UNIVERSITY OF CAPE COAST

SENIOR HIGH SCHOOL

STUDENTS' PERCEPTION OF COMPUTER LABORATORY

LEARNING ENVIRONMENTS IN THEIR SCHOOL

BY

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DEDICATION

I dedicate this work to my beloved mother Ms. Esther Boatemaa for her prayers, support and encouragement during this period

DECLARATION

Student's declaration

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

Candidate's Signature:…………………………..........   Date:……………………..

Name:………………………………………………………………………………………

Supervisor's Declaration

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

Supervisor´s Signature:…………………………….…   Date:……..…………………

Name:………………………………………………………………………………………….

ABSTRACT

This study focused on senior high school students' perception of their computer laboratory learning environment and how the use of computers affects their learning in urban and community senior high schools. Data was obtained with the Computer Laboratory Environment Inventory questionnaire, administered to 278 second year senior high school students. The sample consisted of 171 males (61.5%) and 107 females (38.5%) with a mean age of students being 17.4 years. The data were analyzed using SPSS to find how frequent students experience a particular factor that affect them when in the computer laboratory and also the difference in how male and female students perceive their computer laboratory learning environment as measured using the t-test.

Four factors, supply material environment, integration, supervision and reliable material environment, were found to influence students' perception of their computer laboratory environment. The findings revealed that students' general perception of their computer laboratory environments in both school types were positive but significantly different in favour of those in urban schools. The findings suggest that serious efforts must be made by the Ministry of Education (MOE) to improve the material environment, particularly, in Community schools. These schools lack the necessary facilities required to perform practical activities in the laboratory. The acquisition of manipulative and recoding skills which are tied to the context of a laboratory and are emphasized by the MOE and the West African Examination Council will continue to be lacking if this is not done.

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INTRODUCTION

Background to the Study

The notion that a learning environment exists which mediates aspects of educational development began as early as 1936 when Lewin (1936) recognised that the environment and the interaction of the individual were powerful determinants of behaviour. Since Lewin´s time, international research efforts involving the conceptualization, assessment, and investigation of perceptions of aspects of the classroom environment have firmly established classroom environments as a thriving field of study (Fraser, 1994, 1998, Fraser & Walberg, 1991). For example, recent classroom environment research has focused on constructivist classroom environment (Taylor, Fraser, & Fisher, 1997), cross-national constructivist classroom environment (Aldridge & Fraser, 1999; Fisher, Rickards, Goh, & Wong, 1997), science laboratory classroom environments (McRobbie, Giddings & Fraser, 1993), computer laboratory classroom environment (Newby & Fisher, 1997), computer-assisted instruction classrooms (Stolarchuk & Fisher, 1999) and classroom environment and teachers' cultural back grounds (Khine & Fisher, 2001).

Research has shown that classroom learning environments play an important role in determining student success. Current issues, especially those that involve recent scientific discoveries that can affect local and global communities, are ideal for promoting knowledge-centered classroom environments in which knowledge is connected to personal and societal issues. The issues, and the scientific knowledge associated with them, can help motivate students, provide evidence to dispel common misconceptions, provide survey topics to involve parents and community members, increase content knowledge, and provide opportunities for students to apply their current understandings to new situations, including assessment tasks.

Computing has been a subject of academic study since the 1960s. Initially it was taught in courses with titles such as Computer Science, Computer Studies or Electronic Data Processing and these were intended for the computing specialist, who would start their careers as programmers or systems analysts. Computer Science has established itself firmly as a discipline in most universities and in such courses the emphasis is on the study of computer systems themselves. The other terms mentioned have, in general, been replaced by Business Computing or Information Systems, which is now emerging as a discipline in its own right. Courses under these titles concentrate on the application of computers to business problems. In addition, many universities offer programmes in Software Engineering and Computer Engineering. All the courses mentioned involve the study of programming as the means by which computer based systems are developed. The introduction of the microcomputer in the early 1980s led to the wider use of computers throughout tertiary education in courses including business, education and engineering. Here, the computer is often used as a tool to assist in learning, as a means of delivering educational material and for on-line assessment. More recently, the availability of multimedia has extended the use of computers to other areas such as graphic design. The internet has also made the workstation an invaluable educational and research tool. This has led to the inclusion of some form of computer education in most disciplines at the university level.

One aspect that most computing courses, both specialist and non-specialist, have in common is the computer laboratory class. This is understandable given that using a computer is perceived as a skill. For specialist courses this would mean learning to programme, something that cannot be done simply by reading a book and requires practice (Azemi, 1995). The skill in using computers must be mastered before any progress can be made, and laboratory classes provide an opportunity for students to gain proficiency. The joint ACM-IEEE Curriculum Task Force recommended that introductory computer science courses should be supported by extensive laboratory work (Denning et al., 1989; ACM/IEEE-CS, 1991). More recently the ACM SIGCSE Working Group on Computing Laboratories published guidelines for the use of laboratories in Computer Science education (Knox et al, 1996). Their report was predicated on a number of assumptions. One of such assumptions was that laboratory experiences are relevant in most Computer Science courses across all levels from literacy and language courses for non-specialists to graduate level theory courses. It discusses a number of aspects in detail, and these are the scope of laboratories, the relationship between lecture and laboratory, pedagogy, an internet repository, institutional support and the use of technology. Although the focus of this report is the use of laboratories in Computer Science Education, many of its recommendations are relevant to non-specialist laboratories.

Whatever the computer laboratory class experience is, there are a number of ways in which it can be done. The two extremes are the closed or formal laboratory (Lin, Wu & Chiou, 1996) and the open laboratory, sometimes known as the drop-in laboratory. The formal laboratory is scheduled in the same way as lectures and tutorials with specific exercises being set for students. They are generally staffed by a lecturer of higher grade who is available to help guide the students. On the other hand, open laboratories allow students to come and go as they please with technical assistance being provided by laboratory demonstrators who are often senior students. For these, an instructor assigns a problem and students work on it in their own time usually on their own. Most computing classes run in Australian and UK universities provide formal scheduled laboratory classes, with different levels of prescription with respect to the work to be done. However, in the United States, it seems that the open laboratory is the norm and a study showed that only about a third of the university courses surveyed used formal classes (Denk, Martin & Sarangarm, 1993).

The concept of environment as applied to educational settings refers to the atmosphere, ambience, tone, or climate that pervades the particular setting. Research on classroom environments has focused historically on its psychosocial dimensions; those aspects of the environment that focus on human behaviour in origin or outcome (Boy & Pine, 1988). Reviews of classroom environment research by Fraser (1998), and Anderson & Robert (1988), have delineated at least ten areas of classroom environment research. One of the strongest traditions of classroom environment research has been the study of links between classroom environment and student cognitive and affective outcomes.

Learning environments have been a subject of academic research for over thirty years (Fraser, 1993), and although the concept of a classroom environment is a subtle one, teachers have always been aware of it in an informal manner. The research in this area has succeeded in conceptualising learning environments, and it arose from two independent programmes which started at about the same time. The study of classroom environments has demonstrated that perceived classroom environment may be predictive of student learning.

A study of how students perceive their computer laboratory environment is desirable since it has been found that learning environment and psychosocial perceptions can make a difference in how students learn and achieve their goals (Henderson, Fisher & Fraser, 1998; McRobbie, Ruth & Lucas, 1997; Myint & Goh, 2001). Tel (1991) notes that perceptions influence human behaviour and this has been found to exist in almost all countries of the world. International research efforts involving the conceptualization, assessment, and investigation of perceptions of all aspects of the classroom environment have now firmly established the classroom environment as a thriving field of study (Henderson, Fisher & Fraser, 1998). The increased use of computers in classrooms has led to studies to evaluate the effectiveness of computer assisted learning (Maor & Fraser, 1993, Teh & Fraser, 1994) and to investigate the association between gender, computer experience and perceived environment (Levine & Donitsa-Schmidt, 1995).

Statement of the Problem

High School education is of strategic importance to a country's development and capacity building, particularly because students of high school age and young people in general make up more than 60 percent of the population of Africa (Bregman, & Stallmeister, 2002; Akoojee & McGrath, 2005). Information Communication Technology (ICT) has been an integral part of education in certain schools in Ghana for some time. However, many schools still do not have computers or information resources with which they can provide resource-based education. Since the time formal schooling was introduced in Ghana to date, educational provision has been skewed in favour of those in the urban communities and there has been inequitable distribution of educational resources and services (Asiedu-Akrofi, 1978). Most schools in the urban areas have been in existence since the colonial or early postcolonial era. Since their establishment, most of these Senior High Schools have faced problems of poor infrastructure, lack of logistical support, inadequate material input, and lack of qualified teachers.

In the light of such general inequalities in Ghana's school system, a current challenge is the equitable implementation of ICT policy for high schools. This issue becomes intricate when factors such as accessibility of electricity and telephone grids, the current state of school infrastructure, and availability of technical support are considered. The government made promises to ensure the standardization of all Senior High Schools in terms of resources and quality of output (Ministry of Education, 1999). To date, community high schools that have been established in Ghana are faced with problems of poor infrastructure, lack of material input, inadequate logistics, and lack of qualified teaching personnel in ICT.

The environment in which the majority of these schools operate does not promote any serious learning and academic work. The introduction of ICT in the school system in Ghana is an innovation. However, in Ghana, the educational system currently does not have any coherent ICT policy framework in place. The current lack of policy framework for ICT implementation in the educational system shows that they are not equipped to keep up with the ICT revolution that is taking place. However, education policy makers in the country still have the chance to take advantage of the technology that is becoming more widely available.

In an attempt to address this issue, this study hopes to identify the various ideas that students' hold about their computer laboratory learning environment in order to suggest ways to well-equip the laboratories to enhance the teaching and learning of ICT in our schools.

Purpose of the Study

This study seeks to identify and explore the factors which explain senior high school students' perception of their computer laboratory environment. The study also sought to find out whether students from urban and community schools perceive their computer laboratory environments differently. Furthermore, the research aims to establish whether there are gender differences in students' perceptions of learning environments in computer laboratory.

Research Questions

The study attempts to answer the following questions:

1. What is student's general perception of their computer laboratory environment?
2. What factors explain students' perception of their laboratory learning environment?

Hypotheses

The following hypotheses were also tested:

1. There is no statistically significant difference between boys and girls in their perception of their computer laboratory environment.
2. There is no statistically significant difference between students in urban and community schools in their perception of their computer laboratory environment.

Significance of the Study

This study has provided factors which affect students' perceptions of their learning environment. It has also provided information about what practices in the learning environment promotes positive student attitudes. The findings provide teachers with suggestions about how to make computer laboratories more equitable for boys and girls and about students' learning environment, which will enable them to adopt strategies that might improve the learning environment for the study of ICT. The study is significant because there has been little research into how learning environment affect student perceptions of their computer laboratory learning environment in Ghana. The magnitude of discrepancies between boys' and girls' perception of the computer laboratory learning environment will provide a basis for evaluating the learning styles of male and female students.

Limitations of the Study

A number of constraints served as limitations in this study. These included the duration of the study and sample size, access to computers in the laboratory by students at anytime and homogeneity of subjects in intact classes. However, steps were taken to minimise these effects.

Due to financial and time constraints a wider coverage of Ghana could not be studied, therefore a number of schools were selected and as such results cannot be generalized.

Secondly, researcher used only one research instrument and if he had used other research instruments, such as observation, focus groups discussion and interviews, he would have obtained wide range information to enrich the study.

Finally, a questionnaire was the instrument used to collect data since it required a little time of the respondents, cost and distribution. The only weakness for the questionnaire is that it involves the probing for details or explanations of the responses is not possible, since it involves only ticking of answers that are already provided.

Delimitation of the Study

The study was limited to senior high schools with computer laboratories in rural and urban communities in the Central Region. The study also covered only three schools from each of the two communities. Findings, conclusions and recommendations were not extended beyond this population.

Definitions of Common Terminology

The following terminology has been used throughout this document.

Application May be used to refer to a type of software such as a word processor

	or generally to the use of computers in a particular situation.
Bulletin Board	The facility of a networked server computer to allow messages to be posted for others to read.
Computer	Electronic machine, operated under the control of instructions stored in its own memory, that can accept data (input), manipulate data according to specified rules (process), produce results (output) and store the results for future use.
Computer Literacy	Concerning the knowledge, skills and attitudes which enable a person to use computer technology to benefit themselves and others in relation to tasks they wish to accomplish.
Computer Awareness	Concerning the understanding of the role of computer technology in society and the social implications associated with the use of computer in society.
Curriculum	The word curriculum comes from Latin meaning to run a racecourse. Its meaning in education has come to mean a combination of the learning outcomes, pedagogy, and content that students are to address.
E-mail (Electronic Mail)	Text messages and computer files exchanged through computer communication, via Internet or intranet networks.
Hardware	The tangible components of computers including processors input, output, communications and memory.
ICT (Information & Communications	Typically used to refer to computer technologies but strictly speaking should also include other technologies used for the

Technology)	collection, storage, manipulation and communication of information. In some places the term IT (Information Technology) is used.
Interactive Multimedia	The use of a computer to control and present combinations of media such as text, graphics, video and sound. Sometime the term is shortened to multimedia.
Internet	The international network of networks of computers using common protocols such as TCP/IP.
Intranet	A communications network, based on the same technologies used for the internet but only available to authorised users within an organization or company.
Learning Outcome	That which students may demonstrate from what they have learned. In the Curriculum Framework these are described as sets of outcomes associated with areas of learning.
Online	Usually refers to connection to host/server computers as found on the internet.
Pedagogy	A strict dictionary definition would state that pedagogy concerns the science of teaching children. It concerns what teachers do when they interact with children to support their learning. Most educators would consider that pedagogy encompasses the beliefs and actions of teachers including their teaching strategies, the organization of learning experiences and of the learning environment generally.
Server	A computer used to provide a service over a network. It may be a web server, print server, email server etc.

Software	The sets of instructions and data used by computers, sometimes referred to as computer programs.
TCP/IP (Transmission Control Protocol/ Internet Protocol)	The communications protocol used to define the 'rules' for the transmission of data between computers and network wishing to be part of the internet.

Organization of the Study

The study consists of five chapters. The first chapter deals with introduction of the study which is made of the background to the study, statement of the problem, purpose of the study, research questions, limitations of the study, delimitations of the study, significance of the study and definitions of common terminology used in this document. The second chapter reviews the related literature on the study focusing mainly on the concepts of ICTs and perception. The third chapter deals with the research methodology and the fourth chapter covers the presentation and discussion of results. The last chapter comprises the summary, conclusion and recommendations based on the findings of the study.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Introduction

This chapter reviews literature related to the study. The focus is on how computer use in schools impacts on learning, learning environments, students, teachers and schools. It also describes the conceptual framework for the study.

The review begins with a background to the use of computers in schools, then touches on the rationale for computers in schools, followed by a discussion of the findings of current international research on the impact of ICT on aspects of learning and teaching. Finally, the conception of perception is explained.

Concept of Learning Environment

Learning environments

Learning environments in schools typically involve one or more adult teachers connected with a number of students, usually in well defined physical settings. These people interact and form a variety of relationships, creating what Salomon (1994) calls "a system of interrelated factors that jointly affect learning in interaction with (but separately from) relevant individual and cultural differences" (p. 80). This is what Wubbels, Brekelmans and Hooymayers (1991) term the "relationship dimension" in learning environments at school. The learning environment has a physical as well as a relationship dimension. Physically it may be in a room, full of particular furniture and equipment. Curriculum materials such as books and videotapes may also be present. The curriculum also has a place in the relationship dimension of the environment in that the students and teacher(s) are focused on certain processes and content in the curriculum and have a relationship with that curriculum and the methodologies that are associated with conveying the curriculum. Students and teachers may have very different relationships with different components of the curriculum. The place of computers in learning for the majority of children is most likely to occur in the classroom and, for an increasing number, at home. Most experts in the field of educational computing (e.g. Lynch, 1990; Olson, 1988; Rieber, 1994) would characterise computers as interactive and thus admit them a place within the relationship structures of the classroom learning environment, not just the physical environment.

The basis of learning environments

The classroom learning environment provides a structure to describe the setting in schools within which learning is organised and the roles of the teacher and students occur. However, it does not describe the reasons or purpose behind the construction of any particular environment. This is dependent on the beliefs and actions of those responsible for setting up the environment, particularly the underlying pedagogical philosophy of the teacher. There is little doubt that the pedagogical philosophy to which most ‘Western’ educational leaders and researchers subscribe is that of constructivism.

Learning Linked to Educational Quality in the Classroom

Learning is not simply memorizing what is taught, nor is it being able to perform on a final examination. Fundamentally, learning people's capacity to benefit from and contribute to society, while increasing their capacity for further learning (Wegner 1997). Learning a particular skill provides students with access to work for and with others who value that skill. This is as true of theoretical mathematics as it is of carpentry. Other opportunities include the chance to influence political or civic affairs, promote family development, and protect the environment.

Measurement of Learning

If educational quality has ultimately to do with learning, problem educators have often faced is the issue of measurement. On one hand, the definition of learning as personal transformation and growth across the full spectrum of human endeavor provides outcomes that do not lend themselves to measurement. On the other hand, education systems need to have fairly standardized and reliable measures of whether children are learning. Those who wish to pay attention to the deeper definition of learning often oppose the advocates of standardized achievement measures. Consequently, educators have done themselves a great disservice by protracting this debate. It is important that measuring those basic building blocks of learning in the quest for an elusive measure of the perfect, all-encompassing educational outcome does not occur. At a minimum, simple testing instruments of what children can do allow teachers, parents, and education officials alike to talk specifically about what children are learning, thus " uncomplicating" the issue of educational quality.

Factors Influencing Learning

Quality is ultimately defined in terms of how much learning actually takes place, but it also depends on whether the conditions for that learning are being created.

Measures to Support Learning

The transformation of schooling to truly support learning is not simply a matter of gaining more local support and international financing to improve the physical infrastructure, teacher qualifications, instructional materials, and management systems. A considerable amount of research has been conducted on what can be described as the "education production function" to define those factors considered to influence educational quality (Fuller, 1985; Heyneman et al 1981). However, the research usefulness in improving educational policy, planning, and management, to say nothing of improving learning, has been problematic. In one recent review of over 400 studies of student achievement, Hanushek (1997) found that there was no strong or consistent relationship between student performance and school resources. He notes, “the clearest message of existing research is that uniform resource policies will not work as intended. Simply providing more funding or a different distribution of funding is unlikely to improve student achievement."

A variety of perspectives and explanations have been proposed regarding why increased resources are necessary but not sufficient for improving learning outcomes. One explanation is that national policies and plans in most developing countries simply are not effectively implemented (Craig, 1990). Another is that our analytic tools are inadequate and they do not take into consideration the complex hierarchy of factors that must be addressed to improve quality (Riddell, 1997). These include the health and well being of the child and family; the conditions and relationships within the classroom; the culture of the community and parental involvement in the management of the school; and the policies, planning, and organization of the larger educational system. Others argue that national policies and programs (for countries receiving international assistance) have failed to focus on the school as the crucible where learning takes place. Finally, others observe that the centrality of the learner consistently is left out of the equation (Abbott, 1997).

Designing Learning Environments

Learners in supportive environments have high levels of self efficacy and self-motivation and use learning as a primary transformative force (Bereiter & Scardamalia, 1989). To be effective, instructional multimedia should address the unique sources for learning differences that influence success. More specifically, it should emulate the instructor's experienced, intuitive ability to recognize and respond to how individuals learn differently and creatively foster interest, value, and more successful, independent learning. An efficient way to accomplish this challenging task is to determine common learning-difference profiles and match individualized solutions to audiences differentiated by these profiles. This is actually simpler than it seems. Research helps us broadly describe three learning orientation profiles. Descriptions for mass customized learning environments that fit each of the learning orientation profile include:

1. **Transforming Learners** prefer loosely structured, flexible mentoring environments that promote challenging goals, discovery, strategies, problem solving, and self-managed learning.

2. **Performing Learners** prefer semi-structured environments that stimulate personal value and provide details, tasks, processes, and creative interaction (hands-on) not exploration and great effort.
3. **Conforming Learners** prefer simple, safe, low-learner control; structured environments that help learners achieve comfortable, low-risk learning goals in a linear fashion.

These descriptions support the broad variability in learning from a whole-person perspective, not simply in cognitive terms. They consider how emotions and intentions influence learning and thinking processes. These are powerful influences that guide how successfully individuals intend to learn. A closely matched learning environment will clearly have a positive impact on the accessibility, affordability, and quality challenges that now confront global education and training.

Concept of ICT in Education

Conceptual Definition of ICT

By definition, ICTs include electronic networks-embodying complex hardware and software - linked by a vast array of technical protocols (Mansell and Silverstone, 1996). ICTs are embedded in networks and services that affect the local and global accumulation and flows of public and private knowledge. According to the United Nations Economic Commission for Africa, ICTs cover Internet service provision, telecommunications equipment and services, information technology equipment and services, media and broadcasting, libraries and documentation centers, commercial information providers, network-based information services, and other related information and communication activities. This is quite an expansive definition. It is not uncommon to find definitions of ICTs that are synonymous with those of information technology (IT). For example, Foster defines IT as 'the group of technologies that is revolutionizing the handling of information' and embodies a convergence of interest between electronics, computing and communication (Drew and Foster, 1994).

Chowdhury (2000) writes that ICTs encompass technologies that can process different kinds of information (voice, video, audio, text and data) and facilitate different forms of communications among human agents, among humans and information systems, and among information systems. They are about capturing, storing, processing, sharing, displaying, protecting, and managing information. Duncombe and Heeks (1999) simplify the definition by describing ICTs as an “electronic means of capturing, processing, storing and disseminating information”.

In this review, the terms IT and ICTs will be used nearly synonymously and in a somewhat broad sense. The terms designate the information processing interaction between providers and users of information and also the development and application of information-processing systems that may not be regarded as part of the development of telecommunications/telematics per se. It is important to emphasize that these technologies only provide new mechanisms for handling an already existing resource, namely information. Chowdhury (2000) presents the position taken by realists that in an increasingly global village, ICTs have the potential of helping the poor to acquire literacy, marketable skills and so on. However, Barlow (1998) believes that common perceptions of the potential of the digital age are limited by the habits of mind one develops in an industrial society. These habits are different for those who have grown up in poverty with no television sets for instance to shape their world view. Most of these people are found in Africa and the developing world in general. The basis of this argument is weak, however, since Barlow has no empirical evidence to support his assertion, apart from his experiences in the countryside of a developed country. Braga (1998) builds a case that concludes that the countries that are better positioned to thrive in the new economy are those that can rely on: widespread access to communication networks; the existence of an educated labour-force and consumers; and the availability of institutions that promote knowledge creation and dissemination. This may suggest that developing countries are at a disadvantage in comparison to developed countries. Similar sentiments are shared by Mansell and Wehn (1998). Brown (1994) argues that ICTs are simply tools. Significantly, no single tool can solve a global problem. The author gives examples of where ICTs can play a significant role such as in the creation of jobs and in the reduction of distance. However, the author points out that it would be preferable if the labour-force were educated in this information age.

This contention puts into perspective a major challenge faced by policy-makers in Africa in efforts intended to develop strategies that can bring the information revolution to the continent. In essence, to create truly national, integrated information infrastructures, there has to be the simultaneous acceleration of the use of high-tech and low-tech information services (Wilson, 2002). In addition, according to this publication, there is need to nurture the development of highly sophisticated, world-class channels, capable of carrying the digitized content that now races through the world's financial systems, educational institutions and business networks. At the same time, policy makers must carefully address the information needs of the vast majority of their populations with low per capita incomes, who are mostly rural based.

Schools, Learning and Computers

Any discussion about the use of computer systems in schools is built upon an understanding of the link between schools, learning and computer technology. When the potential use of computers in schools was first mooted, the predominant conception was that students would be ‘taught’ by computers (discussed by Mevarech & Light, 1992). In a sense it was considered that the computer would ‘take over’ the teacher’s job in much the same way as a robot computer may take over a welder’s job. Collis (1989) refers to this as “a rather grim image” where “a small child sits alone with a computer” (p. 11).

During the late 1970s and early 1980s, computers became more affordable to schools, permitting a rapid decrease in student-to-computer ratios. While tutorial and D&P software continued to be developed (Chambers & Sprecher, 1984), a range of other educational software was developed that was not based on the premise of teacher replacement, for example, simulation software, modelling and tool software. However, the major argument used to support the introduction of greater amounts of computer hardware into schools concerned the perceived need to increase the level of computer literacy of students (Carleer, 1984; Downes, Perry, & Sherwood, 1995).

Towards the end of the 1980s and into the 1990s, while the computer literacy rationale still remained (Hannafin & Savenye, 1993; Hussein, 1996), the major rationale for having computers in schools was more concerned with the need to use computers to improve student learning (Welle-Strand, 1991). Broadly speaking, computer literacy is a component of Technology Education, which is distinct, but not necessarily separate from, using technologies such as computer systems to support learning and teaching processes. The latter is generally referred to as educational technology; and is applied to a wide range of technologies such as blackboards and chalk, pencils, books, and slide-rules to television, facsimiles, and computers. This review will focus on the use of computer systems as educational technologies.

Since the beginning of the 1990s, educators have been particularly concerned that very little of the potential of computers to support learning in schools seems to have been realised, despite a sufficient installed base of computers. Numerous studies (Becker, Ravitz, & Wong, 1999; DeCorte, 1990; Plomp & Pelgrum, 1992) have shown that few teachers facilitate substantial student use of computers. Therefore, while it is assumed in this review that computer support for learning is essential, some discussion of the rationale is required as a background to later discussions concerning models for the use of computing systems to support learning and teaching.

Computer Laboratory Learning Environment

There are two main ways in which the practical component of computer science and information systems courses, the computer laboratory class, may be organized. They may be closed laboratories, which are scheduled and staffed in the same way as other classes, or open laboratories where the students come and go as they please. In Ghana, it is the closed laboratory that provides the practical experience for students.

ICT Integration in Learning Environments

A critical component of theories of constructivism is the concept of proximal learning, based on the work of Vygotsky (1978), which posits that learning takes place by the learner completing tasks for which support (scaffolding) is initially required. This support may include a tutor, peer or a technology such as the applications of computers. This has led to the use of the term computer supported learning. Computer supported learning environments are those in which computers are used to either maintain a learning environment or used to support the student learner in this Vygotskian sense (DeCorte, 1990; Mevarech & Light, 1992). Therefore the technology is used to help create the types of learning environments and the types of support for learning that are known to be ideal, that Glickman (1991) argues have been ignored or failed to be implemented widely in the past. The aim is to create learning environments centred on students as learners and a belief that they learn more from what they do and think about rather than from what they are told. If the aim is to offer new learning opportunities, or to improve the way in which current learning activities are implemented, then the overall effectiveness of learning environments and episodes is of paramount concern, not whether they are more effective with or without computers. It is important that the ever changing nature of computer-based technology not overshadow the enduring nature of learning and the solid and ever increasing base of knowledge about learning. This knowledge is not superseded by new technologies; rather, it can inform the use of new technologies when applied to learning. Therefore, in implementing computer support for learning it is necessary to start by deciding what a student, teacher or school wants to achieve. To achieve these outcomes, teachers can then rely on long traditions of educational theory, their own experience and knowledge of the educational situation (e.g., student attributes) to make decisions about what the learning environment should look like, and what inputs into the learning process are required. Finally, teachers can identify what problems are associated with providing these environments and inputs, and tailor computer and other support to provide solutions. In essence, the judgement of teachers and their support structures are relied upon to choose appropriate strategies. This approach ends with decisions concerning computer support rather than starting with such decisions (Campione et al., 1990). The Committee on Developments in the Science of Learning (2000) suggested five ways to use ICT to establish and sustain effective learning environments:

1. Real world problems
2. Scaffolding
3. Feedback, reflection and guidance
4. Local and global communities
5. Extending teacher learning

They assert that many aspects of ICT make it easier to create environments that fit the current understanding of the principles of learning.

The Rationale for ICT in Schools

It is necessary to develop a thorough rationale before beginning to use computers in schools and classrooms. There is little or no point in providing computers in schools unless such a rationale has been completed. With the increasing availability of computer hardware it is important that teachers do not become engrossed in the machine but focus rather on their primary role as educators. Teachers need to extend their imaginations with the awareness that as developments in computer technology occur they will be able to achieve more of their goals. Since the 1960's the computer has been heralded, by some, as the solution to many problems in education. Many early computer scientists saw the possibility of the computer replacing teachers in schools. However these pictures of students sitting behind computer terminals for much of the day have largely not occurred in mainstream schools and most would not like this to be realised (Collis, 1989). There are three main rationales for ICT in schools: one concerns the organisational productivity of the school, and the other two focus on the needs of students: technological literacy and support for their learning.

Apart from a few exceptional schools, in the 20th century computers had only a minimal impact on what happens in classrooms (Becker et al., 1999). There has been much debate over the reasons for this discrepancy between the potential and what is realised. The computer is one of a range of technologies now available to teachers and students. In past decades technologies such as radio, television and overhead projectors similarly had little lasting impact on the experiences of students and teachers in schools. In these cases a large amount of money was spent on these resources which some would argue would have been better spent on other resources. It is important that scarce resources to support learning in schools are not wasted and therefore care needs to be taken in choosing to use computers to support learning. Historically, technology has been developed to solve problems, improve living standards and to increase productivity.

ICTs and Collective Access Points

Adebgola (1998) argues that deliberate steps should be taken to make sure rural communities have access to ICTs. If this is not done, the so-called digital-divide will just widen. The approach suggested is that of ‘infocommunes’ to help to overcome some of the impediments caused by the weak infrastructural base of ICTs in the developing world. With reference to education, Butcher (1998) states that practical examples of the use of new technologies tend to reinforce the notion of the expanding gap between the rich and the poor, instead of demonstrating practical solutions to the problem. He suggests that more resources should be spent on opening up access to marginalized communities in innovative and cost-effective ways; otherwise, ICTs serve only to perpetuate greater economic and educational marginalization.

Benjamin (2000) notes that there has been great interest in using telecentres to provide access to ICTs, in projects initiated by governments, the private sector, international donors, and community organizations. These projects are viewed as a means of addressing the lack of ICTs throughout Africa, and of assisting in providing universal access to both telephony and other forms of ICTs. In his presentation, he reviewed various initiatives throughout Africa. He assesses two types of telecentres: type A, micro enterprise telecentres, and type B, bigger, donor-funded telecentres. This could be viewed as a more specific contribution that flowed from Benjamin & Dahms’s (1999) basic description of the role of telecentres in development. In an earlier paper before telecentres were widely developed in poor countries, Ernberg (1997) simply wanted to know whether universal access can be achieved through Multipurpose Community Telecentres and whether it would be viable for business.

ICTs and Education

The importance of ICTs and education is a topic that runs across all thematic areas on ICTs and development. For example, with reference to gender studies, there is a comment that men are more likely to have the income to purchase the ICTs and have a slightly higher level of education, which predisposes them to trying new technologies (Rathgeber, 2002). The general argument is that an illiterate or poorly educated people cannot wholly absorb ICTs. In addition, many argue that ICTs should be introduced into school curriculum so that children learn how to use these technologies from an early age. A good starting point in general would be the ILO report (ILO, 2001). Others are Perraton and Creed (2002) and Hawkins (2002). In ILO's (2001) view, ICT is a 'meta-technology' characterized by pervasive effects on the economy as a whole, and on areas of scientific and technological advance well beyond the ICT sector itself. The key issues outlined revolve around life at work in the information economy that ensures work is independent of location. This factor is bound to change management practices, the nature of the employment contract, and the quality of work. One question is whether the information economy will be a jobs economy. The report places considerable emphasis on the independence of work from any physical location. The report also deals with the widening digital divide and how markets will be affected by the new technologies. The authors note that ICT is merely a tool, and would not substitute for genuine development. However, ICT offers tools that may accelerate development. One of the most important avenues is literacy and education, which are vital for reaping the advantages of this era, and there must be lifelong learning from schools to the work environment.

ILO (2001) advances the position that the level of national income is strongly related to ICT diffusion and is clearly the distinguishing feature of the divide between industrialized and developing countries. The cost and availability of telecommunications determines the extent to which the Internet is used, and per capita access costs are most often higher in poorer countries. With reference to poverty, the report shows that there could be a new development paradigm from the possibilities that networking opens up for poverty alleviation. Access to ICT for the poor is more likely to occur at the community level. Poor people could benefit directly through access to the information that the technologies provide or through the potential for greater collective voice and empowerment they allow. In addition, the poor could benefit from the improved quality and reach of health, education and social services because ICTs make governments more transparent and gives them an opportunity to extend their services more broadly and at lower cost if they work at it. Access can be improved through NGOs and other local development agencies in the areas of for example, health care, child welfare, basic education and nutrition.

With direct reference to education, Hawkins (2002) writes about World Links for Development Programme's experiences in connecting schools to the Internet, in training teachers, and in grappling with curriculum and education reform issues in developing countries. He conceptualizes the story into ten practical lessons that policymakers and business and community leaders should consider as they plan to incorporate the Internet in the educational process. The lessons are:

1. Computer Labs in developing countries take time and money, but they work.
2. Technical support cannot be overlooked.

3. Non-competitive telecommunications infrastructure, policies, and regulations impede connectivity and sustainability.
4. Lose the Wires (basically wireless technology is most effective for connecting schools in developing countries).
5. Get the community involved.
6. Private-public sector partnerships are essential.
7. Link ICT and education efforts to broader education reforms.
8. Training, training, training. (Basically that the professional development of teachers sits at the heart of any successful technology and education programme.
9. Technology empowers girls.
10. Technology motivates students and energizes classrooms.

Why computers in schools?

ICT have become indispensable tools in today's information age, making a dramatic impact on the lives of people globally. This effect is most significant in education. The computer has become a motivating tool for teaching and learning in schools (World Bank 2002). The Internet allows cost-effective information delivery services, collaborative and distance education, more than has ever been imagined. A concept such as 'the knowledge revolution' has become a major feature in the literature in recent times (De Horowitz 1993; World Bank 2002). De Horowitz (1993, p. 171), for example, reports on how technologies are inexorably integrated, creating new intellectual capabilities by assisting the human brain and thereby changing most aspects of people's lives.

Recent technological developments worldwide have ushered society into a multimedia age, “where children and adults are being asked to handle information from a bewildering variety of sources. These sources include video, CD-ROM, satellite television and a quiet but insistent multimedia revolution is slowly taking place in schools and colleges” (Thomas 1996, p. 4). Multimedia software stimulates different learning paths by offering information through pictures, text, sound, animation and video.

The present study comes at a time when government in Ghana has questioned the preparedness of teachers and learners in Ghana to meet the demands of the information age. Authors such as Herring (1996) and Campbell (1996) emphasise the importance of computer and traditional information skills in achieving ICT education. Johnson (1995) adds that only certain teaching methods will make effective use of the computer and Internet resources in schools. Todd (1997) emphasise that the role of the media teacher is paramount in creating a successful ICT project in schools.

The paradigm shift envisaged in Curriculum 2007, the new curriculum which is currently being implemented by the Ghana Education Service (GES), is clearly an attempt to address these issues. But is ICT a valid way to achieve this paradigm shift? Roblyer et al. (1997: 29) describe four main areas where ICT can have a positive impact on schools.

1. **Motivation**

   Learners' attention is captured by computers, and they are engaged in productive work; this leads to learners feeling in control of their learning process.

2. **Unique Instructional Capabilities**

Learners can access information from a variety of sources, they can visualize problems and their solutions; computers provide powerful learning tools; learners' progress can be effectively tracked.

3. **Supports new approaches**

Co-operative learning, shared intelligence and higher-order problem solving are facilitated by effective use of computers; advanced learners can move ahead on their own, and the teacher can focus on those who are struggling; learners' information skills are developed rather than rote learning and specific content.

4. **Increased teacher productivity**

Less time is spent on administrative paper work, so more is available to spend on learners; accurate information is readily available; teachers can produce high quality materials; they can access and share resources by electronic means with other teachers from all over the world.

Benefits and Roles of ICTs in Education

As Jhurree (2005) states, much has been said and reported about the impact of technology, especially computers, in education. Similarly, Hepp, Hinostroza, Laval and Rehbein (2004) state that the literature contains many unsubstantiated claims about the revolutionary potential of ICTs to improve the quality of education. Hepp, Hinostroza, Laval and Rehbein (2004) also note that some claims are now deferred to a near future when hardware will be presumably more affordable and software will become, at last, an effective learning tool.

Considerable resources have been invested to justify the place of technology in education, and many research studies have revealed the benefits and gains that can be achieved by students, teachers and administrators (Jhurree, 2005). Although not all of the existing studies can be mentioned here, the following authors have often been mentioned in the literature:

To begin with, Hepp, Hinostroza, Laval and Rehbein (2004) state the following reasons for the application of ICTs in education:

1. **A new society requires new skills:** Due to the fact that ICTs are the preeminent tools for information processing, new generations need to become competent in their use, should acquire the necessary skills, and therefore must have access to computers and networks during their school life.
2. **Productivity enhancement:** Schools are knowledge-handling institutions; therefore, ICTs should be fundamental management tools on all levels of an educational system, from classrooms to ministries.
3. **A quest for quality learning:** Schools should profoundly revise present teaching practices and resources to create more effective learning environments and improve life-long learning skills and habits in their students. In order to address the questions of "How can ICTs be applied to support education change?" and "How can its application in education in turn support sustained economic development and social transformation?" Kozma (2005) suggests the following four types of approaches in general:

A. ICTs are used to improve the delivery of and access to education. This approach can improve education on the margin by increasing the efficiency by which instruction is distributed, but it need not involve fundamental change.

B. ICTs are the focus of learning. By learning ICT skills, students become better prepared for work that increasingly involves the use of ICTs.

C. ICTs can be used to improve student understanding, increase the quality of education, and thereby increase the impact of education on the economy.

D. Knowledge creation, technology, technological innovativeness, and knowledge sharing can contribute to the transformation of the education system and to sustained economic growth and social development.

Moreover, Papert (1993) identified the following positive effects on students of ICTs in education:

1. Enhanced motivation and creativity when confronted by the new learning environments,
2. A greater disposition to research and problem-solving focused on real social situations,
3. More comprehensive assimilation of knowledge in the interdisciplinary ICT environment,
4. Systematic encouragement of collaborative work between individuals and groups,
5. Ability to generate knowledge,
6. Capacity to cope with rapidly changing, complex, and uncertain environments,
7. New skills and abilities fostered through technological literacy.

Furthermore, Kozma and Anderson (2002) claim that ICTs are transforming schools and classrooms by bringing in new curricula based on real world problems, providing scaffolds and tools to enhance learning, giving students and teachers more opportunities for feedback and reflection, and building local and global communities that include students, teachers, parents, practicing scientists, and other interested parties.

Similarly, Hepp, Hinostroza, Laval and Rehbein (2004) state that the roles ICTs play in the educational system can be pedagogical, cultural, social, professional and administrative.

1. **Pedagogical Tool Role:** ICTs provide a new framework that can foster a revision and an improvement of teaching and learning practices such as collaborative, project-based and self-paced learning.
2. **Cultural, Social, and Professional Roles:** The cultural, social and professional roles of ICTs are exercised primarily through an effective use of the vast amount of information sources and services available today via Internet and CD-based content for the entire educational community: students, teachers, administrators and parents.
3. **Administrative Roles:** ICTs have important roles to play in making school administration less burdensome and more effectively integrated to the official information flow about students, curricula, teachers, budgets and activities through the educational system information pipelines.

As Kozma and Wagner (2003) claim, ICTs can affect the pace at which the learning gap is bridged in developing countries, both domestically and in relation to other nations. The great challenge is to harness the advantages of those technologies, in order to improve the delivery and quality of educational services, as well as to accelerate the rate at which knowledge is distributed and learning chances and outcomes are equalized throughout society (Wagner, Kozma, 2003).

ICT Developments in Learning

School can be seen as an institution that both upholds and reforms tradition. School is a sanctuary of closed knowledge, protecting its educational autonomy with every means available. The closed code of school can be contrasted with, for example, the open code of the Internet. For the media-savvy teacher, ICT constitute a never ending source of information and pedagogical challenges, as they provide an opportunity to establish virtual classrooms uniting school classes in different parts the world. In a progressive school, ICT might serve a fundamental pedagogic purpose: to generate discussion across all barriers. The purpose should not be to persuade those who think, act and look differently to conform, but to look for opportunities for a common understanding and a better future together.

Students use ICT to participate in and complete various learning tasks, whether formal or informal. It is interesting to consider the unprecedented range of opportunities for learning ICT use offers students people. The literacy requirements of the media culture extend from the ability to read text to the capacity to operate and understand the meanings delivered by various devices such as compact disc and other music players, the computer, the mobile phone and video equipment - skills that often precede the acquisition of traditional literacy. It is possible to conceive of online chat rooms as a pedagogical forum that facilitates learning in a wide range of areas including skilled word use, interaction unattached to gender, and demarcations crucial for identity work. Sending text messages through the mobile phone produces its own media lore and in its way functions to reform the language, and the gaming culture enhances sensory and aesthetic perceptions and produces cognitive skills that have so far been studied very little but have already been identified as a means of access to the digital future. In addition, increasingly affordable computers and powerful and versatile software are enabling young people to produce their own music in self-made studios.

A range of subcultures is springing up around the globe and appears to be spontaneously generating a new generation of communication. According to Paul Willis, confidence in one's own skills and the motivation for the creative learning that occurs in the media culture arise from creative consumption and the copying of pleasure-generating cultural products. Learning based on the consumption of culture should be perceived as normal, and no distinction should be made between production and consumption in this context. Cultural practices are the practices of learning, and learning even in school settings are filled with meanings linked to the media culture. According to Willis, humanity is on the verge of a new electronic folk age.

ICT in Education

Most analyses of ICT in the educational sector focus on the impact it has had on pupil teaching/learning. However, this focus although obviously important, direct changes in the way teaching and learning are organized should be only part of the effect ICT has in the organization of the education sector. The role of ICT in education can be analyzed in three parts:

1. Changes in the management of the educational sector associated with ICT.
2. Changes in the work process in education associated with ICT
3. Changes in the training of educational personnel and of students associated with ICT.

ICT and Management of the Education Sector

ICT has contributed greatly to networking among schools and universities and among individuals in schools and universities. This has been especially true in the developed countries, and is now spreading to developing countries. Many schools and almost all universities now communicate internally and externally largely through e-mail. However, schools hardly use ICT to manage the quality of output, or to raise teacher productivity, or to reduce costs through analyzing spending. With the advent of high-speed personal computers in the 1990s, computers became a permanent fixture in school offices. Individual teachers can hook up to central data files in the school. ICT systems can be use mainly for collecting enrollment data, student attendance, basic information on teachers, and basic information on schools. In other words, ICT mainly helps administrators get a better idea of the size of the educational system, student dropout and repetition, and the number of students per teacher. In some sense, this can be characterized as measuring the efficiency of the educational system and as a first step in improved resource allocation. Educational administrators need to have basic information on student and teacher flows, probably also of school supplies, and how much the system is spending on various inputs, in order to make the most basic resource allocation decisions. Undoubtedly, ICT has played an important role in improving data collection in ed!ucational systems. It has also made these data more widely available to school personnel, parents, and the public at large through central administration Web sites, and in some countries through direct access to central or district databases by school personnel.

ICT and Changes in the Work Process in Education

ICT rarely acts as a catalyst by itself for schooling change yet can be a powerful lever for realizing planned educational innovations (Venezky and Davis, 2002, p. 13). It suggests that the drive to reform teaching and the organization of the teaching learning process in schools is aided by ICT, which often stimulates additional reform and innovations. In schools, one of the most important ways that ICT changes student and teacher work is by creating new networking possibilities directly with other schools or, indirectly, to informational data bases on the World Wide Web. ICT can change student and teacher work around teaching and learning. When computers are readily available to students and teachers are also trained to use computers, students can do a major part of their schoolwork using Web resources, preparing written work on their computers, and consulting special databases and learning software to help with their math. Teachers can also consult databases for lesson plans, can interact with other teachers to share teaching ideas, and can help students become more self-sufficient and creative in their schoolwork.

The Academic Benefits of Using ICT in Education

Research on cognitive impacts addresses the effect of ICT both on what students think (intellectual content) and on how students think (intellectual competence). Studies of the effect on intellectual content focus on the relative advantage of ICT in the delivery of instruction in traditional subject areas, and measure the effect in terms of standard subject area achievement examinations. Studies of how students think are primarily concerned with postulated side-effects of ICT on students' reasoning skills.

In the mid-1980s, a number of meta analyses found consistently positive and moderately high achievement gains at all educational levels from computer mediation in traditional subjects, especially math. These studies also suggested that Computer Assisted Instruction (CAI) was more effective in lower educational levels and with lower-achieving students. CAI drill and practice applications that reinforced traditional instruction were much more effective than tutorial applications that substituted for human instruction. Wenglinsky found significant gains for students in cases where ICT was used for applications that stimulate higher order thinking (Maldonado, 2000, p. 17). Wenglinsky's results also showed that students that used computers for drill and practice, controlling for other variables, did worse than the control group, and that the more time students spent doing lower order drills, the worse they did on the assessment of educational progress. This contradicted earlier findings (Kulik, 1994). But Wenglinsky's study does not correct for selection bias; those students doing more drill and practice may have also been the students weaker in math; and he was only estimating math achievement at one point in time, not gain scores, as estimated by many of the studies Kulik reviewed.

ICT and Teacher and Administrator Training in Education

Teacher in-service training in ICT is a huge industry in most countries. The training should, however, not be viewed by teachers as required to earn the points needed for pay increases as this can cause the problem of relatively little learning taking place in these in-service courses. At such in-service trainings, teachers can watch documentaries and attempt to model their own teaching on the key elements shown. They can interact with other teachers, and trade experiences and critiques. The premise of the training is that better pedagogy leads to more learning and better student outcomes.

ICTs and Gender

People in developing countries in general depend heavily on the government and the private sector to supply social and technical services to the poor. Therefore, when there are systemic failures in these sectors, the poor suffer and in the absence of parallel, formal, knowledge-based social infrastructures, those who suffer the most are women and children. This view is partially supported by Ningo (1999). Although Ningo's study is on governance and ICTs, he emphasizes that one cannot achieve good governance without sensitivity to gender issues in the context of ICT development. Most women are still excluded from access to information, which essentially means access to power.

In all the gender related studies, the focus is on women, except Sharma (2001) that covers both men and women. Women are generally the poorest and least educated in the developing countries. With the development of ICTs, there are many who are raising concern that ICT development is an area women can actively participate in but if certain issues are not taken into consideration, then women will be continually marginalized. Sharma (2001) believes that ICTs offer many opportunities for poverty alleviation and employment generation for marginalized women and men. The main hindrance to the achievement of these benefits for the poor lies in the problems of access, high costs, and minimal human resources. He argues that the private and civil sectors must work in synergy to enhance the benefits of ICT.

Odedra-Straub's (1995) study was on women in IT. She notes some of the general problems, such as lack of financial resources to purchase the hardware and software, and the lack of sufficient computer education and training facilities which aggravate the lack of skills. She concludes that it was difficult to assess the impact of IT on African women properly. The main recommendation in the paper is the need for more IT education and training opportunities for girls and women.

Huyer (1997), on the other hand, wrote during the same period, but discussed issues of access, the benefit to African women of using ICTs, and their role in the production and dissemination of information. The author discusses how to empower African women through ICTs and the barriers to their full use of these technologies, the first being the high rates of illiteracy. According to the author, one of the major findings was that the type of information accessed by women is an important consideration. It is recommended that ICTs be located in local institutions to which women have open and equal access, such as health centers, women's NGOs and churches

A study that is not wholly on women, but that is nevertheless relevant is that of Obijiofor (1998). He compares the Western perspective of communication with the modes of communication in Africa. Communication in Africa is categorized into rural and urban forms, the urban being largely associated with Western influences. Rural communication is largely oral, with people expecting immediate feedback; any modern communication channel should therefore take this into consideration. His hypothesis is that African societies have strong and enduring socio-cultural influences and will therefore embrace technology that promotes greater interaction and sustains kinship. Based on this premise, he sees the telephone as the 'future' technology as it embraces the central element of the African mode of communication – orality. The Internet is considered too impersonal. The challenge, therefore, lies in improving basic infrastructure and ensuring accessibility to, and affordability of, telephone services. An interesting perspective in this study is the emphasis that communication in Africa is largely gender-based.

In general, traditional African societies had certain norms of communication, which limited the areas of discourse open to women. The author believes that new communication technologies will replace (and already have) this form of discrimination and gradually lead to a new era of information democratization. African women are now able to discuss openly issues once considered 'taboo', and sometimes the anonymity provided by the new ICTs has enabled this. His conclusion is summarized into three scenarios, the preferred one being an Africa that does not totally embrace the new technologies without matching them to its socio-cultural practices.

Men's and women's attitudes, needs and perspectives on ICTs are likely to differ and it is important to address the specific needs of women according to Rathgeber (2002). Therefore, a re-conceptualization of the use of ICTs as tools for African development may be necessary, but this must be done in parallel with the reorganization of existing information. Such a move could provide a new role for African universities and research institutions. She argues that the telecommunications policies adopted by many African governments do not make distinctions between the attitudes and needs of male and female users. In addition, these 'gender-neutral policies' tend to favour men, as they are likely to have the income to purchase the ICTs and have a slightly higher level of education, which predisposes them to trying new technologies. In essence, Rathgeber's thesis is that, although the new ICTs can marginalize both men and women in Africa, women are likely to be slower in adopting the new technologies, unless strategies are developed to deliberately include them. To prepare the ground, there should be more emphasis on ensuring that girls become involved in science and technology at an early age. The information they access should be relevant to them, comprehensible and easily available.

ICTs in Developing Countries

The idea that IT can help developing countries is intriguing to many, because of the benefits that have apparently been realized in the West (Avgerou, 1990). As Avgerou (1990) notes 'the literature sometimes contains a naïve taken-for-granted assumption that the success of the West is attributable to ICTs, and therefore bringing the benefits of this development to poorer countries is simply a matter of delivering IT'(p. 243). Motivated by the prospect of greater economic, social, educational and technological gains, both developing and developed countries, are bringing about education reform, with a clear focus on ICT integration in education (Jhurree, 2005).

Although ICT is now at the centre of education reform efforts, not all countries are currently able to benefit from the developments and advances that technology can offer (Kozma & Anderson, 2002). Significant barriers that are often referred to as "the Digital Divide" limit the ability of some countries to take advantage of technological developments (Kozma & Anderson, 2002). Thus, developing countries are faced with challenges related to access, pedagogy or assessment when using ICT to improve and reform education.

Due to the fact that much research in the area of technology integration in education has been conducted in technologically advanced countries, but little in the developing countries, few statistics are available from developing countries (Jhurree, 2005). According to Jhurree (2005), this might imply that the former countries now possess a wealth of knowledge, skills, expertise, and the competitive edge that most of the latter countries do not possess. On the other hand, as Jhurree (2005) suggests, the latter countries can gain a lot from the expertise of their advanced counterparts. Consequently, developing countries might not require investing as much as their more developed counterparts have had to do (Jhurree, 2005). According to a study undertaken by Kozma and Anderson (2002), both developed and developing countries are beginning to use their investment in ICTs to reform education. Moreover, Hepp, Hinostroza, Laval and Rehbein (2004) claim that developing countries have become anxious about the widening gap between their reality and the aggressive ICT policies of some developed countries. Consequently, there is a more urgent need to improve the quality and equity of education to bridge the gap between developed and developing nations, and ICTs are perceived as necessary tools for this purpose (Hepp, Hinostroza, Laval & Rehbein, 2004).

ICTs in Ghana: Strides, Challenges and the Way Forward

Where is Ghana coming from? The speed with which Information Communication Technology (ICT) is developing and its impact on socio-economic activities cannot be overemphasized. ICT, according to UNDP, has been defined to include the full range of electronic technologies and techniques used to manage information and knowledge. It is imperative that Africa is not excluded from the technological revolution. It is a stark fact that the use of ICT has been integrated into virtually every facet of commerce, education, governance and civic activity in developed countries and has become a critical factor in creating wealth worldwide. Unfortunately in Africa, ICT has barely taken a foothold. Computer illiteracy and lack of access to ICT are widely recognized as an increasingly powerful obstacle to the economic, civic and political development of Africa. According to the UN ICT Task Force, nowhere is the digital divide more pronounced than in countries of the African continent. Africa is the most unconnected in an increasing connected world. This is where Ghana as a country finds itself.

Lifting Ghana from the ICT doldrums

However, development of ICT has been argued to provide leapfrogging opportunities for developing countries such as Ghana. According to the Data Development Group of the World Bank, ICT infrastructure in Ghana is progressing as compared to other low-income countries globally and above the 1.1% average for the Sub Saharan Africa. The government of Ghana both past and present and other agencies have over the years made several strides to develop the ICT infrastructure so as to bridge the digital divide between Ghana and the developed world. Prominently featuring among these initiatives is the development of a national fibre optic network called Voltacom Project by the nation's power hub, the Volta River Authority. Recently, Ghana signed an agreement with Microsoft Corporation under which the largest and richest ICT Company in the world would provide resources to improve ICT education in Ghana. To recap, it is important to note that Ghana in 1995 became the first country in the Sub Saharan African to have full internet connectivity. Though Ghana is not yet there as far as ICT infrastructure is concerned, it has been able to chalk some successes in attracting some foreign investors to the country. Some of them are Affiliated Computer Services (a Fortune 500 company and a global leader in IT and Business Process Outsourcing), Data

Management International Inc., Rising Data Solutions, Global Response, Busyinternet, AQ Solutions and Supra Telecom. Most of these companies operating in the country have recorded an average of 50% in revenue and profits. Other U.S companies like Cincom System Inc. a call centre and Convergys Corporation are expected to open offices in Ghana.

Problems and Challenges

However, despite these massive investments in ICT infrastructure and ICT capacity building, Ghana still to a large extent is digitally isolated from the Global Village because it lacks the critical drive and strategies to harness the full potential of ICT for the socio-economic development of the country. These have been some of the challenges facing the full ICT deployment in the country.

Ghana Telecom, the national carrier that is supposed to be at the forefront of ICT development is certainly struggling and has failed to keep up with the times. For the past three years, the carrier has faced a number of challenges. These range from Voice-over IP and international traffic termination issues. This has led GTs international revenue dropping, by as much as $15-$30m per year. Other factors such as bad debt, which is estimated to be as high as $40-$45m annually, in addition to bad management are hampering efforts to operate this critical organization more efficiently and competitively. Mr. Albert Kan-Dapaah, then Minister of Communications and Technology clearly indicated that Ghana needed about 800 million dollars to improve telecommunication infrastructure to support the development of Interconnect Communication Technology (ICT) industry. He further postulated that investment in the telecommunication sector had been declining thus delaying infrastructure expansions and slowing the deployment of value added advanced communication and technological services. (Ghana webs Business News of May 27, 2003)

Among the many identifiable challenges facing the development of the full potential of ICT for education, research and development in the country has been the brain drain syndrome. The effects of the brain drain can be argued to have contributed not only to lack of medical and other critical professionals in the country but also ICT gurus. This has resulted in the lack of the critical mass of ICT engineers and scientists relevant for undertaking ICT related projects professionally. It has also been found out that the most talented people in the area of Science and Technology, if they have not left Ghana for more attractive environments often pursue private agendas. Above all, one critical hurdle has been the lack of enabling environment and the political will to do things. It is interesting to note that Ghana governments have been described in certain circles as a bad virus to ICT development. Ghana can now boast of National ICT Policy document but more needs to be done. Some of the questions that need answers and reflection among others are: Do we have the political will, resources both money and human to embark on the 14 ICT AD priority areas? Do we have the right government, leaders and policy implementers who will defy all odds to create the necessary structures for ICT to take off and to make this dream a reality?

The way forward

However, the solution towards bridging the divide will require a mix of the following strategies: One key solution is to create the necessary awareness in all the organs of government namely the executive, legislature, judiciary and the Press. For us to pull everybody along on the ICT development continuum, it demands the full awareness of our ICT development agenda. The executive should be prepared to sacrifice and prioritize this sector among others on our development agenda and to implement the agenda to the core; the legislature should fully understand the concepts and all the implications of ICT and be prepared to sell this agenda vis- a- vis their political manifestos; the judiciary should be prepared to react swiftly to legalities concerning ICT and the Press should be up and doing in the selling of ICT opportunities and creating the necessary awareness among the citizenry. Much is actually expected from the executive to lead this crusade and to drag all citizens both local (young and old, politicians of the other divide, etc) and foreign towards this development. The zeal with which the current President has been identified in dealing with ICT issues should be manifested in all the executives and the other stakeholders who matter. Based on the recent comparative studies on dynamic industrial clusters in developed and developing countries, it is paramount to create an open and supportive and economic environment or Habitat including a good investment climate, economy and social infrastructure to support entrepreneurship, a culture to encourage innovation and allow failure. In addition to national policies that allow free and open entrepreneurship and national e-government services, regional and community level leadership is necessary to encourage innovative application of ICT to public services, health, education and all aspect of community life. This then requires the efforts of all the citizenry in the maintenance of rule of law. There should be an aggressive human capacity building through training workshops, seminars and courses in collaboration with local and international institutions. Once again, these platforms should not be perceived as talking shops, holiday making ventures and a means to earn some per diem. Ghanaian workshops and training session have been branded as such. However, there should be the conscious efforts to select and support well meaning Ghanaian executives and staff from the various ministries and agencies who actually matter, prepared to learn and impact but not on the basis of seniority or otherwise to attend conferences and courses. We are all witnesses to some conference participants who end up sleeping because of their handicaps in the subjects and themes. The responsible sector ministries should continue to attract the qualified personnel and be prepared to seek the necessary advice (transcending party lines), learn and implement. The call for improvement of the sector based on development, expansion and modernization of communication infrastructure to achieve universal service and access to basic and value added communication service cannot be over-emphasized. As the Honourable Minister of Communication, Mr. Kan-Dapaah rightly put it, the need for this improvement is even more imperative now. The world economy is experiencing the impact of rapid globalization and emerging information age, which is bringing about a new global economic order (see Ghana web's Business News on May 27, 2003).

ICT in Ghana's New Educational Reform

Ghana has since independence made significant strides in its education system. The education landscape in Ghana today is the result of major policy initiatives adopted by past governments as well as the present one.

Indeed these initiatives have not only helped in structurally transforming the education system but also improved considerably access, quality teaching and learning, infrastructure delivery as well as management efficiency. Despite the successes these reforms have had on the educational landscape of Ghana, it has not done much to address the need of the nation in terms of producing a human capacity with all the requisite training in ICTs. Realizing this, governments started introducing computers into Senior Secondary Schools in the late 1990s. The following statement expresses the Government of Ghana's commitment in this direction:

"The ICT revolution is having tremendous impact on the rapid development of world economies and making national economies more interdependent than they were some years ago. The Ministry is therefore committed to making Ghana a key player in today's digital age. To this end, the Ministry has embarked upon a programme to streamline computer studies in secondary schools. Already, a draft ICT policy has been prepared and submitted to Cabinet for approval. A curriculum has also been developed for ICT training and examination at the West Africa Senior Secondary School Certificate Examination (WASSCE) Level. In addition, every effort is being made to provide telephone facilities to all senior secondary schools and training colleges to enable them have access to the Internet".

President John Kufuor recently launched yet another educational reform based on recommendations of Educational Reform Review (2002). The reform prescribes a four-year programme for students and mandates them to study five core subjects, namely: English, Mathematics, Integrated Science, Social Studies and Information and Communication Technology (ICT). Greater emphasis is placed on Science, Mathematics and Information Technology with skills in ICT as a further priority. The government recognizes that ICT skill have become crucial for the survival of the global world and commits to extend the national broadband backbone connectivity throughout the country to facilitate the development of ICT infrastructure in schools. If this is the case, then it is good indeed because it will go a long way to solve some of the ICT access problems.

Concept of Perception

In psychology and the cognitive sciences, perception is the process of acquiring, interpreting, selecting, and organizing sensory information. The word perception comes from the Latin word, percepio, meaning receiving, collecting and action of taking possession, apprehension with the mind or senses. Many cognitive psychologists hold that, as we move about in the world, we create a model of how the world works. That is, we sense the objective world, but our sensations map to percepts, and these percepts are provisional, in the same sense that scientific hypotheses are provisional. As we acquire new information, our percepts shift. In the case of visual perception, some people can actually see the percept shift in their mind's eye. Others, who are not picture thinkers, may not necessarily perceive the 'shape-shifting' as their world changes. Just as one object can give rise to multiple percepts, so an object may fail to give rise to any percept at all: if the percept has no grounding in a person's experience, the person may literally not perceive it.

Cognitive theories of perception assume there is a poverty of stimulus. This (with reference to perception) is the claim that sensations are, by themselves, unable to provide a unique description of the world. Sensations require 'enriching', which is the role of the mental model. Perceptions, not sensations, are self-evident "givens." Epistemology in philosophy is to verify the nature of the perception. To do this, one is first aware of an entity. The verification process makes an identity of it by making measurements, i.e., automatic comparisons. The mental integration of two or more percepts creates a concept. The whole concept of perception is very much connected with all aspects of our lives Perception is one of the concepts, which is widely discussed in the sociological and physiological literature. Various definitions are developed for this issue. Basically there is not much disagreement that perception is “a process of information extraction by which people select, organize and interpret sensory stimulation into meaningful and coherent picture of the world." (Berelson and Steiner, 1964, p.712) In other words, it is how people make sense out of the world around them.

Earliest literature sometimes brings the analogy of perception with mechanical processes like photographing or recording the sound. But this comparison is hardly appropriate since such mechanical processes are just the reflection of society and are not affected by interests, needs, beliefs, attitudes or experiences of individual perceiving that. Forgus and Melamed (1976) based their description of perception on cognitive structures. These are the processes that determine how humans interpret their surroundings. Humans interpret their surroundings on a "higher" level than those of animals, which perceive the world in terms of stimulus-response or reflex-tropistic actions. Humans, on the other hand, perceive their world through information processing. Because all humans extract information from their environment through the same general process, Forgus and Melamed proposed that scientists must pursue the concept of perception by the avenue of information processing. This approach makes perception the central step in the acquisition of knowledge and higher thought. Perception is the "superset," composed of learning, memory and thinking as "subsets" of perception.

Because of the assumption that learning is a subset of perception, it must also be assumed that the process of learning affects the perception of the individual. Learning is defined by Forgus and Melamed as "the process by which this information is acquired through experience and becomes part of the organism's storage of facts in memory." (1976, p. 228). These stored facts in memory then facilitate increased perception by the individual. The chain begins at the stimulus affecting the individual, which triggers learning, which furthers thought. Thinking is considered the highest perceptual process. Thinking is defined as the process occuring when an individual is solving problems. Forgus and Melamed's definition of perception links thinking, learning and perception. This idea of perception as being composed of learning, memory and thinking helps to explain the development of an individual's higher concepts such as language and mathematics, which affect the individual's ability to further perceive their environment.

For example, a baby's perception of the world is initially limited to physical stimuli such as touch, light and sound. These stimuli help the baby learn to process items about their surroundings, which in turn lead to higher thought as the baby continues to develop through childhood and into adulthood. It is important to understand that each process is not independent of the others in this model. All three components (learning, memory, thought) are subsets of perception. Information extraction cannot occur without these building blocks. It is also important to understand that this model is a two-way model. As learning leads to thinking, further thought reinforces learning. Perception is cyclical. We gather information about the world and interact with it through our actions. Perceptual information is critical for action. Perceptual deficits may lead to profound deficits in action (for touch-perception-related deficits).

Allport (1954) defined perception as that which has to do with awareness of object or condition about us and to a large extent dependent upon the impressions these objects make upon our senses as well as an understanding awareness of the recognition of these objects. Thus in primary sense, perception can signify means whereby we come to recognize, identify or characterize something by means of the senses, otherwards, to become aware of stimuli. Though the term has become well established through traditional usage, some modern psychologists prefer to use word perceiving to emphasis that a process is involved. The process involves sensory stimulations being translated into organized experience, that experience or percept is the joint product of the stimulating and the process itself. Perceiving is subject to the influence of learning. Perception is a mental interpretation of physical sensations produced by stimuli from the external world (Pitman, 1990). It is a positive or negative feeling towards a psychological object. According to Evans (1975) perception of things or any subject matter can be permanent, and this would in turn influence a person's actions towards that particular thing. A wrong perception is called misconception.

From the definitions above, perception can be seen as not attitude but a prelude to attitude. The attitude is the precondition of behaviour. Attitudes towards science could be broken down into 3 components;

1. Belief-disbelief

Example: Logical reasons for believing computer to be of personal and social value; computer has made a better place to live in.

2. Like-dislike

Example: Using computer is boring; playing with computer is a good hobby.

3. Behaviour

Example: I would like or not like to be a computer scientist.

Once the student learns these aspects, they are more or less testing and would prove difficult to change no matter the difficulties they encounter in their studies. This would in turn help to shape not only their perceptions of using computer but also their learning environment. Lack of understanding of the basic concepts of ICT can affect the performance of students.

Influences on Perception

There are several factors that can influence one's perception. These factors are both external and internal. These are what draw attention to a subject.

External Factors on Perception

1. Background

Background provides the backdrop upon which humans make perceptions. Backgrounds include noisy rooms or smoky air.

2. Extensity

Extensity refers to an item's size. People generally notice larger items over smaller objects. Given the same color or presentation, a larger item will be seen before a proportionately smaller item.

3. Intensity

Intensity concerns how high above the required threshold level of perception a stimulus is. For instance, a more vividly colored photograph tends to draw attention over a muted portrait. According to Weber's Law, a stimulus must at least reach the just noticeable difference in intensity before the individual will perceive a change.

4. Concreteness

Abstract ideas are more difficult to understand than concrete examples. Concrete ideas explain concepts better and generally receive more perceptual attention than abstract ideas by reducing complexity.

5. Contrast

Underlined typeface draws attention because of contrast; it is different from the text surrounding it. As defined by Rice, contrast "can create apparent intensity of stimulus without utilizing size, loudness or colour."(p. 301) Contrast is different only when considered in its context.

6. Novelty

What is not typical draws attention. Differences in what is considered unusual can complicate this influence on perception. However, all humans notice what is not expected over the mundane.

7. Repetition

Although repetition may also dull one's senses, in its initial stages repetition draws attention by repeating the stimulus. So long as that stimulus is not regularly expected, it may increase the odds for perception.

8. Velocity

Motion tends to draw attention over stationary objects. Perceived movement may be actual or in the case of art or photography simulated.

9. Conditioned Stimuli

Certain stimuli are ingrained into human attention. Examples of these are telephone and doorbell rings, sirens and flashing lights. Even though these stimuli are often repeated, they do not lose their effects because humans have become so attuned to them.

Internal Factors on Perception

Perception is influenced by culture, learning, motivational support, predisposition to new situations and frequency of past confirmation of a congruent type.

1. Learning

Of all the factors that influence the perception of an individual, learning is the most paramount. In every new situation, learning takes place and for that reason it becomes crucial in determining correlates that exist between our past experiences. Because of the assumption that learning is a subset of perception, it must also be assumed the process of learning affects the perception of the individual. Learning is defined by Forgus and Melamed as "the process by which this information is acquired through experience and becomes part of the organism's storage of facts in memory" (1976). These stored facts in memory then facilitate increased perception by the individual.

2. Culture

Culture in simple terms, is the sum total of the way of life of a people. People belonging to a similar culture; perceive people, events, issues and objects in similar ways, hence culture having influence on perceptions.

3. Motivation

Motivation is another factor that influences the perceptual frame of an individual. Even though perception of an individual to objects of percepts is dependent upon his economic, social-cultural and psychological needs, motivation has a role to play. Exhaustion makes humans more aware of the need for rest. Hunger alerts the desire for food. Any time a person is motivated by an internal stimulus, they are more likely to perceive items related to that stimulus. With motivation, the individual may re-structure his internal awareness, up, encourage or discourage person from their normal ways of doing things. But depending on the level or the degree as well as the frequency and source of motivation, the perceiver may or may not change the views he holds concerning the object of percept.

4. Interest

People in the market for a new vehicle are more likely to notice automobile advertisements. When an individual's interest is high for a specific item, that item is more likely to be perceived.

5. Need

Need similarly draws attention to those items which are needed. Petrol is necessary for driving, so when the fuel in a vehicle is low the driver naturally notices filling stations.

Perception is highly subjective and depends upon our needs and expectation as well as our past experience. Perceptions are form by an individual about a subject or an issue in the course of his daily interaction with his environment. In the course of forming perception, an individual shapes like and dislikes. The perception may have towards an objection or issue could be positive, negative or neutral. Perception could be formed by the degree of familiarity one has in connection with an issue. The more familiar one is with an issue, the greater the probability that one will acquire a favourable or a positive perception towards it.

Factors Affecting Students' Perception of their Computer Laboratory Environment

1. Textual Material

ICT has become an integral part of education in certain schools in Ghana for some time. However, many schools still do not have computers or information resources with which they can provide resource-based education. Most schools face problems of poor infrastructure, lack of logistical support, inadequate material input, and lack of qualified teachers.

2. Lack of Teachers

The training of teachers is perhaps the most crucial aspect of ICT implementation. Teachers need to be trained to develop key competencies in the use of ICTs. It must be noted that these go beyond the mere knowledge of basic computer software. The main aim is to develop teachers as multi-skilled educational professionals who can cope with the challenges of using technology to transform their classrooms and schools. It involves an understanding of the new curriculum, and how computers can be useful in bringing its aims to life.

3. Teaching Methods

Bloom (1981) wrote that teaching and learning aids are objects that make teaching more effective learning easier. Children learn by doing and observing. The above calls for real life situations in computer laboratories, which bring the student close to what is been taught. Brunner (1966) wrote that the way a subject is taught could affect the subject perception by the students. He advocated for special teaching methods in the handling of subjects as ineffective teaching methods can affect the way students perceive the subject. He suggested change in the system to enable students understand the subject with minimum difficulty. Students' interest could be generated through the occasional setting of projects in ICT.

Concept of Selective Perception

Selective perception occurs when two different individuals perceive a stimulus in different ways. According to Assael(1992), selective perception operates at two levels: a higher and a lower. In the case of a high-level case of selective perception humans selectively choose or expose themselves to information that confirms previous beliefs or helps them make informed choices. Low-level selective perception occurs when humans block out information to avoid overload.

Selective perception serves at least two purposes.

Perceptual vigilance leads individuals to the information they need or desire. Humans are constantly bombarded by information from millions of internal and external sources per day. Selective perception allows the individual to sort through the sensory data either consciously or subconsciously in order to choose the most relevant information. This is crucial to low-level processes.

Perceptual defense helps individuals avoid cognitive dissonance by highlighting information that is contrary to firmly-held beliefs and may be rejected. In the case of Ghana Education Service, this explains why most graduate and non graduate teachers tend to vote for candidates within their association: they reduce cognitive dissonance by rejecting messages from the opposition, even though those messages may be truthful.

Just as perception is a superset to learning, memory and thought, selective perception is a superset to various other components.

Elements of Selective Perception

The various elements of selective perception are:

1. Selective exposure
2. Selective attention
3. Selective comprehension
4. Selective retention

Selective exposure

Selective exposure is a result of deliberate human selection of input. Research shows that individuals have a predisposition towards certain stimuli in which they are interested or partial to. In fact, this reinforces the idea of selective perception. A study conducted by

Bradley and Buell showed a statistical significance between exposure to numerous media and individuals who believed they were on the winning side of an election. Those who believed they were on the losing side of the election responded that they were exposed to fewer media. It may be inferred that the "winners" were reinforcing their beliefs by pursuing more media information, while the "losers" were avoiding cognitive dissonance by exposing themselves to less mass communication (1965).

Selective attention

Selective attention provides awareness of supportive information and avoidance of information that is perceived negatively. It does so by selecting the elements from a situation that will be allowed to exert an influence on the perceiver, and focusing attention on those elements. Selective attention is a low-level aspect of selective perception.

Selective comprehension

This element of selective perception interprets information so that it confirms previously held beliefs and attitudes. Selective comprehension is a high-level aspect of selective perception.

Selective retention

This is the memory aspect of selective perception. It is through this mechanism that information selected in the previous steps is stored for later retrieval. Generally this information is given preference to information that does not fall in line with previously held beliefs and attitudes. It is important to understand that learners will not perceive the same message from all teachers. Therefore, the study of selective perception is important in order to make each message reinforce positive images in current users' minds. Understanding selective perception is useful in the following ways:

A. Reinforcing Current Perceptions

Studies of perception clearly indicate that there is a cyclical process involved in perception. A lesson that reinforces positive images in a learner's mind makes the continued assumption of that position easier. Likewise, a lesson that does not reinforce positive construction of knowledge (i.e., a poor lesson) creates dissonance in the learner's mind and risks being perceived in a poorer light than competitors. The stimulus (good or bad) leads to learning, thinking and memory concerning the lesson. This is the learner's perception of the lesson.

B. Communicating to Target Groups

Assael (1992) writes that instructors should clearly mention their lesson objectives when teaching if the target is well-defined. The selective perception principle behind this belief is perceptual vigilance. The clearly-defined target group will already be looking for information regarding the lesson, so it is important to include the information in which that target group is interested.

Basic Assumptions in Designing Perception Measuring Tools

To be able to effectively measure people's perception, some assumptions have been made by researchers about perception itself.

1. A person's perception can be measured by asking questions about thoughts, feelings, and likely actions toward the perceived object.
2. Perception can be measured by a quantitative technique i.e. each person's opinion can be represented by a numerical score.
3. A particular test item, or other behaviour indicating a perception, has the same meaning for all respondents, so a given response is scored identically for everyone making it.
4. Because one question will simply not address all the likely domains of a perception, perception test items are arranged along an evaluative continuum ranging from favourable to unfavourable.
5. Each perception statement should represent a different and independent view about the attitude objects and should cover both favourable and unfavourable perceptions, so that the nature of the response to one item should not affect the response to another.

Methods of Measuring Perception

Several methods have been developed for measuring perception. Three most common of these methods are The Thurston Scale method, The Liket Scale method and the Social Representation conceptualizations.

1. The Thurston Scale

Thurston's method involves defining and identifying the object, then making a pool of opinion statements, some positive, some negative and some neutral. He develops 3 scales of measuring attitude namely: Paired Comparisons, Equal-appearing intervals, and Successive intervals. The Paired Comparisons method requires that perception comparisons be paired in every possible combination. This method is considered tedious because 20 students alone will result in 190 pairs. In Equal-Appearing Intervals method judges sort statements one at a time on a range of extremely favourable to extremely unfavourable. It is much like likert scaling, except that neutral items are required to incorporate the entire spectrum of attitude about an object. The Successive Interval method is an extension to the equal-appearing intervals scaling. It uses the number of times different judges rate a statement to develop the rank order for the scales (Farris, 2005).

2. The Likert Scale

However, if we want to measure abstract objects, we must define them clearly so the researcher and the subject will have the same object in mind. Likert believed in constructing multiple scales, or narrowly Likert stressed that when trying to measure perception for something, it is easier to measure for tangible objects than for abstract objects defining scales so other dimensions would not be included. He generated an item pool which included statements about beliefs for the object in question. Each item was clearly positive or negative. Likert did not use neutral statements.

3. Social Representation Method

This method assumes that social constructions – ideas and opinions which we hold are molded by what other people believe and say. "Our reactions to events, our responses to stimuli, are related to a given definition, common to all the members of the community in which we belong" (Moscovici, 1983, p.5). Augoustinos (1991) indicated that, group members of each community have similarities and differences (individuality) and if social representations are cognitive structures shared on a group basis, agreement between members of that group should increase with age. In spite of the numerous methods developed to measure perception, no one method has proved highly satisfactory to researchers owing to some major constraints identified in perceptions measurement.

Problems in Perception Measurement

One major problem identified in perception measurement is the variability and difficulty in defining the 'perception'. The study of perception as a means of measuring behaviour has therefore been greeted with mixed feelings. While some view perception guide actions and thus, can be measured from the later, some psychologists, are skeptical abut it since people may say one thing and do another. Other major problems in attitude measurement include lack of common methods of measurement and Reliability and Validity problems. Although the Likert scales are generally considered more reliable than Thurstone scales, validity still remains a contested issue (i.e. is what is being measured a perception?). Critics would say that what are actually being measured are demand characteristics. Therefore, measuring attitudes and their relationship to behaviour is a complex and subtle business although very necessary in research.

Summary of Literature Review

This review set out to identify and evaluate relevant strategies in local, national and international research and initiatives related to measuring and demonstrating the impact of ICT in schools with regard to: students, learning and the learning environment, teachers and teaching strategies, organisational change, and other areas relevant to teaching and learning in senior high schools in Ghana. This included the conception of learning environment and the rational for the use of ICT in schools. As a result a framework was developed to articulate the areas of impact of ICT in schools and strategies for monitoring and evaluating each of the areas of impact at the school and system levels.

CHAPTER THREE

RESEARCH METHODOLOGY

Introduction

This chapter discusses the research design and the process of empirical investigation which guided by the research questions and hypothesis. The research methodology is explained with specific reference to the data collection, the relevant data processing techniques and method use to interpret the data collected.

Research Design

Research design provides the glue that holds the research project together. A design is used to structure the research, to show how all of the major parts of the research project, the samples or groups, measures, treatments or programmes and methods of assignment work together to try to address the central research questions.

For the purpose of this study, a descriptive survey was used. This design was used because the sample was neither multiple groups nor multiple wave of measurement. Also it was used because the research did not aim to establish a cause-effect relationship. The descriptive survey design is relevant in most observational or descriptive studies.

Descriptive survey is used to obtain information concerning the current status of the phenomena to describe what exists with respect to variables or conditions in a situation. The methods involved range from the survey which describes the status quo, the correlation study which investigates the relationship between variables, to developmental studies which seek to determine changes over time. Generally, in a descriptive study, the emphasis is on estimation rather than testing.

Survey studies assess the characteristics of whole populations of people or situations. School surveys are used to gather data concerned with internal or external characteristics of a school system. Descriptive research has as its major objective the description of something like behaviour. This design is appropriate because it does not permit manipulation or control factors that may influence the subjects' behaviour or performance by the researcher. It also focuses on contemporary events and the research questions are exploratory. Descriptive study is conducted to help in planning resource allocation, identify areas for further research and provide informal diagnostic information

Sample

Sampling is the process of selecting a proper subset of elements from the full population so that the subset can be used to make inference to the population as a whole. The sampling frame must be representative of the population. A larger sample size was chosen to make the sample more representative of the population. The sampling method that was used for selecting the sample from the population was simple random sampling. In simple random sampling, there is an equal chance for each member of the population to be selected for the sample. The instrument was administered to students from six co-educational senior high schools in the Central Region undertaking different courses. For the purpose of the study, the schools were grouped into two: Urban High Schools (UHS) and Community High Schools (CHS). A sample of 278 students who have had at least one year of ICT laboratory experience was randomly chosen from the six schools. There were 131 students from CHS and 147 students from UHS. The sample consisted of 171 males (61.5%) and 107 females (38.5%). The mean age of the students was 17.4 years with a standard deviation of 0.86 years.

Instrument

The instrument for assessing computer laboratory environment is based on the actual version of the Personal form of the Science Laboratory Environment Inventory (SLEI) designed by Fraser, Giddings & McRobbie (1993). The SLEI has five scales, Student Cohesiveness, Open-Endedness, Integration, Rule Clarity and Material Environment, using five items per scale. Initially, all scales except Rule Clarity was seen as being relevant to computer laboratories. The instrument called the Computer Laboratory Environment Inventory (CLEI) was used to measure students' perceptions of the computer laboratory class as a learning environment. Students' perception of their computer laboratory environment was measured using a 23-item Computer Laboratory Environment Questionnaire (CLEQ) developed for the study (see Appendix B). The Science Laboratory Classroom Environment Inventory (SLEI) developed by Fraser, McRobbie & Giddings (1993) served as a guide in developing the CLEQ. In developing the CLEQ it was assumed that students' perception of their computer laboratory environment was multi-dimensional. The scales measured Supervision, Integration, Technology Adequacy, and Laboratory

Availability. Each item was scored on a five-point Likert-type scale (5-Almost Always, 4-Often, 3-Undecided, 2-Not Often, 1-Amost Never). The higher the scale score, the more a student would demonstrate that particular scale of perception.

When using a classroom environment instrument, it is usual to validate the instrument by the use of Cronbach's alpha coefficient as an index of internal consistency (the extent to which items in the same scale measures the same dimension), so the internal consistency of each scale of the instrument was pre-tested. Table 1 presents alpha coefficients for the CLEI using individual student as the unit of analysis.

Table 1: Internal Consistency (Cronbach Alpha Coefficient) of each Scale of Perception Instrument

Scale	Alpha reliability
Supply material environment	0.73
Integration	0.64
Supervision	0.67
Reliable material environment	0.61
Overall	0.82

Table 1 shows the internal consistency of all the CLEI scales. It was realized that all the four scales had an alpha reliability greater than 0.60, which is the minimum acceptable reliability of scales for research work.

It was realized that items 1, 2, 3, 4 and 5 loaded on supply material environment, items 6, 7, 8 and 9 answered reliable material environment, items 10, 11, 12, 13 and 14 on supervision while items 15, 16, 17 and 18 loaded on integration. Factor analysis led to the removal of five items (Items 19, 20, 21, 22 and 23) from the CLEI. The reasons were that items 11 and 16 loaded significantly on more than one scale. Item 14 seemed to be a strange measure of material environment and were therefore removed. Open - Endedness did not emerge as a factor during the validation of the CLEI as items 4 and 19 that belonged to that scale were deleted.

For the purpose of this study, item analyses procedures were conducted on the set of 18 items making up the CLEI. Table 1 presents alpha coefficients for the four CLEI scales using the individual student as the unit of analysis. Coefficients ranged from 0.61 to 0.76, exceeding the threshold of 0.60 given by Nunnally (1967) and cited by Henderson, Fisher and Fraser (1998) as being acceptable reliability for research purposes. The overall Cronbach alpha coefficient was 0.84. There were very low neutral responses suggesting evaluative quality (that favourable-unfavourable feeling toward and object or idea) of the instrument. Also the data generated by items of the CLEI instrument are distributed across Likert's continuum, which also suggests evaluative quality.

Data Collection

An introductory letter was obtained from the Center for Continuing Education to be given to the headmasters of the schools. This was to inform the headmasters of the mission of the researcher and thereby allowing the researcher to collect the data. The respondents were told that the exercise was for academic purpose and that confidentiality was assured in order to motivate them to give their responses without reservation.

In each of the six schools, questionnaire was distributed to students in their computer laboratory by the researcher. Students were allowed enough time to complete the questionnaire. The questionnaire was coded to indicate school and age of respondents. The completed questionnaire was collected the same day.

Data Analysis

Descriptive statistics were adopted for presenting and analyzing the data in this thesis. The researcher summarized patterns in the responses from the sample by the use of by the use of frequency tables and percentages.

Items in the questionnaire consisted of closed ended items. The data collected from the closed end items was analysed using the Statistical Package for Social Sciences, (SPSS). Since the study is purely descriptive, descriptive statistical analysis was used.

For computation into the SPSS, the coded questionnaires were fed into the computer. Frequencies for the items were computed. The data was synthesized and transformed into tabular form to illustrate the relative proportions where applicable. The analysis was done using the research questions. Trends that emerged were highlighted and comments were passed on them in relation to the literature that was reviewed. To determine the internal consistency (reliability) of the instruments, the Cronbach's Alpha was used. The independent samples t-test was used to compare the mean scores for the data provided by the students. This was done to test the two (2) hypotheses formulated to guide the study. For the purpose of the study, it was assumed that more than one factor explain the perception of students as far as their computer laboratory is concern.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This chapter is devoted to the results of the analysis of the data collected. The chapter is organized under two main headings. Whenever applicable, tables are provided to illustrate and support the findings. The chapter is organized under two main headings. Section one covers results of the analysis of background characteristics of respondents and research questions using simple percentages. Section two covers the analysis along the line of the hypothesis formulated to guide the study.

Background Characteristics of Respondents

This part of the analysis sought to find out whether students have different backgrounds in terms of characteristics and experiences they have been exposed to in their computer laboratory learning environment. It is important to know the background characteristics and experiences of respondents in order to make informed decisions about how they see their computer laboratory learning environment.

For the purpose of the study, six schools were chosen randomly with three in urban and three from rural communities. Table 2 gives an account of the schools under study.

Table 2: Senior High Schools Respondents Attend

School Name	School-type	Frequency	Percent (%)
Ghana National College	Urban	49	17.6
Aggrey Memorial	Urban	52	18.7
University Practice	Urban	46	16.5
Edinaman	Community	57	20.5
Eguafo	Community	31	11.2
Jukwa	Community	43	15.5
Total	6	278	100

From Table 2, we realize that almost equal number of schools was chosen from urban and rural areas. The focus was to make sure a fair knowledge of what existed in the two settings is obtained.

The schools were, therefore, grouped into two types: Urban High School (UHS) and Community High School (CHS). The highest number of respondents, 57, was selected from Edinaman while 31 were from Eguafo being the least. The schools were categorized into two groups according to where they were located. The categories are shown in Table 3.

Table 3: Category of School

School-type	No. of Respondents	Percent (%)
Urban	147	52.8
Community	131	47.2
Total	278	100

It can be seen from Table 3 that the sample of 278 students was made up of 147 (52.8%) form the Urban schools while the remaining 131 (47.2%) came from Community schools.

The data also took into account the gender of respondents. The result is reflected in Table 4.

Table 4: Gender of Respondents

Gender	Frequency	Percent (%)
Male	171	61.5
Female	107	38.5
Total	278	100

From Table 4, it can be seen that the sample consisted of 171 males (61.5%) and 107 females (38.5%).

Respondents were also asked to indicate their age. The result is presented in Table 5.

Table 5: Age Distribution of the Study Sample

Age	Frequency	Percent (%)
15-17	235	84.5
Over 17	43	15.5
Total	278	100

We realize from Table 5 that a majority of the students 235 (84.5%) were 17 years or below with just 43 (15.5%) above 17years.

Research Question 1: What is students' general perception of their computer laboratory environment?

Question one was formulated to find out how students in their study generally perceived their computer laboratory learning environment.

The extent to which laboratory equipment and materials are available and adequate is an important factor to consider when studying learning environment. Items 1, 2, 3, 4 and 5 were used to assess students' perception on Supply material environment in their learning environment. The result of the analysis is presented in Table 6.

Table 6: Students Assessment of Material Supplied in their Laboratory Environment

Response	No. of Respondents	Percent (%)
Almost Always	101	36.3
Often	62	22.3
Undecided	34	12.2
Not Often	51	18.3
Almost Never	30	10.8
Total	278	100

Table 6 shows the extent to which the materials in the laboratory are adequate. About 36% of students agreed this is the case at any point in time whiles 10% do not agree totally to this fact. An appreciable proportion of students, (12.2%), were undecided about supply of material environment when it comes to computer laboratory.

The extent to which there materials in the laboratory yield good results was also observed. Items 6, 7, 8 and 9 were used for that purpose. The outcome of the responses is presented in Table 7.

Table 7: Reliability of Material Environment

Response	No. of Respondents	Percent (%)
Almost Always	94	33.8
Often	36	12.9
Undecided	22	7.9
Not Often	49	17.6
Almost Never	77	27.7
Total	278	100

Table 7 shows the extent to which the equipments and material in the laboratory yield the expected results. 130 (46.7%) of the total sample agree this is the case at any point in time whiles almost the same number, 126 (45.3%) do not agree totally to this fact. A small number, 7.9%, of students were left undecided about this observation.

Supervision is a crucial area as far as laboratory is concerned. Items 10, 11, 12, 13 and 14 were used to collect data in that respect. The result of the analysis is shown in Table 8.

Table 8: Supervision in the Laboratory

Response	No. of Respondents	Percent (%)
Almost Always	97	34.9
Often	62	22.3
Undecided	20	7.2
Not Often	53	19.1
Almost Never	46	16.5
Total	278	100

From Table 8, it can be observed that 97 (34.9%) students are definite about the fact that at any point in time, there is some form of supervision in the laboratory. However 46 (16.5%) of students are very definite about the fact that this is not the case.

The study also assessed the level of integration in the use of the laboratories. Items 15, 16, 17, and 18 were used to collect that information. The result is tabulated in Table 9.

Table 9: Level of Integration in the Laboratory

Response	No. of Respondents	Percent (%)
Almost Always	70	25.2
Often	66	23.7
Undecided	26	9.4
Not Often	66	23.7
Almost Never	50	18.0
Total	278	100

The extent to which what is taught in classroom is integrated with computer laboratory activities are reported in Table 9. It can be seen that, a greater number of students are sure that whatever is taught in the classroom has some relation to what is done in the laboratory.

Research has suggested that a positive classroom environment enhances and motivates student learning. From the results of the study, students generally had a good perception of their learning environment. The psychosocial dimensions emphasized in this study were the four computer laboratory climate scales of Supply material environment, Supervision, Reliable material environment and Integration. The results of this study suggest that students' perception of their computer laboratory climate to be good. The students appear to enjoy a positive classroom climate with high levels of supply material environment, supervision and integration but low levels of reliable material environment. This suggests that even though students are supportive of the fact that there is enough supply of materials, not all materials provide reliable result. This could be regarded as a negative indication and should not be treated lightly. As reliable results is essential for effective learning to take place in the laboratory, it would be worthwhile to examine further what could be done to help students study in a reliable environment.

Research Question 2: What factors explain students' perception of their computer laboratory learning environment?

The essence of this question was to explore factors that determine how students perceive their learning environment.

The approach used in deciding the number of factors underlying students` perception of their laboratory learning environment was to generate a scree plot. The 23 items from the CLEI were analysed using principal axis factor analysis. The result is shown by the scree plot in Figure 1.

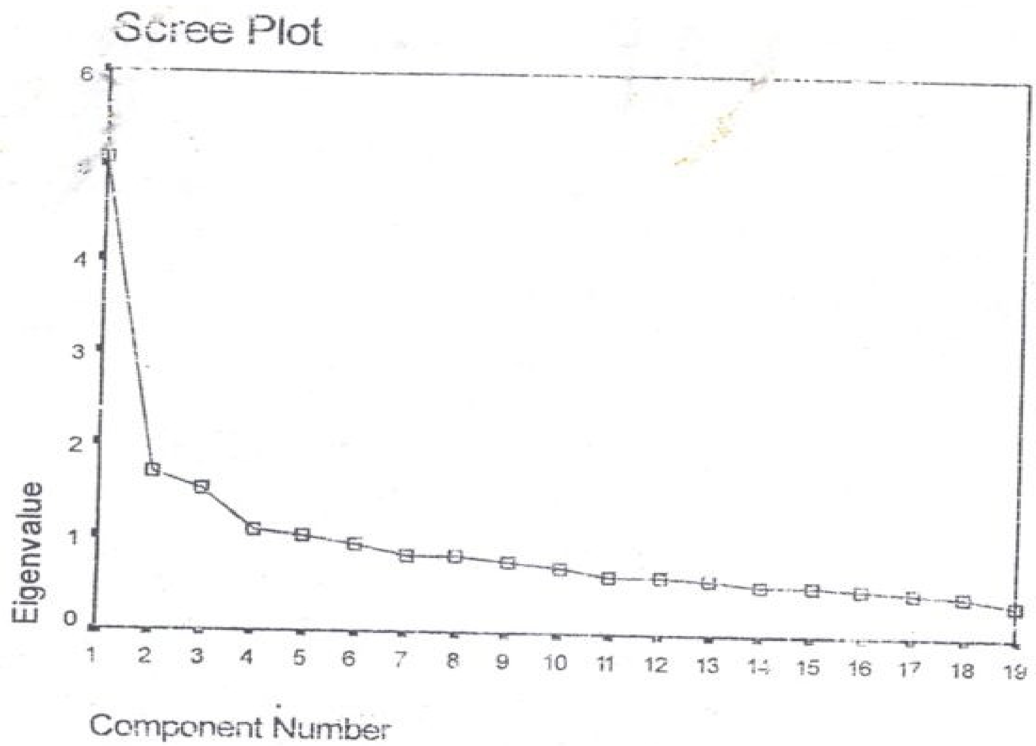

Figure 1: Scree plot of eigenvalues of perception instrument

From Figure 1, it can be seen that four scales had their eigenvalues more than 1. This confirm that the CLEI consisted of more than one linear scale and hence the assumptions that more than one scale influence students´ perception of their computer laboratory environment was upheld.

Even though the scree plot strongly suggests a final solution with three principal components, there were five eigenvalues greater than one. The rotation of these five components using varimax rotation and the resultant interpretations station seemed more reasonable. Consequently, four factors with eigenvalues greater than one were rotated using Varimax rotation procedure. Table 10 Shows the loadings obtained as a result of the factor analysis.

Table 10: Rotated Component Matrix Showing Factor Loadings and Amount of Variance Explained for the Final Perception Instrument

	Factor			
Item Number	**1**	**2**	**3**	**4**
8	607			
13	606			
2	560			
20	550			
7	504			
12		598		
9		569		
18		524		
10		486		
17		484		
22			652	
15			575	
1			514	
6			462	
21				486
5				485
3				484
23				452
% of Variance explained	26.6	9.1	8.2	6.2
Eigenvalue	4.6	1.7	1.4	1.1

Table 10 shows rotated component matrix with factor loadings and amount of variance explained for the final perception instrument. Factor 1 = Supply Material Environment, Factor 2 = Supervision, Factor 3 = Integration and Factor 4 = Reliable Material Environment.

It was found out that more than one scale influence students' perception of their computer laboratory environment. The study identified four factors that underlie students' perception of their computer laboratory environment. The four factors that emerged in this study and their interpretations are given in Table 11.

Table 11: Scale and Description of the Final Perception Instrument

Scale	Description
Supply material environment	Extent to which laboratory equipment and materials are available and adequate
Reliable material environment	Extent to which laboratory equipment and materials are reliable when used
Supervision	Extent to which students receive help and are guided by their teachers during ICT practical activities
Integration	Extent to which laboratory activities are integrated with non-laboratory theory classes

The final form of CLEI and their descriptions are presented in Table 11.

From the results of the scree plot, it was realized that the CLEI consisted of more than one linear scale and hence the assumptions that more than one scale influence students´ perception of their computer laboratory environment was upheld. Four factors were found to explain students' perception of their computer laboratory learning environment. They are supply material environment, integration, supervision, and reliable material environment.

Testing of Hypotheses

Hypothesis 1: There is no statistically significant difference between boys and girls perception of computer their laboratory environment.

This hypothesis sought to explore how boys and girls perceive their computer laboratory learning environment.

Testing for the differences between the two groups, boys and girls, was done using the t-test. The t-test gives an indication of the separateness of two sets of measurements, and was thus used to check whether two sets of measures are essentially different (and usually that an experimental effect has been demonstrated). The independent samples t-test was used because measures from the two samples being compared do not come in matched pairs. Table 12 gives the t- value of the two groups, male and female.

Table 12: The T –Test Value for the Independent Groups

Sex of Student	N	Mean	SD	Mean Difference	t	p
Female	107	3.49	.73	0.12	2.94	0.03*
Male	171	3.38	.69		0.01	0.99

*p<0.05

From Table 12, it can be seen that a t-value of 2.94 produced a p-value of 0.03. Similarly, a t-value of 0.01 gave a p-value of 0.99. This clearly is not in agreement with the null hypothses when it comes to female students.

The gender-type related difference on the scales was explored using the instrument. The scale means and standard deviations for the preferred perception scores for male and female students obtained for each of four CLEI scales are tabulated in Table 13.

Table 13: Scale Means and Gender Difference in Students` Perception of their Computer Laboratory Measured by CLEI Scales

	Male		Female				
Scale	**Mean**	**SD**	**Mean**	**SD**	**Mean Difference**	**t**	**p**
Supply material Environment	17.49	3.21	17.48	2.92	0.01	-2.79	0.01*
Integration	20.87	2.42	21.23	2.38	0.36	0.88	1.23
Supervision	19.36	2.87	19.64	2.88	0.28	-0.53	0.59
Reliable material environment	20.89	2.34	21.35	22.12	0.46	1.54	0.12

*p<0.05

From Table 13, it can be seen that the score of p for supply material environment was 0.01 and is less than 0.05, the reference figure.

Examining whether there is any significant difference between boys and girls in their computer laboratory environment gave a p-value of 0.03. This is less than the reference value of 0.05 and this suggest there is a significant difference between the two groups. Also a test on gender difference in students` perception of their computer laboratory measured by the CLEI scales revealed that when it comes to reliable material environment, supervision and integration, both male and female students have just about the same perception. The p-value for each of the mentioned scales was more than 0.05 and hence indicates that there was really no statistically significant difference in the perception as far as these scales are concerned. However, students from both groups perceived differently when it came to the supply of material environment. The t-value of 0.01 is less than 0.05 and hence bringing up a satistically significant difference as far as this scale is concern. The above explanations suggest a rejection of the null hypothesis that there is no statistically significant difference between boys and girls in their perception of their computer laboratory environment. Female students generally had a positive perception of their computer laboratory learning environment.

Hypothesis 2: There is no statistically significant difference between students in urban and community schools in their perception of their computer laboratory environment.

This hypothesis sought to find out if there is any difference in the way the two school-types see their computer laboratory learning environment.

Testing for the differences between the two groups, urban and community schools was done using the t-test. The t-test gives an indication of the separateness of two sets of measurements, and was thus used to check whether two sets of measures are essentially different (and usually that an experimental effect has been demonstrated). The independent samples t-test was used because measures from the two samples being compared do not come in matched pairs. Table 14 gives an account of the t-value of the two groups.

Table 14: The T –Test Value for the Independent Groups

Category of School	**N**	**Mean**	**SD**	**Mean Difference**	**t**	**p**
Urban	147	11.14	3.08	4.74	2.90	0.01*
Community	131	6.40	2.07		1.09	0.28

*p<0.05

From Table 14, it can be seen that a t-value of 2.90 produced a p-value of 0.01 and this suggest that the null hypothses is not true and that there is a significant difference between the two school-type when it comes to how the students perceive their computer laboratory learning environment.

The school-type related difference in perception was explored using the t-test to test whether there is significant difference the means of the two school category. Table 15 reports the categories of school difference as measured by the CLEI.

Table 15: Scale Means on the Perception Instrument

	Community		Urban				
Scale	**Mean**	**SD**	**Mean**	**SD**	**Mean Difference**	**t**	**p**
Supply material Environment	3.51	0.33	3.63	0.41	0.12	2.10	0.03*
Integration	3.59	0.64	3.85	0.53	0.26	1.23	0.09
Supervision	3.77	0.46	4.04	0.46	0.27	3.29	0.99
Reliable material environment	3.57	0.63	3.83	0.44	0.26	-1.19	0.13

*$p<0.05$

The Table indicates that the null hypotheses that there is no statistical difference between students from the school-type can be rejected when it comes to supply of material environment. The results show a statistically significant difference between students in urban and community schools in their perception on supply of material environment. A general comparison of the means shows that students from urban schools had a positive perception of their computer laboratory learning environment than their counterparts in the rural schools. A test was therefore conducted on the various items that relate to this scale. The means and standard deviations were compared and reported in Table 16.

Table16: Mean Scores for Items Constituting Supply Material Environment Environment in Two School-Type

Item No.	Supply Material Environment	Urban		Community	
		Mean	SD	Mean	SD
2	We have enough computers in our school computer laboratory for practical	2.64	2.26	1.36	1.23
7	Our school computer laboratory has enough room for individual/group work	2.73	2.65	1.42	1.51
8	Our school computer laboratory is an attractive place to work	3.23	2.31	1.37	1.51
13	The materials students need for practicals are readily available in our school computer laboratories	2.26	2.01	1.34	1.21
20	We are supplied with all the equipments we need for our experiments in our school laboratory	3.07	2.24	1.32	1.41

Average score = 2.30; Maximum score = 5.00

Table 16 shows mean scores for items constituting supply material environment. It indicates that items 2 and 13 were below the average of 2.50 in Community schools.

Discussion

The results of this study suggest that students' general perception of their computer laboratory learning environment appear is quite positive. Students perceived their computer laboratory learning environment as not fully equipped with materials. This could be regarded as a negative indication and should not be dismissed lightly. As supply of material environment is essential for effective learning to take place in classrooms, it would be worthwhile to adequately equip schools with the needed facilities and replenish their stock of equipment and material from time to time.

The hypothesis that there is no significant difference between boys and girls in their perception of computer laboratory environment was tested. A general comparison of means obtained by males and females on the preferred scale of the CLEI showed that females scored significantly higher. This suggested that females generally had higher expectations of their computer laboratory learning environment than their male counterparts. This finding is in line with that reported in previous research on gender differences in classroom environment perceptions (Lawrence, 1987; Wong & Fraser, 1996).

Female students perceived that within their computer laboratory, there are adequate supply and availability of materials. This finding is hardly surprising and appears to corroborate with similar findings on gender differences in the classroom. In a study by Goh and Fraser (1997), they found that at primary school level, the girls in Singapore generally viewed their classroom environments more favourably than boys. In Fisher and Rickards' (1998) study, statistically significant gender differences were detected in student's responses to classroom environment scales. They found that females perceived their learning environment in a more positive way than do males.

The hypothesis that there is no significant difference between students in urban and community high schools in their perception of computer laboratory environment was also tested. School-type related a difference in perception was explored and showed that the population means on the scales are the same for urban and community schools. Therefore, the result of this study shows a significant difference between students in urban and community schools in the perception of their computer laboratory environments.

Students from urban schools perceived significantly, a more favourable supply material environment than their counterparts in community schools. This result is not surprising since urban schools' laboratories are expected to be very well equipped. A less favourably perceived supply material environment could arise if equipment and materials are not replaced when they get spoilt or are exhausted. Also, increase in population of students per laboratory session could outnumber the quantity of equipment and materials available in schools. Mean scores for the items constituting supply material environment indicate that students felt the quantity, availability and supply of equipment and materials were unsatisfactory in these schools. The mean scores of the rest of the items on the supply material environment scale of communtiy schools were only a little above average. Since this scale accounts for more than a half the total variance of students' perception of their psychosocial environment, it is a very important factor to be considered in setting up computer laboratories to promote ICT practical activities in schools. Computer laboratories with scanty equipment and materials would definitely not make a good impression on students. Students from both type of schools however, had similar perceptions of the reliability and use of computer laboratory equipment and materials. The higher than average scores on this factor for both school types and the fact that there was no significant difference between them shows that to some extent there were some workable computers in the computer laboratories in both school types.

In summary, this chapter provided answers to two research questions and two hypotheses formulated for the study. The findings reveal that respondents generally had a positive perception of their computer laboratory environment.

Another finding of the study was that gender had a bearing on the way students perceived their computer laboratory learning environment. In the same vein, a statistically significant difference was noted between schools in urban and rural communities.

Finally, the study was conclusive on the assumptions that more than one scale influence students´ perception of their computer laboratory environment learning environment.

In summary, the study identified four factors that underlie students' perception of their computer laboratory environment. These are (a) supply material environment, (b) reliable material environment (c) integration, and (d) supervision. This means that more than one factor significantly influenced students' perception of their computer laboratory environment. This confirms findings from other studies reviewed in the literature (Fraser

& Walberg, 1991; Fraser, 1994; Henderson, Fisher & Fraser, 1998; Taylor, Fraser & Fisher, 1997; Chin & Wong, 2002; Raaflaub & Fraser, 2002).

The results also showed that students' general perception of their computer laboratory environments in both urban and community schools were positive but significantly different in favour of students in urban schools. Students from urban schools expressed significantly more satisfaction with the quantity, availability and supply of equipment and materials in their computer laboratories than their counterparts from community schools. This factor dominated students' perception of their computer laboratory environments. The difference between the perception of students in urban and community schools may reflect the laboratory conditions in these schools. However, there was no significant difference in how students from both type of schools perceived the reliability and use of equipment and materials in their computer laboratories. Also students from both urban and community schools appear to enjoy very high and similar levels of supervision and integration.

Material environment and integration as factors influencing students' perception of their learning environments have been reported in studies by other researchers (Fraser, McRobbie & Giddings, 1993; Henderson, Fisher & Fraser, 1998; Chin & Wong, 2002; Raaflaub & Fraser, 2002). For example, Chin and Wong (2002) reported that in Singapore, primary school pupils surveyed indicated they wanted a much better material environment for the study of ICT. However, unlike these studies, which had only one material environment as a factor, this study found two types of material environment, which were clearly distinguishable.

Even though integration as a factor influencing students' perceptions of their laboratory environment has been reported in the literature, supervision which has not yet been reported in the literature was found in this study to be a factor influencing students' perceptions of their computer laboratory environment in both urban and community schools.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Introduction

The purpose of the study was to investigate the perception senior high school students have about their computer laboratory in some selected schools in Central Region. This chapter presents a summary of findings and conclusions drawn from the study. It makes recommendations for action and suggests areas for further study to improve upon the utilization of computer laboratories in senior high schools in the country.

Summary of Study

The researcher aimed at finding out how students perceive their computer laboratory learning environment and how it affects their learning in selected senior high schools in Central Region. Three schools were selected from urban communities and another three from rural communities. The researcher administered 278 questionnaires. The results of the data analysis provided a number of findings with respect to students' perception of their computer laboratory learning environment and how it affects their learning process. These are:

1. All the six schools had computer laboratory with computers setup for use.

2. Students in general had a positive perception about their computer laboratory.

3. Even though students had a good perception of their computer laboratory learning environment, female students were very much optimistic about this learning environment than their male counterparts. This therefore means the rejection of the null hypotheses that there is no statistical difference between male and female perception as far as this study is concern.

4. It also came up that four factor, Supervision, Integration, Supply Material Environment and Reliable Material Environment, explained students' perception of their computer laboratory learning environment.

5. Similarly, the hypotheses that there is no statistical difference in perception between rural and urban schools was tested and rejected.

6. It also came out clearly that the difference in perception by students from rural and urban schools was in the area of supply material environment.

Conclusions

It appears that the computer laboratory environment Inventory (CLEI) to assess the computer laboratory environment in senior high schools in Ghana and to establish whether there are any link to school-type yielded positive results. When used in high school education in Ghana, each scale in the CLEI was found to have satisfactory internal consistency.

Significant differences were also found in this computer laboratory environment. This finding implies importantly that these female students, having experienced positive learning environments at the laboratory, would be more inclined to establishing positive learning environments in their classroom to enhance their learning. This definitely would reinforce the concept of effective classroom management and the need to create a positive learning environment. Such information can then be used with other source of data to be aware of the changing needs of the classroom environment.

Recommendations

The finding that generally, students had positive perceptions of their computer laboratory environment means that in spite of all the problems associated with the organisation of practical activities, ICT teachers can take advantage of students' positive perception to organise and sustain practical activities in schools. The finding that the availability and adequacy of ICT equipment and materials is a strong factor, which distinguishes the psychosocial perception of students' in urban and community schools, suggests that to improve ICT laboratory environments in schools priority attention needs to be given to this factor. It is obvious that many schools do not meet the GES syllabus requirement of having well- equipped computer laboratories for students to pursue ICT. The MOE must therefore adequately equip schools with the needed facilities and replenish their stock of equipment and material from time to time. The finding that supervision was a factor influencing students' perception means that teachers should strengthen the support they give to students during computer laboratory activities.

The MOE and GES must reconsider the emphasis placed on manipulative skills, which are not directly tested in the practical examinations. If however, manipulative and recording skills will continue to be emphasised by MOE and the GES then serious efforts must be made by the MOE to improve Senior High School computer laboratories particularly in community schools to make them more attractive to students. This will enable students undertake all the basic practical activities.

Areas for Further Research

For further studies, researchers are encouraged to attempt to cover more schools in the Central Region as well as other regions and attempt to conduct an observational study on the effect of computers on learning.

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APPENDIX A

INFORMED CONSENT FORM

CENTRE FOR CONTINUING EDUCATION

(UNIVERSITY OF CAPE COAST)

Tel #: 042-35203/36946

Fax: 042-36946

Email: cceucc@yahoo.com

University Post Office

Cape Coast

Our Ref. No: CCE//93/Vol.4/

June 11, 2008.

Your Ref. No:

TO WHOM IT MAY CONCERN:

LETTER OF INTRODUCTION

The holder of this letter:…………………………………………… is a student at the University of Cape Coast. He/She is required to carry out a research study towards the fulfillment of the requirements for the award of Master of Education degree in Information Technology.

The research topic is:…………………………………………………………… ………………………………………………………………………………… I shall be very grateful if you will offer him/her any facilities by way of given him/her access to such literary and study material and information as will be useful. As many of the topics have to be treated with historical background, he/she will find useful any other contracts that you may consider advisable to suggest for the purpose.

The need for this sort of research work remarks so great that the University will be only one of the parties who will be indebted for any help you may be willing and able to give.

By this letter, therefore, we have authorized the holder to approach you with the assurance that you will help in any way you can.

Thank you.

Yours faithfully,

Betty K. Addo-Nkrumah (Mrs.)
(Asst. Registrar)
For: Director

APPENDIX B

COMPUTER LABORATORY ENVIRONMENT INVENTORY (CLEI)

Bio-Data

School:………………………………….Form:…….Age:……Sex: Male[ ] Female [ ]

Directions

This questionnaire contains statements about practices, which could take place in your computer laboratory class. You will be asked how often each practice actually takes place. There are no "right" or "wrong" responses. Your opinion is what is needed about what actually takes place during computer lessons. Think about how well each statement describes what happens in your computer class. Tick the appropriate column corresponding to what actually takes place. Be sure to give a response to each statement. If you change your mind about any response, just cross it out and tick another. Some statements in this questionnaire are fairly similar to other statements. Don't worry about this. Simply give your opinion about all statements. *Remember that you are being asked how often (Almost never, Not Often, Undecided, Often, Almost always) each of the following actually takes place.*

	Statements	Almost Always	Often	Undecided	Not often	Almost Never
1	We have enough computers in our school computer laboratory for practicals					
2	Our school computer laboratory is an attractive place to work					
3	Our school computer laboratory have enough room for individual/ group work					
4	The materials student need for practicals are readily available in our school computer laboratory					
5	We are supplied with all the materials we need for our					

	Statements	Almost Always	Often	Undecided	Not often	Almost Never
	practicals In our computer laboratory					
6	Practicals we have in the computer laboratory do not yield accurate results					
7	Computers in the laboratory in our school are faulty					
8	We don't get the opportunity to handle every equipment in our school computer laboratory					
9	Computers in our school computer laboratory give wrong results					
10	Teachers do not supervise what we do during practicals in our school computer laboratory					
11	Students are required to follow certain safety rules in our school computer laboratory					
12	Our teachers do not come round to supervise what we are doing during practicals in our school computer laboratory					
13	There is a recognized way of doing things safely in our school computer laboratory					
14	We are asked to perform computer practicals in our school computer laboratory without any guidance					
15	At school we are taught the theory before the practicals in the computer laboratory					
16	The theories we have during computer lessons are not related to the practicals we have in our school computer laboratory					
17	What we do in our school computer laboratory sessions help us to understand the theory we learn in class					
18	We make use of the theory taught in class during computer practicals in our school computer laboratory					
19	In our school students are allowed to go to beyond the regular computer laboratory work and do some practicals on our own					

	Statements	Almost Always	Often	Undecided	Not often	Almost Never
20	Students help each other during computer practicals in our school computer laboratory					
21	The computer laboratory in our school is crowded when we are having practiclas					
22	Our computer laboratory is not a comfortable place to work					
23	We are not allowed to do our own practicals in our school computer laboratory					

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