. He is credited with knowledge, skills and attitudes from the day he or she is born which requires development, through guidance, encouragement and motivation.

It is therefore not a gainsaying to say that the quality of education is largely dependent on the quality of instruction provided in the classroom. There is no doubt that technology has become incorporated into our school system. Computers are not only used as means of helping schools analyse data, they have become pervasive tools toward optimizing students‘ learning. For example, students are regularly using the internet to gather and assimilate information for use in research assignments. According to Traynor (2003), computers are used in preparing –electronic" presentations using computer presentation programmes and LCD projectors. He was also of the view that many schools have incorporated interacted computer-based instruction into programme to provide students opportunities to master specific educational objectives or standards.

According to Schofield and Davidson (2003), computer-based instruction can be referred to as a self-learning technique usually offline/online, involving interaction of students with programmed instructional materials. It is an interactive instructional technique whereby a computer is used to present the instructional material and monitor the learning that takes place. CBI uses a combination of text, graphic sound and video in enhancing the learning process. The computer has many purposes in the classroom, and it can be utilised to help a student in all areas of the curriculum. CBI refers to the use of the computer as a tool to facilitate and improve instruction. CBI programmes use tutorials, drill and practice,

simulation and problem solving approaches to present topics and they best test the students‘ understanding.

Previous studies by Schofield and Davidson (2009) have succeeded in examining typicality, types, advantages and limitation of computer-based instruction. Typical CBI provides: text or multimedia content, multiple-choice questions, problems, immediate feedback, notes on incorrect responses, summarised students‘ performance, exercises for practice and worksheets and tests.

Researchers first divided computer-based instruction into four subcategories through the works of McKinnon, Nolan, and Sinclair (2000). The first is drill and practice sessions. Researchers suggested that the computer can be an addition to the drill and practice method of traditional instruction through relevant practical exercises. Drill and practice sessions provide feedback and practice on a topic taught to the student at a previous time. The computer has many advantages over the worksheet method of drill and practice. The computer can provide different questions for each at the proper developmental level. It can decrease the time required for the lesson by grading and providing more instantaneous feedback. The computer can increase the number of questions available for the lesson.

The second major category is tutorial sessions. The tutorial mode is a method for presenting new information to the student and then reinforcing it with appropriate questions. The student interacts with the computer much as a student would interact with a tutor in a one-to-one session. Concepts are presented to the student, the student‘s grasp of the material is measured, and the computer then provides more instruction or remedial instruction based upon his or her response. The third category is games. Games are a valuable way to teach concepts such as spelling and mathematics. Games allow students to learn repetitive material in different ways to elevate the tedium. The final category is simulations. Computers can be used to simulate scenarios in which students can

experience situations that are too dangerous or expensive for real life. The sciences and fine arts benefit most from simulation software (Lepper, &Gurtner, 1989).

According to Wade (2006), computer-based instruction typically include: drill-and-practice (drill and practice provide opportunities for students to repeatedly practice the skills that have been previously presented and further practice is necessary for mastery); tutorial (tutorial activity includes both the presentation of information and its extension to different forms of work, including drill and practice, games and simulation); games (game software often creates a content to achieve the highest score and either beat others or beat the computer); simulation (simulation software can provide an approximation of reality that does not require the expense of real life or its risks); discovery (this provides a large database of information specific to a course or content area and challenges the learner to analyse, compare, infer and evaluate based on their explorations of data) and problem-solving (the approach helps children develop specific problem skills and strategies).

2.4 Effects of computer based instruction

According to Levin and Wadmany (2006a), majority of the research studies indicates that CBI brings several possible advantages as a teaching/learning tool. The main strength of the computer as a learning medium is its ability to process information quickly. This makes it possible for the computer to accept and act upon a variety of different kinds of response from the learner and to provide information in textual, graphical, and animated form. There are three advantages of usage of technology in teaching and learning physics: interactivity, connectivity and controlling of learning environments.

Day (2006) reports that computer suggest opportunities for learner control, improved enthusiasm, associations to the real world, and enhance student achievement as measured in variety of ways, including, but not exclusively limited to, ~~–s~~tandardized achievement tests". Day (2006) further stated that CBI benefits most students when compared with

traditional instruction because it increases student interest, reduces anxiety, provides more time on task, and provides instant feedback for the student.

Empirical studies by Cotton (2001) reveal that CBI benefits students with the following: self-sufficient learning, independent learning, the exercising of various senses and the ability to represent content in a variety of media. In computer-based instruction environment students can fix their pace of learning. That is to say, with self-paced learning, learners can progress as slowly or as quickly as they like through a programme. In addition to this, if students want to replicate some task or review some material again, they can do so as many times as they wish. The programme will not tire out or complain about repetitions as sometimes teachers do. Also, students can leave out a topic if content is already known or understood, making the learning process more efficient. CBI provides a self-directed learning to students, and allows learners to become empowered to take increasingly more responsibility to choose, control, and evaluate their own learning activities which can be pursued at any time, in any place, through any means, at any age. Simply put, learners can decide what they want to learn and in what order.

According to Fletcher-Flinn and Gravatt (1995), people remember 20% of what they hear, 40% of what they see and hear and 75% of what they see, hear and do. Therefore, the more senses are used through which we obtain information, the easier to keep in mind. The fact that the computer can exercise various senses and present information in a variety of media can enhance the learning process. As a result, students can retain knowledge.

According to Mahmood (2006), CBI is visually attractive, when it presents concepts using demonstrations that are made attractive by animation, colour, and sound. Besides this, computer-based instruction captures and holds the students‘ attention by providing opportunities for competition where the opponent is the student‘s previous performance. It also eliminates the misconceptions by providing immediate feedback, since immediate feedback prevents learning concepts incorrectly. As Cotton (2001) indicated teachers can

benefit from CBI since it can be programmed with concept, level and ability specificity; that is, the students are not challenged outside his or her demonstrated ability range, nor are they allowed moving to a higher level until they have mastered the level on which they are working.

A study by Lam (2000) on the effects of computer-based instruction on language classes in Japan found several advantages to computer-based instruction. The study was conducted by surveying the students‘ attitudes in English classes. Lam found that students study in a more active way when using a computer. The students could not passively sit in class and listen to the teacher. They were forced to be involved. Immediate feedback was indicated as one of the major benefits of computer-based instruction. The instruction is individualised. Each student progresses at his/her own pace.

Another meta-analysis conducted by Jamison, Suppes, and Wells, (1974) during the 1970s assessed the effectiveness of drill-and-practice, problem solving, simulation, and tutorial computer-based instruction programmes. The study found that computer-based instruction plus traditional instruction was more effective than traditional instruction alone. The study found that students at the elementary level benefited from a combination of the traditional teaching methods with computer-based instruction. Another conclusion found in the study was that economically disadvantaged students benefited to an even greater extent academically from their more affluent peers.

A meta-analysis by ChanLin, Hong, Horng, Chang and Chu (2006) reviewed sixteen major studies between the years 2000 and 2005. The study found that students that received computer-based instruction as well as traditional instruction scored at the 66th percentile on tests of achievement compared to the control subjects who scored at the 50th percentile. The study suggested that computer-based instruction is approximately twice as effective as peer tutoring.

Crystal (2001) conducted a study involving junior high students. The study found that computer-based instruction was the most effective instructional delivery system compared to video alone. In 2000, a large project integrating technology with the curriculum was studied. The study involved grades one through eight. All grades met the goals set forth in the study while several grades exceeded the predicted increase.

Eugene (2006) used meta-analysis to aggregate the findings from more than 500 individual research studies of computer-based instruction. He drew several conclusions from his work. Eugene (2006) determined that students who used computer-based instruction scored at the 64th percentile on tests of achievement compared to students in the control conditions without computers who scored at the 50th percentile. He also found that students learn more in less time when they receive computer-based instruction. Finally, Eugene (2006) found that students like their classes more and develop more positive attitudes when their classes contain computer-based instruction.

Hinson (2005) conducted a study comparing the academic achievement of students in grade six through twelve who received traditional education only was compared to students of the same age that received traditional teaching methods supplemented with computer-based instruction. Students who received the computer-based instruction attained a higher academic achievement than 58.2% of the students only receiving traditional instruction. Hinson (2005) also compared achievement of students across a twelve-year period. One group of secondary students received instruction utilising computers while the other group did not. On average the secondary students that received computer-based instruction made greater gains in academic achievement than 57% of the students who only receiving traditional instruction.

Another study on the effects of computer-assisted instruction on students was published by Schofield and Davidson (2003). Schofield and Davidson‘s (2003) subjects were 98 college undergraduate students in two sections of a computer literacy class. The students were

randomly assigned to one of two treatment groups to study linear function. One group received substantially more computer instruction. The other group was taught in the traditional lecture method. Schofield and Davidson (2003) gave each group a pre-test and a post-test. The group that received the computer instruction scored significantly higher on the post-test. No significant difference was found on the pre-test. The students in the group receiving computer instruction scored significantly higher on post-tests than the group that did not receive the computer instruction. The authors draw the conclusion that a relationship exists between the use of computer-based instruction and a higher level of academic achievement.

Computers have been widely touted as a way to increase student motivation. Wernet, Olliges and Delicath (2000) found in a survey of current research in England that the most frequently cited motivating aspects of computer-based instruction include the novelty of working with a new medium. Wernet, Olliges and Delicath (2000) on the effects of computer-based instruction found the individualised nature of the instruction as a major reason for the increase of motivation. Two other studies also found a significant increase in motivation but found the chief cause as the opportunities for learner-directed instruction. The opportunities for rapid feedback were found to be a reason for improved motivation by two other studies.

A study by Warschauer (1996) of the University of Hawaii supports these findings. Warschauer conducted a study on student attitude toward learning. Warschauer studied 167 English as second language students in twelve universities academic writing courses in Hong Kong, Taiwan, and the United States. He found significant increases in motivation of students using computers. One of the findings indicated that the greater the extent of computer-use in the class, the greater the increase in motivation. The study cited the greatest benefit in motivation obtained through the use of computer-based instruction as the increase in personal empowerment of the students.

A study by Johnson (2000) in Lafayette Parish in Lafayette found that effective use of computer-based instruction can be utilised with a minimum of time. The school system has a programme that allows for pullout of low-achieving students. The programme allows students to utilise a computer-based software programme for ten minutes per day. In the initial stages of the programme, the system allowed one group to use the software while another group did not. After a period of two months the school system found that the students using the programme had increased in mathematics achievement by a statistically significant level as measured by a locally developed test.

A study conducted by High (1998) supports this conclusion. He studied a group of students enrolled in introductory statistics at a four-year college in Long Island, New York. Four sections of the same basic statistics class were used in the study. The professors for two of these sections utilised software to supplement their teaching. The students in these classes were required to carry out a series of computer exercises and projects during the semester as part of their assignments for the class. The remaining two classes were taught in the traditional lecture method. The students were surveyed one week before the final exam on their attitudes toward the class and their expected grade for the course. After the final exam, the survey responses and the grades were compared. A significant relationship was found between the student‘s mathematics average and their anticipated grade in the course for both groups. The class receiving the computer-based instruction scores significantly higher on the final exam and had a much more positive feeling toward the class than the group receiving only the traditional lecture method of instruction.

Another study of similar type was conducted by Edward (1970) who reviewed 219 research studies from 1990 to 1997 to assess the effect of technology on learning and achievement across all learning domains and all ages of learners. From these analyses, the researcher reported that students in technology-rich environments experienced positive

effects on achievement in all major subject areas. Sivin-Kachala also stated that students in technology rich environments showed increased achievement in preschool through higher education for both regular and special needs children. He found students‘ attitudes toward learning and their own self-concept improved consistently when computers were used for instruction.

Brown (2000) conducted one of the more complete studies of the effect of computer-based instruction on learner achievement. Brown conducted a scientific study of the effect of computer- based instruction on mathematics achievement. The study was conducted in a large urban North Carolina public school system. The system had an enrollment of approximately 100,000. Overall 42% of the students in the school system were black, 50% were white, and 8% were from other racial and ethnic groups. The study divided the students into two groups, an experimental group that used the CBI programme and a control group of students who were not exposed to the CBI programme. The study involved students from three schools in eleven different classes. All the schools and teachers volunteered to participate in the study. The effectiveness of the programme was evaluated by making statistical comparisons of students‘ mathematics achievement on the State of North Carolina‘s required end of grade and end of course test. The study was conducted over a two-year period of 1997-1998 and 1998-1999.

The majority of the use of the software occurred before school began for the day. Students were allowed access to the lab as soon as they arrived at school. The CBI programme studied was fundamentally Math. It was chosen because of favourable reviews it received by independent evaluators in two journals published by the National Council of Teachers of Mathematics. The software covered all areas of mathematics except calculus and probability. Pretest and posttest scores on the state end of grade examination for the students were collected. The author of the study utilised a two-tailed T test to determine if a significant difference was present. The study demonstrated that the students who

utilisedthe computer-based instruction scored significantly higher than the students who did not participate. The algebra students using the CAI made a 17% jump in scores (Brown, 2000).

A recent study by Traynor (2003) found that utilising computer-based instruction improved instruction over only using traditional methods. The study compared the effects on many types of learners including special education, non-English proficient, and regular education. The students showed significant pretest-posttest gains.Traynorfurther found that students who received instruction supplemented by CBI attained higher academic achievement than did 63.31% of those receiving only traditional instruction.

A very recent study by Powell, Aeby, and Carpenter, (2003) studied the effects on achievement of computer-based instruction as compared to instruction without the computer-based instruction. The experimental design included a pretest and posttest. The study used subjects that were characterised as disruptive by their school. The authors found that an improvement in the subjects‘ academic achievement was found by the use of computer-based instruction.

Wade(2006) identify the following as advantages of CBI: one-to-one interaction, great motivator, freedom to experiment with different, instantaneous response/immediate feedback to the answer elicited, self pacing allowing students to proceed at their own pace, help teacher to devote more time to individual students, privacy helps the shy and slow learner to learn, individual attention, learn more and more rapidly, multimedia helps to understand difficult concepts through multi-sensory approach, and self directed learning – students can decide when, where and what to learn.

2.5 Barriers to the use of CBI

Over the past several decades technology has been exploited in various ways to achieve a variety of educational goals. In the past, various researchers employed several research

methods in an attempt to understand the distinct ways in which computers can help educators in improving the teaching and learning process (Dawson, 2008). According to Dwason, school teachers could use computers for different purposes like for teaching purposes, administration purposes, and personal purposes. The literature on computers and constructivist reforms also described a variety of activities that were permitted with the use of computers that were not feasible otherwise.

Regarding the efficacy of the use of computers in these ways, there was a general concurrence that when combined with traditional instruction, the use of computers could increase student learning and produce higher academic achievement in a variety of subject areas than does traditional instruction alone. It was observed that mere introduction of computers and related technology in the schools could not result in desired adoption of computer use by school teachers, suggesting that there were several systemic and individualistic barriers that seemed to inhibit adoption to a desired extent. As a result, fostering technology usage among individual school teachers remained a critical challenge for school administrators, technology advocates and policy makers (Ivers and Barron, 1998).

Hadley and Sheingold (1993) revealed lack of time, scheduling computer time, too few computers, not enough time in school schedule for computer-based instruction, and inadequate financial support for computers as some of the significant obstacles towards use of computers. In a similar study, Ely (1993) identified dissatisfaction with the status quo, insufficient knowledge and skill, lack of resources, available time, commitment from supervisors, lack of inspiration from leadership contingents, and lack of rewards/incentives, as major barriers.

According to Fisher (1996) convenient access to hardware and software are the major barriers for the school teachers for not using new media instruction. Fisher further maintained that dependence on school teachers‘ self-initiative for acquisition of computer

skills, high levels of anxiety in using computers, lack of computer resources, focus on ‗learning about the computer' instead of ‗learning through computers', were the predominant barriers.

Jenks and Springer (2002) investigated major barriers to computer use experienced by school teachers in Carroll County (Virginia) Public Schools. His study concluded that availability of computers, quality of available software, training, lack of sufficient time for planning and preparation, were the major barriers listed in order of frequency of responses.

Mitra (1998) studied the factors for constraints on school teachers' use of ICT in England. Some notable obstacles reported by the school teachers included: school teacher's lack of confidence, lack of supportive organisational culture within the school, limited access to resources and lack of adequate technical support. Investigators confected that ‗innovation and adaptation are costly in terms of time and energy'. They reasoned that lack of time was the most significant constraint as reported by 86% of school teachers.

In a study by conductedby Ryan(2003, 38 obstacles for implementing computers in the classroom were identified. These obstacles were both material and non-material conditions. The top five obstacles in his list were insufficient number of computers, school teachers' lack of knowledge/skills, difficulty in integrating with instruction, scheduling computer time, and insufficient peripherals. Ryan study revealed that the failure to equip schools with sufficient number of computers and to update school teachers with new knowledge and skills in computer use were the major reasons for the unsuccessful implementation of computers in schools.

In a report on the barriers that existed in schools that prevented school teachers from making full use of ICT in teaching, Jones (2004) summarised some of the key findings: a very significant determinant of school teachers' levels of engagement in ICT was their level of confidence in using the technology; levels of access to ICT and training styles were also significant in determining levels of use of ICT by school teachers; school

teachers were sometimes unable to make full use of technology because they lacked the time needed to fully prepare and research materials for lessons; technical faults with ICT equipment were likely to lead to lower levels of ICT use by school teachers; resistance to change was a factor which prevented the full integration of ICT in the classroom; school teachers who did not realise the advantages of using technology in their teaching were less likely to make use of ICT; there were close relationships between many of the identified barriers to ICT use; any factors influencing one barrier were also likely to influence several other barriers.

Aduwa-Ogiegbaen and Iyamu (2005) reported the effort of ICT usage and obstacles to use ICT in secondary schools in Nigeria. They claimed the obstacles for ICT use in secondary schools as cost, weak infrastructure, lack of skills, lack of relevant software, and limited access to the Internet. The findings of another study by Mohd-Yunus (2007) regarding the main challenges to ICT integration perceived by the school teachers who taught in Malaysian technical schools revealed that ICT integration in teaching and learning was dependent upon adequate access, adequate computer resources, school teacher development opportunities, and onsite support.

Weber (1996) surveyed three major themes related to IT barriers: inadequate instruction, inadequate computer systems and frustration. Examples of barriers that Weber identified include lack of administrative support, financial constraints, policy confusion, logistic limitations, conflicting purchasing decisions, support service deficiencies, and untrained personnel. In addition, he categorised groups of barriers to the use of technology that many researchers have also identified. These are: anxiety; stress; feelings of stupidity, fear of the unfamiliar, and fear of dehumanising effects; the extreme of computer addiction (microcomputer mania); and the extreme of computer phobia (cyberphobia), potentially involving active resistance, and sabotage.

Beggs (2000) posited that one critical barrier pertains to science teachers' poor preparation and lack of confidence related to IT. While there is some evidence of a history of using technology in science classrooms, not all science teachers are ready to use IT in teaching science. Some instructors, even those well educated and highly competent in the field of science, have been documented as fearing technology, most particularly fearing looking stupid in front of their students by failing in their use of IT. Fear of failure is a very legitimate problem. Beggs (1999), also pointed out that many teachers may ask themselves a hard-to-answer question: ―What will I do if the technology fails and I can't complete the lesson as planned?" This may interfere with the adoption of technology in the classroom. Logically, to the extent that teacher training and technical support can answer teachers' questions of what happens when technology does not work, this barrier is reduced.

The U.S. Congressional report as cited in Corbin (2003) reported that the Office of Technology Assessment (OTA) suggested that the lack of experience using technology in the student teaching experience was a major concern. Therefore, it is fair to say that the modest level of IT skills in teachers has been a barrier in its implementation in both education in general, and in science education, in particular. Corbin (2003) found that there were not enough courses on IT in the colleges, particularly related to computer navigation and internet skills. No programmes existed in the colleges of education that allowed students to learn how to integrate IT in the curricula. Neither there were any in-service training programmes in existence that permitted students and educators to develop their knowledge of IT processes.

According to the National Council for Accreditation of Teacher Education (NCATE, 1997), lack of training, knowledge or familiarity leads to teachers' inability to independently integrate subject matter software with necessary computer hardware. A sizeable amount of literature exists that identifies overlapping barriers, lack of teacher knowledge and inability to integrate hardware/software reliably. From this literature, a

picture can be drawn of the perennial ―vicious circle" that illustrates barrier relationships. Teachers' ―fear of failure" is reinforced by failure to use IT successfully. The more a teacher internalizes previous failures, the less likely it is that he/she will be able to solve new compatibility issues. The more demands there are on teachers to make IT work in the classroom, the more fear of failure. These issues have implications for supporting science teachers in the IT implementation.

Corbin (2003) identified five barriers and grouped them into three areas: lack of experience in pre-service training, lack of access to computers at school, and lack of on-site technical support. He also stated that the most important barrier most teachers must deal with is lack of access to computers, either in a laboratory setting or in the classroom. After gathering information through online questionnaires of 170 teachers, Snowman (1995) discussed barriers to IT adoption. Arranged from the most to least frequent, these barriers included: lack of confidence, lack of access to quality resources, lack of time, lack of effective training, technical problems, lack of personal access, and age.

Brush (2003), studied what teachers themselves think are the barriers to IT-related instruction. Nine barriers included in his survey were: lack of hardware, lack of software, lack of network access, lack of time to develop courses, lack of support by department or school, lack of salary support during the development period, lack of students' preparation to handle technology, lack of facilities for student laboratories, and lack of central resources.

2.6 Learning theories

Learning as a process focuses on what happens when learning takes place. The explanation of what happens is called learning theories. Hill (1971) reported two chief values of learning theories: to provide a vocabulary and conceptual framework for interpreting examples of learning that is observed and to suggest where to look for

solutions to practical problems. Learning theories are chiefly descriptive. There is little consensus on how many learning theories there are or how they should be grouped. Merriam and Caffarella (1999) identified behaviourism, cognitivism, social learning, humanist and constructivism theories as key theories of adult learning. This study will use these five theories of adult learning as a conceptual framework.

2.6.1 Behavioural learning theory

Behavioural learning theory was developed by Watson in the early decades of the twentieth century and loosely encompasses the work of Shlechter and Crowder. Watson theory of operant conditioning had a tremendous influence on the development of the early CBI systems (Shlechter, 1991). The basic learning principles of Skinner‘s theory are personalised instruction, controlled operant, immediate feedback, linear sequence of learning, and instructional prompts. Another approach to instruction, devised by Crowder (1962) and involving the use of a branching sequence in CBI for training Navy personnel was the basis for adaptive sequencing.

There are three basic assumptions about the behavioural learning process: behaviour rather than internal thought processes is the focus, environment shapes behaviour, and the principle of contiguity and reinforcement are central to explain the learning process (Grippin& Peters, 1983). Several educational practices can be traced to the behavioural type of learning. The systematic design of instruction, behavioural objectives, notions of the instructor‘s accountability, programmed instruction, computer-based instruction and competency-based education are all solidly grounded in behavioural learning theory. Adult technical and skills training also draws from behaviourism.

Training researchers continue to endorse, explicitly or implicitly, a methodological behaviourism that stresses the importance of objective, observable performance as the primary indicator of training output (Bosco& Morrison, 2000). The concept of behavioural

objectives continues to serve as a method for defining the content of instruction. Wells and Hagman (1989) have demonstrated that objectives have a positive effect on learning at the individual level. In the 1960‘s and 1970‘s, as behaviouristic learning theory was peaking in its influence on training research and practice, learning theorists were becoming less satisfied with behavioural conceptions of learning and memory and increasingly interested in the study of internal knowledge structures and cognitive processes that underlie task performance. The positive effects of behavioural objectives and the learning process are now discussed in cognitive rather than behavioural terms (Bosco& Morrison, 2000).

2.6.2 Cognitive learning theory

A break from behaviourism occurred with the importation of the notion of insight learning in the gestalt theories of Wertheimer, Kiffka, and Kohler (Moore & Fitz, 1993). These theorists took issue with the proposition that all learning consisted of the simple connection of responses to stimuli. They insisted that experience is always structured and that we react to a complex pattern of stimuli. The learner perceives stimuli in organised wholes, not in disconnected parts. The learner organises his/her perceptual field according to four laws: the law of proximity, the law of similarity and familiarity, the law of closure, and the law of continuation. Gestalt psychology is classified within the family of field theories where the total pattern or field, stimuli, or events determine learning.

Perception, insight and meaning are key contributions to cognitivism from Gestalt learning theorists. A major difference between Gestaltists and behaviourists is the locus of control over the learning activity. For Gestaltists it lies with the individual learner and for behaviourists it lies with the environment. The shift to the individual and the learner‘s mental processes is characteristic of cognitivist-oriented learning theories (Merriam &Caffarella, 1999). Most contemporary cognitive psychologists hold that learning consists of individual constructions of knowledge. Learning is a personal event that results from

sustained and meaningful engagement with one's environment. This view also holds that learning cannot be viewed apart from the social and cultural contexts in which it occurs (Prawat&Floden, 1994).

Lewin (1951) developed what he referred to as a field theory. According to his theory, each individual exists in a life space in which many forces are operating in the environment. Behaviour is the product of the interplay of those forces; the direction and relative strength of which can be portrayed by the geometry of vectors. Learning occurs as a result of a change in cognitive structures produced by changes in two types of forces: change in the structure of the cognitive field itself, or change in the internal needs or motivation of the individual. Lewin saw success as more potent motivating force than reward and gave attention to the concepts of ego-involvement and level of aspiration as forces affecting success. He felt that the urge for self-actualisation is the driving force motivating all human behaviour (Knowles, Holton, & Swanson, 1998).

Piaget and Bruner focused on the cognition and theory of instruction, which had an impact on learning theories. Piaget (1972) conceptualisedbehaviour of the human organism as starting with the organisation of sensory-motor reactions and becoming more intelligent as coordination between reactions to objects becomes progressively more interrelated and complex. A basic assumption of Piaget's theory is that a different type of assimilation and accommodation occurs at each stage of development. A person must wait until the final stage of development, the formal operational stage, to develop the cognitive structures necessary for dealing with abstract environmental relationships (Shlechter, 1991).

Thinking becomes possible after language develops and a new mental organisation is created. Piaget's theory of cognitive development influenced many CBI designers. Papert (1980), who helped design the LOGO system (a programming language for children), was greatly influenced by Piaget's theory. While basically agreeing with Piaget about the assimilation and accommodation process, Papert (1980) argues that cognitive development

can be expedited by providing the student more formal operational experiences. A student can acquire these needed experiences by programming a computer with the LOGO authoring language. Using and combining different commands to form a coherent computer graphic and debugging a programme are examples of formal operational experiences. The cognitive influence became more prevalent as computer technology became more sophisticated.

Bruner's (1986) interest was in the structuring and sequencing of knowledge and translating this into a theory of instruction. He did, however, have a basic theory about the act of learning which he viewed as involving three almost simultaneous processes: acquisition of new information, transformation or manipulating knowledge to make it fit new tasks, and evaluation to see if information is adequate to the task.

Gardner (1985) defines cognitive science as a contemporary, empirically based effort to answer long-standing epistemological questions, particularly those concerned with the nature of knowledge, its components, its sources, its development and its deployment. Three features cited by Gardner generally associated with cognitive science that apply to computer-based instruction are: cognitive science is explicitly multi-disciplinary, drawing especially upon the disciplines of psychology, linguistics, anthropology, philosophy, neuroscience, and artificial intelligence; a central issue for this discipline is cognitive representation, its form, structure, and embodiment at various levels; and the faith that the computer will prove central to the solution of problems of cognitive science, both in the conduct of research to investigate various cognitive representations and in providing viable models of the thought process itself.

Bednar et al. (1995) refer to knowledge as some entity existing independent of the mind of individuals and which is transferred ~~–in~~side." Consistent with this view of knowledge, the goal of instruction, from both the behavioural and cognitive information processing perspectives, is to communicate or transfer knowledge to learners in the most efficient and

effective manner possible. Knowledge can be completely characterised using the techniques of semantic analysis. One key to efficiency and effectiveness is simplification and regularisation: thought is atomistic in that it can be completely broken down into simple building blocks, which form the basis for instruction. Thus, the transfer of knowledge is most efficient if the excess baggage of irrelevant content and context can be eliminated. While behaviourist applications focus on the design of learning environments that optimise knowledge transfer, cognitive information processing stresses efficient processing strategies.

Bosco and Morrison (2000) reported that cognitive theory is now the dominant theoretical viewpoint in research on learning and memory resulting in two notable trends: the greater use of mental constructs to define task requirements, through the cognitive task analysis method, and the greater willingness to devise training interventions for mentally demanding tasks. Glaser (1990) reviewed cognitive research and reported that learning processes and instructional implications showed very few commonalties across the task domains. He was confident that an integrated theory would eventually be designed to prescribe a mix of instructional approaches for specific training purposes.

Contemporary approaches to computer-based learning are more often rooted in cognitive learning theories. They focus not on the product technology of the computer but on the idea technologies afforded by the computer (Kulik and Bangert-Drowns, 1983). Idea technologies tend to emphasise constructivist orientations to learning. The effects of technology on learning can best be understood when classified as ―effects of" versus ―with" the computer on cognition (Kulik and Bangert-Drowns, 1983).

Research on the effects of the computer on cognition attempts to determine if cognitive residue results as a consequence of the interaction between the individual and computer, such as an increase in general problem-solving ability or mathematical reasoning. Research with technology focuses on how human processing changes in distinct,

qualitative ways when an individual is engaged in an intellectual activity using the computer as a tool. Taken interactively, an intellectual partnership is formed between the individual and the technology; the resulting changes to cognition cannot be understood when the individual or the technology is considered apart. An emphasis on learning with media, as opposed to learning from media, may help to resolve some of the debate and controversy surrounding media research (Kozma, 1991b).

2.6.3 Social learning theory

Social learning theory which combines elements from both behaviourist and cognitivist orientations suggests that people learn from observing others. It was not until the 1960‘s that Bandura focused more on the cognitive processes involved in the observation of subsequent behaviour. Virtually all learning phenomena resulting from direct experiences can occur on a vicarious basis through observation of the people‘s behaviour and its consequences for the observer (Bandura, 1976).

Bandura‘s observational learning is characterised by the concept of self-regulation. The four processes of attention, retention or memory, behavioural rehearsal, and motivation influence observational learning. More recently, Bandura has focused on self efficacy as it influences learning (Merriam &Caffarella, 1999). Bandura‘s theory has particular relevance to adult learning in that it accounts for both the learner and the environment in which he or she operates. Behaviour is a function of the interaction of the person with the environment. This is a reciprocal concept in that people influence their environment, which in turn influences the way they behave (Merriam &Caffarella, 1999).

Rotter‘s (1954) theory assumes that much of human behaviour takes place in a meaningful environment and is acquired through social interactions with other people. Seven propositions and attendant corollaries that delineate relationships among the concepts of behaviour, personality, experience and environment frame his theory. Rotter‘s theory

assumes that much of human behaviour takes place in a meaningful environment and is acquired through social interaction with other people (Phares, 1980).

Key to understanding which behaviour in the individual‘s repertoire will occur in a given situation is the concepts of expectancy and reinforcement (Merriam &Caffarella, 1999). Expectancy is the likelihood that a particular reinforcement will occur as the result of specific behaviour. The motivation to engage in adult learning activities might be partly explained by Rotter‘s notion of locus of control. Another connection to adult learning for the social learning theory is the importance of context and the learner‘s interaction with the environment to explain behaviour.

2.6.4 Humanist learning theory

Humanist theories consider learning from the perspective of the human potential for growth. Humanists refuse to accept the notion that either the environment predetermines behaviour or one‘s subconscious. Rather, human beings can control their own destiny; people are inherently good and will strive for a better world; people are free to act, behaviour is the consequence of human choice; and people possess unlimited potential for growth and development (Rogers, 1983). From a learning theory perspective, humanism emphasizes that perceptions are centered in experience, as well as the freedom and responsibility to become what one is capable of becoming. These principles underlie much of adult learning theory that stresses the self-directedness of adults and the value of experience in the learning process.

Rogers‘ (1983) client-centered therapy is often equated with student-centered learning. He believed that learning should include personal involvement; involve both affective and cognitive aspects of a person; be self-initiated - a sense of discovery must come from within; be pervasive - the learning makes a difference in the behaviour, attitudes, perhaps even the personality of the learner; be evaluated by the learner - the learner can best

determine whether the experience is meeting a need; and focus on experiential learning - when experiential learning takes place, its meaning to the learner becomes incorporated into the total experience.

2.6. 4 Constructivism learning theory

The historical roots of constructivism are most heavily grounded in developmental psychology and social learning theories. A constructivist maintains that learning is a process of constructing meaning. Meaning is made by the individual and is dependent on the individual‘s previous and current knowledge structure. Learning also involves providing experiences that induce cognitive conflict, and hence, encourages learners to develop new knowledge schemes that are better adapted to experience. To a constructivist, learning must be situated in a rich context, reflective of real world contexts, for this constructive process to occur and transfer to environments beyond the training classroom. How effective or instrumental the learner‘s knowledge structure is in facilitating thinking in the content field is the measure of learning (Bednar et al., 1995).

The learner must construct an understanding or viewpoint; the content cannot be pre-specified. While a core knowledge domain may be specified, the student is encouraged to search for other relevant knowledge domains that may be relevant to the issue. It is clear that knowledge domains are not readily separated in the world; information from many sources bears on the analysis of any issue. A central or core body of information must be defined; however, the boundaries of what may be relevant cannot be defined (Bednar et al., 1995).

The constructivist view does not accept the assumption that types of learning can be identified independent of the content and the context of learning. It is not possible to isolate units of information or make a prior assumption of how the information will be used. Instead of dividing up the knowledge domain based on a logical analysis of

dependencies, the constructivist view turns toward a consideration of what real people in a particular knowledge domain and real life context typically do. The overarching goal of such an approach is to move the learner into thinking in the knowledge domain as an expert user of that domain might think. The goal should be to portray tasks and not to define the structure of learning required for achieving a task. It is the process of constructing a perspective or understanding that is essential to learning; no meaningful construction is possible if all relevant information is pre-specified (Resnick, 1987).

CHAPTER THREE

METHODOLOGY

3.1. Overview

This chapter discusses the research design, population, the sample and sampling procedures, research instrument, validly and reliability of the instrument, data collection and data analysis procedure.

3.2 Research design

According to Aczel (1996) the aim of experimental research is to investigate the possible cause – and effect relationship by manipulating one independent variable to influence the other variable in the experimental group, and by controlling the other relevant variables and measuring the effects of the manipulation by some statistical method. By manipulating the independent variable, the researchers can see if the treatments make a difference on the subjects.

The experimental design(pretest – posttest control group design) was used so that the researcher can control subject characteristics threat to internal validity, observe possible changes on dependent variable and therefore was able to measure the degree of changes that has occurred. The design of the research was based on the effect of using CBI method in Physics teaching as independent Variable against students‘ outcome performance in class test as the dependent variable. The outcome provided the bases for comparison of the degree to which students‘ have mastered the skills that has been taught in class.

3.3 Population

The research population comprised all science students and teachers of AgonaNyakromSenior High School. The target population in the area of research was 208.

3.5 Sample

The subjects for the study were sixty (60) randomly selected pure science students of AgonaNyakrom Senior High Technical School; out of which ten (10) are girls and the rest are boys. They have different socio-economic backgrounds and their ages ranges from sixteen (16) to twenty-three (23).

3.4 Sampling procedure

Purposive and simple random techniques were used in the sample process. In purposive sampling, the researcher sample with the purpose and objectives of the study in mind. With this technique, researchers normally have one or more specific predefined groups they are seeking. This therefore called for sampling specific groups or types of people who are experts or knowledgeable in a given area. The purposive sampling technique was used to sample the teachers for their educational background and experience in the subject matter. The simple random sampling technique was used to select the students. This technique was used by the researcher to ensure equal representation of them to bring balance to the data collected from these respondents. The researcher used the nottery method. The researcher wrote 1 on six pieces of papers and 2 on twenty-three pieces of papers representing the total number of students in the school. These papers were folded and put in a bowl and at an assembly meeting, all the students were asked to pick one paper each. Those who picked 1 were selected as part of the sample. Again, the researcher wrote 1 on twenty pieces of papers and 2 on another twenty pieces of papers. The sample size of 60 was used for the study. The selected students were divided in to two groups namely group 1 (Experimental group) and group 2(Control group) so that changes in the experimental group could easily be compared to those in the control group.

3.5 Research instrument

The research instruments used in this study were multiple choice tests used both in the pre-test and posttest, and an attitude questionnaire.

The multiple choice was developed by carefully selecting standard questions from WASSCE papers. It contained items, which tested knowledge of simple concepts, applications and reasoning skills. The sixty (60) minutes test consisted of thirty (20) multiple choice questions on knowledge and understanding.

The attitude questionnaire consisted of thirteen (10) items, which dealt with student's perception of the effect of the computer on their learning.

3.6 Content validity

The quality of a research instrument or a scientific measurement is determined by both its validity and reliability (Cresswell, 2005). The procedure by which the content of the test is judged to be representative of some appropriate domain of content is the validity of the content. The design instruments were developed in consultation with my supervisor and other expert who also provided excellent advice for correction and amendment. The items were subjected to critical examination to ensure that they valid and relevant to the study.

3.7 Reliability of instrument

Reliability refers to the consistency of data when multiple instruments are gathered (Aczel, 1996). A pilot test of the study will be conducted of 10 students from selected classes in the school. The scored obtained will be used to determined the reliability

3.8 Data collection procedure

The treatment lasted for two (2) weeks. During the same period, the control group received only conventional learning activities such as lectures, discussions etc. In addition to these, the experimental group used the CBI. Both groups were pretested and post tested using the same test on both occasions. The attitude questionnaires were administered to the students in the experimental group at the end of the treatment.

3.9 Scoring of instrument

The scheme designed for the students' questionnaire was in five (5) point scale to indicate the level of agreement or disagreement to the question.

Strongly Disagree = 1

Disagree = 2

Not certain = 3

Agree = 4

Strongly = 5

3.10 Data Analysis

The data obtained from the questionnaire were quantitative, that is, it was in numerical form. The data was checked for consistency and organized in tables according to research questions. SPSS version 19 and Minitab 16 were used to analyse quantitative data which were presented using simple percentages.

CHAPTER FOUR

PRESENTATION OF RESULT, ANALYSIS AND DISCUSSIONS

4.1 Overview

This chapter consists of presentation of the results, analysis and discussions of the data collected from the field. The chapter presents the background information which comprises of the age and sex distribution of both the students and head teachers among others. The second section of this chapter deals with the main data collected on the variables that constitute the core of this study.

Out of the two sixty-four (64) questionnaires which were administered, 60 were returned representing 93.75%. Additional data which were not captured on the questionnaire were obtained through the use of an interview.

The results from the findings were used to achieve the research objectives of the study. Data collected were analyzed using descriptive statistics.

4.2 Demographic Data

The demographic variables of respondents included the following: sex and age. Demographic variables were presented in Table 1.

Table 4.1. Profile of respondents (Students)

Variable	Percentages (%)
Gender	
Male	70%
Female	30%
Age	
10-15years	-
16-20 years	83.33%
21 and above years	16.66%

The result of Table 1 showed that, 70% of the SHS pupils were males, whiles 30% females. Respondents were selected randomly; therefore the result does not ensure gender balance. It can be deduced from the table that there were more males teachers from the selected schools as compare to females.

The Table again shows, majority of the pupils (70%) were between the ages of 16-20 years, whiles the rest were in the age range of 21 years and above representing 16.66%. This indicates that majority of the students within the prescribed age for senior high students. It implies that majority of the students in the Agona West Municipality enrolled in school at the prescribed age.

Research Question 1:

What are the current computer-based instructional materials in the school?

Instructional methods and materials

In an interview with a physics teacher said that the CBI material used included Electronic workshop version 5.12.

He further added, ―With this program, students could actually see on a screen what happened if a small resistance was used in a circuit where a high resistance was actually required or if a diode was connected in a wrong direction or if a low voltage lamp was connected to a high voltage. In addition, students are also able to see the variouslogic gates on their screens, their various combination to produce the required output (low or high). They could also repeat their experiments over and over without actually damaging anything."

In separate interview another teacher stated ―simulations are powerful tools for helping student understand dynamic systems (McGee et al; 2001). The potential of simulation technique in triggering both logical and creative thinking and enhancing investigative skills among learners cannot be over emphasized. It can expose students to situations that are either unsafe orinaccessible in real life or beyond what is achievablein a school laboratory or expensive to repeat over and over again."

Research Question 2:

How do the various computer-based instructional materials help in improving students' academic performance?

Performance of students in both groups

The first hypothesis stated that there was no significant difference in achievement between students taught with CBL and those taught by the conventional approach. The Mann-Whitney U test was used and the results are presented in Table 2. The Mann-Whitney was used because some assumptions of the t-test like random independent sample and normality of distributions were violated.

The Mann-Whitney test showed that the pre -test scores of the control group and experimental group were not statistically significant (p=0.6134). This indicate there no difference between the two groups before the study was conducted.

However, the posttest results showed statistically significant between the two groups. The Man- Whitney test was significant at (p=0.0000). The performance of the CBI group (experimental) was higher compared to the conventional approach (control) on the post - test as indicated by the Mann-Whitney test which gave mean of 12.133 to the experimental group, while the control group had a mean of 5.333.

Table 4.2: Results of the Mann-Whitney analysis on students' pre and post tests scores of control and experimental groups

	The study group	N	Median	Mean	P- Value
Pre-test scores of the groups	Control	30	3.000	2.933	0.6134
	Experimental	30	3.000	3.233	
Post-test scores of the groups	Control	30	6.000	5.333	0.0000
	Experimental	30	12.500	12.133	

Significant * P<0.05

This therefore indicates that null hypothesis can be rejected; implying that there is a statistically significant difference in achievement on the posttest between the students in the CBI class and those taught by the conventional approach.

The means and the mean ranks show that students taught by the CBI approach performed better than those taught through traditional approach. This finding indicates that the students who received CBI performed better than those used the traditional approach; an outcome similar to Hinson (2005) study comparing the academic achievement of students in grade six through twelve who received traditional education only was compared to

students of the same age that received traditional teaching methods supplemented with computer-based instruction. Students who received the computer-based instruction attained a higher academic achievement than 58.2% of the students only receiving traditional instruction. Hinson (2005) also compared achievement of students across a twelve-year period. One group of secondary students received instruction utilising computers while the other group did not. On average the secondary students that received computer-based instruction made greater gains in academic achievement than 57% of the students who only receivingtraditional instruction. Another study on the effects of computer-assisted instruction on students was published by Schofield and Davidson (2003). Schofield and Davidson‘s (2003) subjects were 98 college undergraduate students in two sections of a computer literacy class. The students were randomly assigned to one of two treatment groups to study linear function. One group received substantially more computer instruction. The other group was taught in the traditional lecture method. Schofield and Davidson (2003) gave each group a pre-test and a post-test. The group that received the computer instruction scored significantly higher on the post-test. No significant difference was found on the pre-test. The students in the group receiving computer instruction scored significantly higher on post-tests than the group that did not receive the computer instruction. The authors draw the conclusion that a relationship exists between the use of computer-based instruction and a higher level of academic achievement. Their findings support the outcome this study.

The outcome of the study is consistent with the argument that when CBI is used Opportunity of learner is control, improved enthusiasm, associations to the real world, and enhance student achievement as measured in variety of ways, including, but not exclusively limited to, ―standardized achievement tests”. Day (2006) He further stated that CBI benefits most students when compared with traditional instruction because it

increases student interest, reduces anxiety, provides more time on task, and provides instant feedback for the student.

This seems to be the case looking at the responses of the students of the CBI group during the interview. Most of those students indicated that The use of computer for learning was an exciting experience, improve level of motivation in this course has increased with the use of CBI materials and with regards to understanding the contents of each topic, the CBI methods of presenting material is better than the traditional classroom presentation.

Research Question 3:

What is the level of satisfaction of the students with the use of computer-based instruction in the teaching and learning process?

To describe the effect of CBI on students' academic achievement in physics, students were asked to indicate their perceptions about their level of satisfaction with the use of computer-based instruction in the teaching and learning process, ranging from strongly disagreed to strongly agreed on a Likert Scale of 1-5 respectively. Detailed explanations to the causes of the poor performance regarding the Likert Scale as shown in Table 2 are given below.

SD-Strongly Disagree D-Disagree NC-Not Certain A-Agree SA-Strongly Agree

Table 4.3: Level of satisfaction of the students with the use of computer-based instruction in the teaching and learning process (students' views)

ITEMS	SD	D	NC	A	SA
The use of computer for learning was an exciting experience	1 3.33%	4 13.33%	2 6.66%	10 33.33%	13 43.33%
In understanding the contents of each topic, the CBI methods of presenting material is better than the traditional classroom presentation	3 10%	2 6.66%	5 16.66%	13 43.33%	7 23.33%
The CBI approach provides greater collaboration among students	1 3.33%	5 16.66%	4 13.33%	10 33.33%	10 33.33%
My level of motivation in this course has increased with the use of CBI materials	3 10%	1 3.33%	2 6.66%	9 30%	15 50%
The information in all the chapters in the programme was clear and unambiguous	3 10%	4 13.33%	4 13.33%	11 36.66%	8 26.66%
The amount and quality of the materials in the programme were just about right compared with what would normally be covered in the traditional classroom.	2 6.66%	2 6.66%	1 3.33%	14 46.66%	11 36.66%
The use of CBI materials has increased my degree of interest in physics	1 3.33%	2 6.66%	1 3.33%	12 40%	14 46.66%
The use of computers in learning physics made me more creative	3 10%	4 13.33%	1 3.33%	10 33.33%	12 40%
I learned more materials through the use of CBI method than I would have using traditional method	3 3.33%	2 6.66%	1 3.33%	13 43.33%	11 36.66%
I would recommend the use of the CBI method in teaching and learning other subjects as well	2 6.66%	1 3.33%	0 %	15% 50%	12 40%
I would like the traditional method of teaching be replaced completely with the CBI method rather than only supplementing it.	3 %	2 6.66%	0 %	12% 40%	13% 43.33%

Source; field data, 2013.

From Table 2, the first level of satisfaction of the students with the use of computer-based instruction in the teaching and learning process as shown in Table 2 , 3.33% of the students indicated they strongly disagree that the use of computer for learning was an exciting experience, 13.33% said disagreed, 6.66% ticked uncertain, while 33.33% and

43.33% said agreed and strongly agreed respectively. Majority of the respondents indicated their satisfaction with the use of computer-based instruction in the teaching and learning process.

Regarding, ―In understanding the contents of each topic, the CBI methods of presenting material is better than the traditional classroom presentation" as shown in Table 2, 10% of the students said they strongly disagreed , 6.66% ticked disagreed, 16.66% indicated uncertain, while 43.33% and 23.33% indicated agreed and strongly agreed respectively. The greater number of respondents agreed that the Computer-based methods of presenting materials is better than traditional method of presentation.

On the issue of ―CBI approach provides greater coloration among students", 3.33% of the students said they strongly disagreed, another 16.66% ticked disagree, 13.33% indicated uncertain, while 33.33% each indicated agreed and strongly disagreed respectively. A very significant number of the respondents maintained that computer-based approach provides greater collaboration among students.

Regarding, ―my level of motivation in this course has increased with the use of CBI materials" as shown in Table 3, strongly disagreed represented 10%, 3.33% ticked disagreed, 6.66% said uncertain, while 30% and 50% said agreed and strongly disagreed respectively. There is a general believe that computer technology allows educators more options for communicating, facilitating the lesson and enhancing the teaching and learning. A research by Schacter and Fagnano (1999) concluded computer technology makes learning easier, more efficient and more motivating. A similar study by Traynor (2003) suggest that computer- based instruction affects cognitive process and increase motivation by the following ways: personalizing information, animating objects on the screen, providing practice activities that incorporate challenges and curiosity, providing a fantasy context and providing a learner with choice over his/ her learning. Their positions support the findings of this study. A study conducted by Wernet, Olliges and Delicath (2000)

on the effects of computer-based instruction whose findings is inconsonance with this present study found that theindividualised nature of the instruction as a major reason for the increase of motivation. Two other studies also found a significant increase in motivation but found the chief cause as the opportunities for learner-directed instruction. The opportunities for rapid feedback were found to be a reason for improved motivation by two other studies.

Again, from Table 3, disagreed and uncertain each represented 13.33%, 10 said strongly disagree, while 36.66% and 26.66% said agreed and strongly disagreed respectively. The result from the table revealed that the information in all the chapters in the programme was clear and easy to understand. This is line with a research by Schacter and Fagnano (1999) who revealed that computer technology makes learning easier, more efficient and more motivating.

Furthermore, from Table 3, 6.66 each % of the students indicated they strongly disagree and disagree, 3.33% said uncertain, while 46.66% ticked and 36.66% said agreed and strongly agreed respectively. The findings shows that an appreciable number of the respondents were of the opinion that the amount and quality of the materials in the programme were just about right compared with what would normally be covered in the traditional classroom.

Again, regarding ―the use of CBI materials has increased my degree of interest in physics ” as shown in Table 3, 3.33% of the students indicated they strongly disagree that use of computer-based materials has increased their degree of interest in physics, 6.66% said disagreed, 3.33% ticked uncertain, while 40% and another 46.66% said agreed and strongly agreed respectively. Day (2006) reports that computer suggest opportunities for learner control, improved enthusiasm, associations to the real world, and enhance student achievement as measured in variety of ways, including, but not exclusively limited to, ―standardized achievement tests". He further stated that CBI benefits most students when compared with traditional instruction because it increases student interest, reduces anxiety,

provides more time on task, and provides instant feedback for the student. A position which support the a revelation by this current study.

From Table 3, 40% of the students indicated they strongly agree that the use of computers in learning physics made me more creative, 33.33% said agreed, another 33.33% ticked uncertain, while 10% and 13.33% said strongly disagreed and disagreed respectively.

From the table, a significant number of the students pointed out thatthey learned more materials through the use of CBI method than I would have using traditional method. This could mean that because the method was new and they also had the opportunity of learning using materials.

Table 2, also revealed that majority of the students recommended the use of the CBI method in teaching and learning other subjects as well. Fifty percent (50%) said strongly agree, 40% indicated agree, while 6.66%and 3.33% ticked strongly disagree and disagree respectively. Also, from table 3, 10% said strongly disagree, 6.66% indicated disagree. Forty percent (40%) and 43.33% of the respondents expressed an opinion that traditional method of teaching be replaced completely with the CBI method rather than only supplementary.A recent study by Traynor (2003) found that utilising computer-based instruction improved instruction over only using traditional methods. The study compared the effects on many types of learners including special education, non-English proficient, and regular education. The students showed significant pretest-posttest gains. Another recent meta-analytic study on the effects of computer-based instruction by Christman and Badgett (2003) found that students who received instruction supplemented by CBI attained higher academic achievement than did 63.31% of those receiving only traditional instruction. The positions of Traynor, Christman and Badgett are line with the findings of this study.

Research Question 4:

What factors serve as barriers to the use of computer-based instruction in the school?

Difficulties associated with CBI

The fourth research question was about the difficulties associated with the CBI as far as the students are concern major difficulty: the absence of the teacher and the lack of opportunity to ask questions. Students indicated that even though they understood the lesson, they would have preferred the more time allocated to the teaching of CBIas the following comments suggest:

Student A, ―Though I understood I would have preferred moretime. It was okay but I wish the teacher was around to give more explanation."

Student C, ―I wish that a teacher had enough time to explain everything detail to us". This seems to portray that although the students understood the lesson, their problem was limited time allocated to the delivery of the subject by teacher. Ely (1993) identified dissatisfaction with the status quo, insufficient knowledge and skill, lack of resources, available time, and commitment from supervisors, lack of inspiration from leadership contingents, and lack of rewards/incentives, as major barriers. Becta (2003) discussed barriers to IT adoption. Arranged from the most to least frequent, these barriers included: lack of confidence, lack of access to quality resources, lack of time, lack of effective training, technical problems, lack of personal access, and age. Bectaand Ely's positions support the findings of this study. On the other hand, the findings of this study is in contrast with a study by Johnson (2000) in Lafayette Parish in Lafayette found that effective use of computer-based instruction can be utilised with a minimum of time. The school system has a programme that allows for pullout of low-achieving students. The programme allows students to utilise a computer-based software programme for ten minutes per day. In the initial stages of the programme, the system allowed one group to

use the software while another group did not. After a period of two months the school system found that the students using the programme had increased in mathematics achievement by a statistically significant level as measured by a locally developed test. Aside the inadequate time, students indicated that one set back to CBI is non-availability of computers which compel the teachers divide students into groups to accommodate the study room:

Student E…–Yes, there exist inadequate resources especially computers and other materials". Student F, –very often it get to a point that two students to one computer, which impact on the absorption level".A study by Hadley and Sheingold (1993) whose findings are in line the current revealed lack of time, scheduling computer time, too few computers, not enough time in school schedule for computer-based instruction, and inadequate financial support for computers as some of the significant obstacles towards use of computers. In a similar study, Ely (1993) identified dissatisfaction with the status quo, insufficient knowledge and skill, lack of resources, available time, commitment from supervisors, lack of inspiration from leadership contingents, and lack of rewards/incentives, as major barriers. Blankenship (1998) also found out in a similar revelations in an investigated into major barriers to computer use experienced by school teachers in Carroll County (Virginia) Public Schools. His study concluded that availability of computers, quality of available software, training, lack of sufficient time for planning and preparation, were the major barriers listed in order of frequency of responses. Another survey conducted by Pelgrum (2001), of nationally representative samples of schools from 26 countries including India, 38 obstacles for implementing computers in the classroom were identified. These obstacles were both material and non-material conditions. The top five obstacles in his list were insufficient number of computers, school teachers' lack of knowledge/skills, difficulty in integrating with instruction, scheduling computer time, and insufficient peripherals. Pelgrum's study revealed that the failure to equip schools with

sufficient number of computers and to update school teachers with new knowledge and skills in computer use were the major reasons for the unsuccessful implementation of computers in schools. His position supports the findings of this study.

Teachers views on difficulties associated CBL were consistent with literature. A physics teacher who participated in the this maintained that teacher attitudes towards computers, Lack of computer skills, lack of quality software and poor training opportunities were some of the critical factors militating against smooth delivery of CBI lesson. Kurina (2000) studied the factors for constraints on school teachers' use of ICT in England. Some notable obstacles reported by the school teachers included: school teacher's lack of confidence, lack of supportive organisational culture within the school, limited access to resources and lack of adequate technical support. Investigators confected that _innovation and adaptation are costly in terms of time and energy'. They reasoned that lack of time was the most significant constraint as reported by 86% of school teachers. A similar report on the barriers that existed in schools that prevented school teachers from making full use of ICT in teaching, Jones (2004) summarised some of the key findings: a very significant determinant of school teachers' levels of engagement in ICT was their level of confidence in using the technology; levels of access to ICT and training styles were also significant in determining levels of use of ICT by school teachers; school teachers were sometimes unable to make full use of technology because they lacked the time needed to fully prepare and research materials for lessons; technical faults with ICT equipment were likely to lead to lower levels of ICT use by school teachers; resistance to change was a factor which prevented the full integration of ICT in the classroom; school teachers who did not realise the advantages of using technology in their teaching were less likely to make use of ICT; there were close relationships between many of the identified barriers to ICT use; any factors influencing one barrier were also likely to influence several other barriers. Beggs(2000) also posited that one critical barrier pertains to science teachers' poor

preparation and lack of confidence related to IT. While there is some evidence of a history of using technology in science classrooms, not all science teachers are ready to use IT in teaching science. Some instructors, even those well educated and highly competent in the field of science, have been documented as fearing technology, most particularly fearing looking stupid in front of their students by failing in their use of IT. Fear of failure is a very legitimate problem. Ertmer (1999) pointed out that many teachers may ask themselves a hard-to-answer question: "What will I do if the technology fails and I can't complete the lesson as planned?" This may interfere with the adoption of technology in the classroom. Logically, to the extent that teacher training and technical support can answer teachers‘ questions of what happens when technology does not work, this barrier is reduced. Their positions support the views expressed by the teachers in this study.

A teachers said in an interview, ―Teacher attitudes towards computers, Lack of computer skills, lack of quality software and inadequate infrastructure negatively affect CBI Lessons and which could be detrimental to students‘ academic achievement.” Aduwa-Ogiegbaen and Iyamu (2005) reported the effort of ICT usage and obstacles to use ICT in secondary schools in Nigeria. They claimed the obstacles for ICT use in secondary schools as cost, weak infrastructure, lack of skills, lack of relevant software, and limited access to the Internet. The findings of another study by Mohd-Yunus (2007) regarding the main challenges to ICT integration perceived by the school teachers who taught in Malaysian technical schools revealed that ICT integration in teaching and learning was dependent upon adequate access, adequate computer resources, school teacher development opportunities, and onsite support. Findings according to the National Council for Accreditation of Teacher Education (NCATE, 1997), on CBI revealed lack of training, knowledge or familiarity leads to teachers‘ inability to independently integrate subject matter software with necessary computer hardware. A sizeable amount of literature exists that identifies overlapping barriers, lack of teacher knowledge and inability to integrate

hardware/software reliably. From this literature, a picture can be drawn of the perennial ―vicious circle" that illustrates barrier relationships. Teachers' ―fear of failure" is reinforced by failure to use IT successfully. The more a teacher internalises previous failures, the less likely it is that he/she will be able to solve new compatibility issues. The more demands there are on teachers to make IT work in the classroom, the more fear of failure. These issues have implications for supporting science teachers in the IT implementation. Their findings are line with the results of this study.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Overview

This chapter summarizes the study and its main findings, makes conclusions from the study and outlines appropriate recommendations.

5.2 Summary of study

Methodologically, the study was a cross-sectional case survey that involved the use of multiple choice tests used both in the pre-test and post-test, and an attitude questionnaire to collect primary from selected pure science students of AgonaNyakrom Senior High Technical School.

Out of the two sixty-four (64) questionnaires which were administered, 60 were returned representing 93.75%. The remaining were rejected due to excessive loss of data.

Data was analyzed using the SPSS 16.0, Excel and Minitab 16.

5.3 Summary of findings

The main findings were summarized below:

1. The result of the main hypothesis postulated for the study revealed that Computer-Based Instruction improves the performance of the students as against the traditional approach.
2. The Man- Whitney test showed there was significant difference between the Computer-Based Instruction and the traditional method.
3. The study revealed that an appreciable number of the respondents were of the opinion that the amount and quality of the materials in the programme were just

about right compared with what would normally be covered in the traditional classroom.

4. The study showed that the use of CBI materials has increased degree of interest in physics, improved enthusiasm, reduces anxiety, provides more time on task, and provides instant feedback for the student.

5. Findings also indicated that majority of the students expressed an opinion that traditional method of teaching be replaced completely with the CBI method rather than only supplementary. They therefore maintained recommended that the use of the CBI method in teaching and learning other subjects as well.

6. It was evident from the study that major obstacles affecting the use of Computer-Based Instruction were inadequate computers, lack of access to quality resources, lack of time, lack of effective training, technical problems and quality of available software, training.

5.4 Conclusions

Based on the findings the following conclusions are made:

Computer-Based Instruction provides opportunities for learner control, improved enthusiasm, associations to the real world, and enhance student achievement as measured in variety of ways.

CBI provides a self-directed learning to students, and allows learners to become empowered to take increasingly more responsibility to choose, control, and evaluate their own learning activities which can be pursued at any time, in any place, through any means, at any age. Simply put, learners can decide what they want to learn and in what order.

It was concluded that dependence on school teachers' self-initiative for acquisition of computer skills, high levels of anxiety in using computers, lack of computer resources, focus on _learning about the computer' instead of _learning through computers', were the predominant barriers

Recommendations

The following recommendations are offered based on the findings of this study:

1. The Ministry of Education, Youth and Sports and the Ghana Education control schools that seek to replace the teacher with the computer since students have indicated the presence like the presence of the teacher in the classroom.

2. Based on the population of the schools, the schools should find ways of increasing the number of laboratories as well as the number of computers in the laboratories since one student to a laptop computer policy has not been effected. This would enable the teachers and students to increase the number of days and hours spent on the teaching of CBI and access to ICT facilities.

3. School authorities should consult internet providers for connectivity at subsidised rates to enable teachers and students to access information from the various search engines as this will broaden the scope of the sources of information in the learning and teaching process using CBI.

4. Barriers that have and are still hindering the integration of ICT in the curriculum should be tackled by policy implementers. In this regard, as teachers are unwilling to change from the traditional methods of teaching to using information and communication technologies, they should be encouraged policy makers and sensitized from time to time to understand the good side of technology.

5. Follow-up support should be provided by the Ghana Education Service in the schools. This must include in-service education and training on the use of CBI for the teachers in the school and discussion of the implications of the use of CBI in teaching and learning.

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APPENDIX A

QUESTIONNAIRE FOR PHYSICS STUDENTS

Dear students, this questionnaire seeks to find out the effect of Computer Based Instruction in Physics in Senior High School students' performance in Nyakrom Senior High Technical School. The purpose of the questionnaire is strictly for research. Any information provided will be treated confidential. No respondent will be identified in either the summaries or the findings arising from this study. Please do well to response all the items.

Thanks for being a part of this research.

Section A: Bio data

Please tick as is applicable to you.

Sex

☐ Male ☐ Female

Age Range

☐ 10-15 ☐ 16-20

☐ 21 and above

Form

☐ Form two ☐ Form three

Instruction: For each of the items below, please tick the number from the scale 1-3 at the right end of the item to indicate your level of agreement or disagreement to the item.

Note the scale

1= Strongly Disagree

2=Disagree

3= Not certain

4= Agree

5= Strongly Agree

Items	**1**	**2**	**3**	**4**	**5**
The use of computer for learning was an exciting experience					
In understanding the contents of each topic, the CBI method of presenting materials is better than the traditional classroom presentation					
The CBI approach provides greater collaboration among students					
My level of motivation in this course has increased with the use of CBI materials					
The information in all the chapters in the programme was clear and unambiguous					
The amount and quality of the materials in the programme were just about right compared with what would normally be covered in the traditional classroom.					
The use of CBI materials has increased my degree of interest in physics					
The use of computers in learning physics made me more creative					
I learned more materials through the use of CBI method than i would have using traditional method					
I would recommend the use of the CBI method in teaching and learning other subjects as well					
I would like the traditional method of teaching be replaced completely with the CBI method rather than only supplementing it					

OBJECTIVE TEST ITEMS

Identify each of the following symbols

1.

a. OR gate b. NOR gate c. AND gate d. INVERTER gate

2.

a. OR gate b. NOR gate c. AND gate d. INVERTER gate

3.

a. One terminal operational amplifier

b. Six terminal operational amplifier

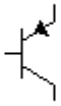
c. Nine terminal operational amplifier

d. Seven terminal operational amplifier

4.

a. Resistor b. Diode c. Capacitor d. Inductor

5.



a. PNP Transistor b. NPN Transistor c. NPP Transistor d. PNN Transistor

6. What happens to the current when the resistance in a circuit is increased?

a. Increased b. Decreased c. Remains the same d. No idea

7. If an inverter is given an input of zero what value will the value of the output?

a. Zero b. one c. two d. half

8. How is a diode connected in a circuit?

a.Negative terminal of the diode is connected to the negative terminal of the battery

b. Negative terminal of the diode is connected to the positive terminal of the battery

c.Positive terminal of the diode is connected to the negative terminal of the battery

e.Negative terminal of the diode is connected to both positive and negative terminal of the battery

9. What happens to the voltage when the current is decreased?

a. Increased b. decreased c. Unchanged d. halved

10. What happens to the voltage when the resistance is decreased?

a. Increased b. decreased c. Unchanged d. halved

11. An AND gate will produce a high if and only the two inputs are high

a. True b. False

12. OR gate will produce a high if and only if the two inputs are high

a. True b. False

13. An AND gate will produce a low if and only the two inputs are low

a. True b. False

14. OR gate will produce a low if and only if the two inputs are low

a. True b. False

15. An inverter is also called a

a. NON b. NOT c. AND d. OR.