UNIVERSITY OF EDUCATION, WINNEBA

AVAILABILITY AND FREQUENCE OF USE OF INSTRUCTIONAL TECHNOLOGIES IN SELECTED SCIENCE COLLEGES OF EDUCATION IN GHANA

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A THESIS IN THE DEPARTMENT OF SCIENCE EDUCATION, FACULTY OF SCIENCE EDUCATION, SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES, IN THE UNIVERSITY OF EDUCATION, WINNEBA, IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF THE DEGREE OF MASTER OF PHILOSOPHY IN SCIENCE EDUCATION OF THE UNIVERSITY OF EDUCATION, WINNEBA

OCTOBER, 2014

DECLARATION

STUDENT'S DECLARATION

I, **GRACE AGYEMAN DUAH,** declare that this thesis with the exceptions of quotations and references contained in published works which have all been identified and acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

…….. ..... ……..

GRACE AGYEMAN DUAH Date

SUPERVISOR'S DECLARATION

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

……..... …….

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DEDICATION

Dedicated to my lovely twins, Adjoa Agyakwaa (Senior) and Adjoa Agyakwaa (Junior), and also to my son Nana Yaw Tweneboah Ashia.

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ABSTRACT

This research was conducted to investigate the availability of instructional technologies in the science departments of selected science colleges of education and the usage of these technologies by tutors in lesson delivery. The target population comprised the 15 science and mathematics colleges of education in Ghana. The accessible population however consisted of four science colleges of education in the Volta and Eastern Regions of Ghana. Questionnaire, informal observation and interview schedules were used to collect data on instructional technologies available in the sampled colleges and how they were used in teaching. The findings indicated that electrically powered instructional technologies such as computers, LCD projectors and video recordings were in a very limited supply in the colleges while the use of these technologies in teaching by the tutors

was also not encouraging. The non-electrically powered materials such as chalkboards, flip charts including locally available materials were commonly used by the tutors during lessons. It was concluded that the use of instructional technologies for science lessons was not going on as expected in the selected colleges of education. This was highly unsatisfactory since colleges of education are tertiary institutions. This apart, the teacher trainees are very likely to be influenced by the instructional approaches adopted by their tutors. Among the most notable recommendations for improvement and efficiency in the use of these materials by college tutors is the support that the college administration must give to the science departments by making available the technologies and the adaptation of maintenance culture in the colleges.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This is the introductory chapter to the research report. It deals with the background to the study, statement of the problem, purpose of the study, research questions, and significance of the study, delimitations and limitation.

1.1 Background to the Study

The main reason for the use of technology in the classroom is to promote meaningful learning. Papert (1994) believed that computers and other technologies provide powerful tools for learning and also noted that schools frequently ignored the broad capacities computers and technologies have for instructional support, isolating them from the learning process rather than integrating them into all areas of the curriculum.

The state of instructional technologies use for science lessons at the different levels of education in Ghana seems not to be encouraging. In schools where instructional technologies such as computers, videos and flip charts are available, some science teachers use them in their lessons to enhance teaching and learning. On the order hand, majority of them do not use these technologies in their lessons due to lack of in-depth knowledge and the requisite skills needed in the use of such technologies effectively in their teaching. Others may have the knowledge and skills but because they are used to the traditional method of teaching, they do not show any commitment to the use of these instructional technologies. Some teachers also lack innovation in finding suitable local substitutes to help their students to understand their lessons. Although the use of instructional technologies in science lessons is not encouraging, enormous benefits can be derived from their use at all educational levels.

The use of instructional resources in the classroom has the potential to help the teacher explain new concepts clearly, resulting in better student understanding of the concepts being taught. In a survey to find factors that facilitated teacher skill, teacher morale, and perceived students‟ learning in technology-using classrooms, Baylor and Ritchie (2002)

found that teachers valued the use of instructional resources in class and that it had a positive impact on students‟ content acquisition and, on the whole, aided class performance.

They further compared traditional methods of teaching (that focused mainly on imparting skills and knowledge) with current approaches where many educators noted the need to prepare students for a life that will be drastically different, a life that will need students to become creative problem-solvers, able to analyze a wealth of information to draw valid conclusions. Learning of this kind is more likely to take root when a variety of instructional resources are used for instruction; that is, technologies that allow for hands-on experiences.

Walter (2005) has noted that instructional media and resources are everywhere around us. Walter started that instructional media are found within the student‟s total continuum of experience, from the concrete to the abstract, both outside and inside the classroom. They provide means whereby teachers teach and students learn. However, the availability of instructional resources does not automatically imply that learning will take place. In addition to availability, learning also depends on the situation, the teacher, her/ (his) enthusiasm, her/ (his) imagination (and creativity), and other unique characteristics. Teacher initiative makes a difference.

According to Beggs (2000), it is not the technology itself but how the technology was used that improved learning and increased students‟ interest. Hence technologies can be

available, but if they are inappropriately used during lessons, the students‟ learning may not be maximized. Similarly the technologies may be available, but, if the science tutors do not know how to use them, then learning that could have been enhanced by the use of the technologies will not occur.

The education system in Ghana, like that of Britain, has three levels: basic school; secondary school and tertiary. Tertiary education embraces institutions such as the universities, the colleges of education (teacher training colleges), and the polytechnics. There are thirty- eight public colleges of education currently in the country and these colleges are run by the government. The colleges of education are expected to train teachers for the basic schools. One important dimension in teacher education is likely to be related to the use of instructional technologies such as flip charts, computers and videos. The researcher‟s interest in technologies that enhance instruction in teacher education dates to when she was undertaking her internship at Mount Mary College of Education, Somanya in the Eastern Region. The internship period enabled her to observe how prospective basic school teachers were trained on how to produce and use teaching and learning materials in the classroom. One role the researcher played was to give students hands-on experiences on how to use the computer for pedagogical purposes, for example the use of power point in teaching and learning. Another thing the researcher did with the student teachers was to group and assign them various topics in order for the students to develop their own instructional materials to be used to teach the respective topics. The experience acquired by the researcher during that period proved that the importance of teaching and learning materials in instruction cannot be overemphasized.

The researcher's experiences led to her study of the use of modern technology for science instruction.

According to Beggs (2000), new technologies, when first encountered, bring mixed feelings of anxiety, fear, as well as frustration, which sometimes lead to not using the new technologies. The researcher observed similar reactions among tutors in the colleges of education. Some tutors in this day and age are not able to use the computer and hence may not be able to incorporate computerized technologies into their training of teachers. The student teachers will extremely be influenced by the tutors‟ instructional approaches since tutors teach as they themselves were taught without using any instructional media (Majed, 1996).

Geisert and Futrell (2000) also elaborated that when the computers first appeared in the classrooms, teachers who used them tended to be those who enjoyed (or at least didn‟t mind) the challenges of communicating with a computer in its language (programming). It is clear that the use of instructional materials of all forms continues to advance, and that there is the need to keep pace with those developments. The situation does not seem to have improved or changed significantly. For this reason this study was designed to provide insight into the causes and persistence of the problem of low instructional technology use in science colleges of education.

1.2 Statement of the Problem

During the researcher‟s involvement in the teaching of student teachers in Mount Mary College of Education in the Eastern Region, she observed variations in the teaching approaches adopted by the science tutors. Some of the tutors took the initiative to identify a variety of technologies and teaching resources for their lessons, while for others, the chalk and the board were the only resources used. The researcher questioned the observed differences in instructional technology utilization by the tutors. She also observed that the training of teachers did not fully materialize because the tutors who were expected to train these student teachers were themselves not knowledgeable enough to competently train the student teachers in the use of the available instructional technologies. This is because some tutors have given up on the use of instructional technologies such as audio/visuals and have resorted to the use of locally available materials such as tutor-made diagrams and real objects only in their teaching.

According to a report for the colleges of education (The Chief Examiner‟s Report, 2006) for integrated science methodology, candidates did not have in-depth understanding of the use of equipment and materials in the laboratories to solve scientific problems. The report recommended that science tutors should integrate instructional technologies and other instructional materials in their lessons to make science teaching and learning meaningful. Consequently, these experiences led to the researcher‟s interest to study the use of modern technology for instruction during science lessons in selected Science Colleges of Education in Ghana. Thus, this study will focus on instructional technologies as they are used by science tutors in the selected colleges of education to enhance instruction and promote the learning of science.

1.3 Purpose of the Study

The purpose of the study was to determine the types of instructional technologies that are available in the Science Colleges of Education and how often science tutors use these technologies in their lessons. Realizing that use of instructional technologies enhances teaching and learning, this study attempted to define the reasons for the inclusion or omission of instructional technologies by tutors in their instruction in the selected colleges. The study was also to find out the competence levels of science tutors with respect to the use of instructional technologies during lessons.

1.4 Research Questions

The study addressed the following research questions:

1. Which types of instructional technologies are in the science colleges of education?
2. How often do science tutors use instructional technologies in their lessons?
3. What do science tutors consider as important factors in influencing their use of instructional technologies?
4. What are the attitudes of the college science tutors towards the use of instructional technologies?
5. What perceptions do college science tutors hold of their competence levels in using instructional technologies?

1.5 Significance of the Study

The purpose of the study was to provide a description of the use of instructional technologies in Science Colleges of Education in Ghana. Realizing that the use of instructional technologies enhances teaching and learning, this study attempted to define the reasons for the inclusion or omission of instructional technologies by tutors in their instruction in the selected colleges.

The description of the factors served as a basis for recommendations of policies and practices to be put in place to enhance the tutors‟ use of the technologies in their teaching. The results may also help the University of Cape Coast (UCC) in planning for further development of modern technologies in Science Colleges of Education. The results may again help the Colleges of Education in planning for further development of modern technologies for Science tutors. Determining teachers‟ knowledge and usage levels of technology and instructional resources in the classrooms will help planners deliver effective in-service education and training programmes, which can increase the likelihood that technology and instructional resources will lead to success.

It is envisaged that the findings and recommendations would become a valuable resource material for teachers, curriculum designers and researchers. Besides, researchers who would want to carry out further studies on this topic would utilize the findings and recommendations of this study as empirical starting point for their own studies.

1.6 Delimitations of the Study

This study concentrated on only the science tutors in 4 selected Science Colleges of Education, two from Eastern Region and the other two from Volta Region. Although

there are 15 Science Colleges in Ghana, the researcher chose 4 because they are closer to her place of work.

1.7 Limitation of the Study

The major limitation of the study was that the instruments used in the data collection had their own inherent problems, for example, the interview could be filtered through the perspective that the participants want the researcher to hear and that would certainly affect the response. Also the observations made might be the beliefs of the researcher. Also, since every teacher has his/ her own belief and techniques in teaching, the result of the observation is likely not to reflect the realities of the tutors‟ performance. The limited time did not allow the researcher to use large sample size as she had to combine this study with her profession.

1.8 Operational Definition of Term

1. Instructional technologies: These are instructional materials and equipment including chalkboards, computers, videos and flip charts used in the teaching and learning process.

1.9 Abbreviations

DFID - Department for International Development

HOD – Head of Department

1.10 Organization of the research report

This thesis is organized into five chapters. The first chapter is the introduction which contains the background to the study, problem statement of the study, the purpose of the study, the research questions and the significance of the study. The limitation and delimitation of the study as well as the operational definition of some terms as they are used in this study have also been captured in chapter one.

Chapter two contains the review of literature related to the study while chapter three provides the details of the methodology that was used for this study. Chapter three also describes the various areas of the study such as the research design, sample and sampling technique, data collection procedures and the data analysis procedures.

In the fourth chapter, there is a presentation of the gathered data, analysis of the gathered data and a discussion of the results. The last chapter which is chapter five covers a summary of the research findings, conclusion, recommendations and suggestions made from the evidence gathered via this project.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Overview

The review of the related literature in this chapter involved the discussion of materials related to various aspects of this study. It is meant to relate the present study to the ongoing dialogue in the literature on the use of instructional technologies and the impacts they have in the teaching and learning of science. The literature is reviewed under the following headings:

i. Theoretical framework
ii. Learning through instructional technologies
iii. Why use instructional technologies
iv. Factors contributing to the use of instructional technologies
v. Attitudes towards the use of instructional technologies
vi. Competences in the use of instructional technologies
vii. Adaptation to change
viii. A discussion on specific instructional resources in this study -- chalkboard, flip charts, projectors, video, and computers.

2.1 Theoretical framework

The theoretical framework on which this study is based is the cognitive theory of multimedia learning (CTML) proposed by Mayer (1997). It is based on the theory that humans have two ways or "channels" of processing information; auditory and visual, otherwise known as the dual-channel assumption. By leveraging both of these means, and by building connections between multiple representations of the same information, meaningful learning is more likely to occur (Mayer, 1997; Mayer & Moreno, 2003).

The cognitive theory of multimedia learning was popularized by the work of Richard E. Mayer and other cognitive researchers who argue that multimedia supports the way that the human brain learns. They assert that people learn more deeply from words and pictures than from words alone, which are referred to as the multimedia principle (Mayer 2005). Multimedia researchers generally define multimedia as the combination of text

and pictures and suggest that enhanced multimedia learning occurs when we build mental representations from these words and pictures (Mayer, 2005). The words can be spoken or written, and the pictures can be in any form of graphical imagery including illustrations, photos, animations, or videos. Multimedia instructional design attempts to use cognitive research to combine words and pictures in ways that maximize learning effectiveness.

The CTML centers on the idea that learners attempt to build meaningful connections between words and pictures and that they learn more deeply than they could have with words or pictures alone (Mayer, 2009). According to CTML, one of the principal aims of multimedia instruction is to encourage the learner to build a coherent mental representation from the presented material. The learner‟s job is to make sense of the presented material as an active participant, ultimately constructing new knowledge. People construct knowledge in meaningful ways when they pay attention to the relevant material, organize it into a coherent mental structure, and integrate it with their prior knowledge.

There is a school of thought which proposes that instructional materials should match individual learning styles, i.e. visual, auditory and kinesthetic (Joyce, Calhoun & Hopkins, 2000; Nayar & Pushpam, 2000). Moreover, students remember best those ideas or concepts that are presented in a way to relate their sensory channels, e.g. audio and visual representations, pictures, charts, models and multimedia (Nayar & Pushpam, 2000). The use of visual teaching aids can provide more concrete meaning to words,

show connections and relationships among ideas explicitly, provide a useful channel of communication and strong verbal messages and memorable images in students‟ minds, and make lesson materials more interesting to students. (Joyce *et al*, 2000). For example, models help students make sense of the world by finding out the why of things and make abstract or imagined concepts seem more real to students.

Furthermore, multimedia can help teachers bring the real world to students through the use of sound and video, interacting with a picture or diagram by enlarging or rotating it. Nayar and Pushpam (2000) reported that when teachers use appropriate media integrated in the curriculum, their students achieve significantly higher learning outcomes. Similarly, Wisniewski (1994) as cited in Killermann (1998) found that students who watched films about AIDS performed significantly better than those students who did not on a test conducted a week later. Killermann (1998) concluded that this might be because of the fact that showing films might help in some way to activate their long-term memory of the subject and the content of the lessons at later time.

With this theoretical framework, the researcher has focused on the use of visual materials, which when used accompanied by verbal explanations, students may pay more attention to the material to be learned, conceptualize and comprehend abstract and difficult ideas, thoughts, and data better in their minds, and store and remember the information more efficiently.

2.2 Learning through Instructional Technologies

The term “instructional technologies”, according to Romiszowski (1988), referred to devices and materials employed in teaching and learning. It includes hardware like blackboards, radio, television, tape recorders, video tapes and recorders and projectors; and, software like transparencies, films, slides, teacher-made diagrams, real objects, cartoons, models, maps and photographs. Similarly, Scanlan (2003) indicated that instructional technology encompasses all the materials and physical means an instructor might use to implement instruction and facilitate students' achievement of instructional objectives. This may include traditional materials such as chalkboards, handouts, flip charts, slides, overheads, real objects, and videotape or film, as well newer materials and methods such as computers, DVDs, CD-ROMs, the Internet, and interactive video conferencing.

Talabi (2001) asserted that instructional technologies are generally designed to provide realistic images and substitute experience to reach curriculum experiences. The technologies are considered the most efficient facilitators in the education set up. They are not substitutes for the teacher. Their use however, calls for an imaginative approach by the teacher who needs to constantly be on the alert for new ideas and techniques to make the lessons presented with different instructional technologies achieve effective outcomes.

According to this author, some devices are designed to present information of a kind that would not be available in an ordinary school experience. Examples include, films, television, sound recordings. Other types of instructional technologies have the function

to help the pupil grasp the underlying structure of a phenomenon. Visual media are primarily for seeing, audio devices for hearing, and multi-sensory materials for use via two or more senses.

Nyame (2006) held the view that instructional technologies are the various materials that appeal to the five senses- seeing, hearing, touching, feeling and tasting which enhance teaching and learning. Ogunmilade (1984) also identified instructional technologies as devices of hardware (equipment) and software (consumables) through which the learning process may be ensured and carried out. In other words, they are the collection of materials and equipment that can be used effectively for communication. These materials are used in the planning process of giving instruction. Instructional technologies with its various types affect different senses and act as an integral part of teaching and learning process, and thus helping to bring about meaningful experiences. In this study, an instructional technology refers to videos, projector and computers in addition to the chalkboard and flip charts that are brought to the teaching and learning process to induce understanding.

2.3 Why Use Instructional Technologies?

The place of instructional technology in the teaching and learning process is undoubtedly essential. Scanlan **(**2003) assert that instructional technologies are used whenever, in the best judgment of the teacher, it can facilitate learning or increase understanding of material being presented. Under this heading the following subheadings have been

reviewed: Instructional technologies for motivation, for capturing students' attention and for explaining concepts.

2.3.1 Instructional technologies for motivation

In the educational arena, according to Charles and Senter (2002), the goal or task to pursue should be student engagement in the learning environment. Teachers strive to bring this desire in their students so they will fully engage in instructional activities and develop in-depth understanding of concepts. Motivation appears in two forms, intrinsic and extrinsic.

Intrinsic motivation is important to students and teachers because of its effect on learning outcomes. Motivation is a significant predictor of academic performance which leads to the conclusion that intrinsic motivation is a major factor in determining academic success (Wilson & Corpus, 2005). If intrinsic motivation is beneficial to student learning outcomes, then it stands to reason that educators should strive to cultivate and enhance the intrinsic motivation of students. Noels, Clement and Pelletier (1999) looked at intrinsic motivation as a performance of an activity simply for the pleasure and satisfaction that accompanies the action. When students are intrinsically motivated, teachers do not have to worry because students are tuned for success. Students who are intrinsically motivated learn more easily on their own because they feel happy learning. Porter (1997) suggested that approaches to new technologies should be developed with an open mind. The challenges that come with new technologies should be seen as opportunities for growth and improvement, and not as obstacles.

On the other hand, extrinsic motivation can be used to bring students in and keep them involved in lessons. Charles and Senter (2002) contended that when teachers speak of motivation as a component of a lesson, they refer to what they do to attract students‟ interest and engage them more or less willingly in the work provided. According to them, the use of technologies, which students can easily manipulate to obtain a required end product, can generate the desire to learn and do more. Resources that students can associate with their everyday life also help to generate that desire to do more.

2.3.2 Instructional technologies for capturing students' attention

Capturing the imagination and attention of today‟s students requires fresh approaches to teaching and learning. Perhaps this is one of the reasons why educators are turning to the use of technological devices to involve students more actively in learning.

Instructional technologies capture and sustain students‟ curiosity and attention throughout their lessons. Williams (1991) noted that the use of the overhead projector enables the teacher to maintain complete classroom control and interest in a lesson. This control is likely to be effective when the teacher wants to direct the students‟ attention either to the technology being used, or the information being displayed by the technology, or to the teacher. By switching on the overhead projector, the students‟ attention is directed to the information being displayed and to the teacher when the overhead projector is switched off (Williams, 1991).

This ability to direct students‟ attention may help to maintain their concentration either on the information being displayed or to the explanation being given by the teacher when the overhead projector is switched off. This concentration by the students on what is going on might help them to follow the lesson and learn whatever concepts are being explained. Such attention also could help teachers become aware of the readiness of students to understand what is being taught.

2.3.3 Instructional technologies for explaining concepts

The teacher can explain concepts that would be difficult to elaborate orally using instructional technologies. When students see the material, its mechanism, and its function, teachers may be saved of the hard explanation and students easily understand what the teacher is talking about. In addition, instructional technologies help pupils acquire listening and observational skills that assist in their understanding of complex concepts. About the use of videos, Majed (1996) noted that, the use of technology makes possible increased individualized instructional opportunities which enable the teacher to have adequate spare time for preparation of instruction that will meet the needs of the learners. When teachers use technologies in their teaching and students are involved in the use of those technologies and notice the relationship and relevance of what the teacher is teaching and the technologies being used, the students‟ attitudes towards learning gets improved, and that prepares them for the technologically oriented society (Majed, 1996). The review on this has significantly directed the researcher as to what pertains.

2.4 Factors Contributing to the Use of Instructional Technologies

The use of instructional technologies should be backed up with encouragement, ready access to technology, training, and support before teachers can take steps towards enhancing how and what they teach with the use of technology (Brace & Roberts, 1996). Spodark (2003) called this an enabling environment that caters for universal student access, reliable networks, multiple opportunities for training, and consulting, and a faculty ethos which values experimentation and toleration of falters.

There are several factors that contribute to the use of technology. According to reviewed studies, when these are put in place, teachers are more likely to use technology. For the purpose of this study, the researcher has reviewed these factors: Training, Availability of technologies, and Provision of support system for Technology use and Access to technologies.

2.4.1 Training

Training instills new skills and abilities to perform tasks which were not possible previously. It provides confidence in teachers in undertaking their duties. Ochs (1993) observed that, while training is an investment in the skill and productivity of programmes, companies (administrators) tend to look at only costs and programmers often see only loss of production time. Although sometimes books may be available for teachers to read about how to produce and use instructional materials, good training courses are always superior because they effectively drill concepts into a format that is easy to master (Ochs, 1993).

Soliciting ideas from teachers about media specialists, teachers were asked what instructional assistance they would desire from the library media specialists. Their responses showed that they would like to be trained to use the emerging instructional technologies effectively including information about how to motivate their students (Turner, 1996). Training on the use of instructional technologies can be done in both pre-service or initial training programmes and in-service programmes.

In the case of Pre-service training, when tutors are undergoing training at the university to become tutors, they need to be exposed to how different technologies are operated and how they can be used in a classroom situation. Practical experiences in actually using those technologies should be part of their training when they are in college, and also when they go for their teaching practice. Likewise, student teachers should also be exposed to this training on the use of technologies. Supervisors should see them using the technologies so that when they qualify they should be able to use them in their classrooms.

Regarding In-service training, it is relevant to consider the administrators of Middle Tennessee State University who organized symposiums and conferences for the faculty on what technology is and how it can be used in course work (Brace & Roberts, 1996). This suggests that tutors in the colleges of education need properly organized workshops and seminars with several presentations for hands-on experiences. In this way they learn to produce some of the technologies and how to use them in a classroom. Brace and Roberts (1996) noted that, lack of training creates a barrier to faculty‟s use of technology in general. Faculty requires hands-on experience through workshops and orientations that are offered at convenient times.

A research study revealed that quality professional training programme helps teachers implement technology and transform teaching practices (Brinkerhoff, 2006). Lawless and Pellegrino (2007) claim that if training programme is of high quality, the period for training lasts longer, new technologies for teaching and learning are offered, educators are eagerly involved in important context activities, teamwork among colleagues is improved and has clear vision for students attainment.

Educators who integrate technology with new teaching practices gained through professional training can transform the performance of the students (Lawless & Pellegrino, 2007). According to Chen (2008), professional training courses must be designed to identify beliefs about successful teaching, policies for enhanced teaching and learning and syllabus design for teaching purposes.

Teachers who are committed to professional development activities gain knowledge of ICT integration and classroom technology organization. Training programmes for teachers that embrace educational practices and strategies to address beliefs, skills and knowledge improve teachers‟ awareness and insights in advance, in relation to transformations in classroom activities (Levin & Wadmany, 2008).

2.4.2 Availability of instructional technologies

For tutors to use instructional technologies in their teaching, the technologies should be made available. Teaching materials can be substituted, they can be improvised and still

deliver the same message. But there are some technologies that cannot be substituted and cannot be improvised, for example, overhead projectors and computers. Such materials need to be supplied by the institution or the Ministry of Education. Hope (1997) reiterated that, for technology to be exploited in an environment, it must first exist.

Unfortunately, decision makers in the Ministry of Education do not emphasize the importance of instructional media in schools due to tight budgets, instructional media do not come in their priorities, or that they do not know the importance of instructional media in the teaching and learning process (Majed, 1996). Such a lack of emphasis is unfortunate given that research demonstrates the positive impact technology has on learning. Instructional and learning technologies are playing an increasingly important role in post-secondary education.

From the classroom point of view, the adequacy of the classroom can facilitate the use of some instructional technologies. In a survey to find student teachers" use of instructional media, Majed (1996) found that over half of the respondents indicated that facilities in the classrooms were not adequate. For example, to use overhead projectors requires a supply of electricity. In Ghana, the inadequacy of facilities in the college of education classrooms may result due to power sockets been vandalized or are not there at all. Furthermore, the intermittent supply of electricity from the power station has an impact on the use of technologies that need electricity.

2.4.3 Provision of support systems for technology use

Different support systems have to be put in place to enable continuity and sustainability when new skills are learned. For example, adequate implementation of use of instructional technologies requires support from the administration, such as financial allocation for technical support and training as well as monitoring and encouraging faculty to use technology in their classes. Though infrastructure support is imperative, school technology leadership is a stronger predictor of teachers‟ use of computer technology in teaching (Anderson & Dexter, 2005). It is believed that a leader who implements technology plans and also shares a common vision with the teachers to stimulate them to use instructional technologies in their lessons. Lai and Pratt (2004) suggested that for effective utilization of technological resources by teachers, there is the need for a strong leadership to drive a well-designed technology plan in schools.

It is important that administrators take the initiative to organize in-house discussions and sharing of ideas on how some of the technologies can be incorporated in the classrooms. Hope (1997) observed that, leadership must foster an environment where teachers are encouraged to be creative and to explore new innovations like technology without leadership with a vision; technology cannot reach its potential in schools.

Another source of support comes from members of staff as they support peers in the use of instructional technologies. Beggs (2000) affirmed the need for such support as instructors, teachers first use instructional technology, and the friendly, helping hand of support can make the experience easier. Peer support can be one of the easiest and most available ways that teachers can get help, but it also calls for collaboration with

colleagues, where those who know how to work with a particular technology are willing to render the support needed. Such support is possible when all members of staff have a common goal and work as a team (Hope, 1997). This collegial bond allows for a free and open exchange of experiences and knowledge among teachers (Weller, 1996).

This support can be in the form of technical support, for example, for computer hardware and its peripherals or for software applications, and may include acquisition of assistance, installation and configuration of equipment and applications, and troubleshooting of hardware and software (Brace & Roberts, 1996). Such assistance could also center on how to operate certain equipment, like video or overhead projectors.

2.4.4 Access to instructional technologies

Access to technological resources in schools is a necessary condition to the integration of technology in education (Plomp, Anderson, Law, & Quale, 2009). Effective adoption and integration of computer into teaching and learning in schools depends mainly on the availability and accessibility of technological resources such as hardware, software, etc. Obviously, if teachers cannot access technological resources, then they will not use them. A study by Yildirim (2007) found that access to technological resources is one of the effective ways to teachers‟ pedagogical use of technology in teaching.

Some instructional technologies are designated in special rooms like computer labs and audio-visual rooms where overhead projectors and video equipment are kept. These

special rooms need to be easily accessed by members of staff when they need to use a particular technology. Brace and Roberts (1996) also emphasized that faculty need access to technology of all types, and give examples like, networked computer, audio-visual equipment must be readily available. It should be noted, however, that availability and accessibility are slightly different because sometimes the equipment may be available at the colleges of education but kept under strict rules.

Brace and Roberts (1996) recommended a check-out system that makes technology available and accessible any time and everywhere. Such accessibility enhances lesson preparation and delivery as well as eliminating the frustrations that teachers may have if they cannot access a particular technology that they have planned to use. Access to instructional resources is not only important, but also the use of suitable kind of tools and programmes to support teaching and learning. Access to appropriate technology means that affordances and constraints (Friedhoff, 2008 cited in Chen, 2010) of a technological tool need to be carefully considered when the tool is incorporated in lesson.

2.5 Attitude towards the Use of Instructional Technologies

Instructional technologies not only make the teachers‟ job easier but also impose a responsibility on them. This is because integrating technology into teaching and learning has always changed the instructional programme, teaching-learning process and learning styles of the students so that teachers have had to adapt to that change (Meyer & Rose, 2005).

Keil (2008) stated that children acquire most of what they know second hand, through others and most of the knowledge occurs in many non-school settings such as through television, museums, toys and other artifacts, the Internet, or even in various games and activities such as chess, cooking, or running a lemonade stand.

However, the efficacy of the use of instructional technology in teaching will largely be determined by the attitudes of the teachers. Vannatta and Fordham (2004) maintained that teachers‟ attitudes and experience are factors associated with computer use. Both positive attitudes about technology and technology skills in combination are accepted precursors for effective use of technology.

It is believed that if teachers perceived technology programmes as neither fulfilling their needs nor their students‟ needs, it is likely that they will not integrate the technology into their teaching and learning. If teachers‟ attitudes are positive toward the use of instructional technologies then they can easily provide useful insight about the adoption and integration of computer and other technologies into the teaching and learning processes.

Demirci (2009) conducted a study on teachers‟ attitudes towards the use of Geographic Information systems (GIS) in Turkey. The study used questionnaire to collect data from 79 geography teachers teaching in 55 different high schools. The study revealed that though barriers such as lack of hardware and software existed, teachers positive attitudes

towards GIS was an important determinant to the successful integration of GIS into geography lessons.

In a similar study, Teo (2008) conducted a survey on pre-service teachers‟ attitudes towards computer use in Singapore. He found out that teachers were more positive about their attitudes towards computers and intention to use computers than their perceptions of the usefulness of the computer and their control of the computer.

Research has shown that teachers‟ attitudes towards technology influence their acceptance of the usefulness of technology and its integration into teaching, (Huang & Liaw, 2005). Korte and Husing (2007) assessed the results of a survey of teachers‟ use of Acer net books involving six European Union countries. It was found that a large number of the participants believed that the use of net books had had positive impacts on their learning. They also stated that it promoted individualized learning and helped to lengthen their study beyond the school day. However, evidence suggested that a small number of teachers believed that the benefits of ICT were not clearly seen and that the use of technology in teaching did not benefit their students‟ learning.

Teachers‟ computer experience relates positively to their computer attitudes. The more experience teachers have in the use of computers and other technologies, the more likely that they will show positive attitudes towards their use. Positive computer attitudes are expected to foster computer integration in the classroom. For a successful transformation in educational practice, users need to develop positive attitudes towards the innovation.

2.6 Competencies in the Use of Instructional Technologies

Research tells us that the single most important factor in determining the successful integration of technology in the classroom is a teacher who is comfortable with and knowledgeable about computers and technology tools. Yet many teachers, especially those who entered the teaching profession before technology assumed such a pervasive role in society, have had little or no special training in computers. Even teachers who can demonstrate basic computer literacy are unlikely to be familiar with the full range of tools that technology can offer, from spreadsheets to digital graphics to instructional software.

According to Bordbar (2010), teachers‟ competence was a major predictor of the integration of technology into teaching. Evidence suggests that majority of teachers who reported negative or neutral attitudes towards the integration of technologies into teaching and learning processes lacked knowledge and skills that would allow them to make informed decision on computer use (Bordbar, 2010). In a qualitative multiple case-study research on primary school teachers‟ competence and confidence level regarding the use of instructional technologies in teaching practice conducted in five European countries, Peralta and Costa (2007) found out that technical competence influenced Italian teachers‟ use of technologies in teaching. However, the teachers cited pedagogical and didactic competences as significant factors if effective and efficient educational interventions are likely to be implemented.

In Portugal, teachers reported different views regarding the most important competences for teaching with technologies. The experienced and new teachers stressed the need for technical skills and attitude, the innovative teachers‟ emphasized curricula and didactic competences and the student-teachers cited technical competence and pedagogical efficiency as significant to integrate instructional technologies in the teaching and learning processes. According to Peralta and Costa (2007), teachers with more experience in the use of computer and other technological tools have greater confidence in their ability to use them effectively.

To conclude, Jones (2004) reported that teachers‟ competence relate directly to confidence. Teachers‟ confidence also relate to their perceptions of their ability to use technologies in the classroom, particularly in relation to their children‟s perceived competence. According to Jones (2004), teachers feel reluctant to use computer if they lack confidence. “Fear of failure” and “lack of ICT knowledge” have been cited as some of the reasons for teachers‟ lack of confidence for adopting and integrating technological resources into their teaching. Teachers who do not consider themselves to be well skilled in using technology feel anxious about using it in front of a class of children who perhaps know more than they do. In this study, it is important to look at the perceptions of administrators and teachers, community participation and involvement, teacher training, the financial costs of the technology and leadership.

2.7 Advantages of Using Instructional Technologies

It is known that the use of instructional technology in teaching science has become more prevalent in the world due to its impacts to educational setting. It is an effort of using available machines to manipulate the environment of individuals with the hope of generating changes in behaviours or other learning outcome. The use of instructional technologies has several advantages for both the teacher and the students.

Talabi (2001) outlined important advantages that are associated with instructional technologies and they are as follows:

a) There is standardized information delivery. Each student sees and learns the same message, hence forming the basis for further study, practice and appreciation.

b) Attention is ensured through the use of instructional technologies. Members are therefore kept informed. The clarity and coherence of a message, the attractiveness of changing images, the use of certain special effects, as well as the impact of ideas that can create or cause effect, cause an audience to laugh or be thoughtful, contributing to the motivational and interest-calling aspects of technologies.

c) The quality of learning can be improved through careful integration of pictures and words. Technologies can communicate elements of knowledge in a well-organized, specific and clearly defined manner. Through much effort from students, learning can be expected to reach an acceptable competency level.

d) Learning can be enhanced since there is reduction of repeated information. This enables important aspects of lessons to be delved into.

e) Learning becomes interesting. Thus, alert instructors are continuously searching for refreshing ways of generating and expanding interest. This is because data presented represent situations, and pose questions in exciting ways.

f) They extend the scope of experience. For example, by using various media, concepts can be taught through real life demonstrations.

g) Instructional technologies help to supply a concrete basis for conceptual thinking whiles increasing learner‟s interest. This means that the media help to stimulate self-activity in learners, making learning more permanent.

h) They enhance retention and transfer of knowledge and support learning through examples and visual elaboration.

i) New content, experiences and expectations could also be presented through the use of instructional media, leading to efficient preservation of records and documents and experiencing materials that could have looked far-fetched.

j) Through the use of media such as LCD projectors, knowledge and information is able to reach a lot of people simultaneously (Ogunmilade, 1984).

k) Instructional technologies are capable of focusing attention on whom and what is important and interesting thereby raising aspirations and whetting the appetite of the learners. This is critical in promoting distance education across various disciplines and almost all forms of education and training, be it formal, informal or non-formal.

l) Instructional technologies also serve as the means of expressing the psychological dimension of life, since without using media it would be very difficult to find expression for certain states of matter. (pp 12-13)

Powell (1978) explained that some ideas cannot be reliably communicated through books. For example, music must be heard, paintings seen, perfumes smelt and wines tasted. Some learners learn things either by reading or hearing and others by combining the senses. Powell notes that experiences such as seeing the way colours change in bright light cannot be learned by reading a text but by experiencing in a different way. This is why understanding media must be employed in understanding of the concepts of all settings particularly where children are involved. Observing how things grow "smaller" with distance will help learners develop a keener perspective and hence responsiveness to their world.

Harford and Baird (1999) as cited in Owusu (2009) stated that instructional technologies convey information more effectively if time is spent planning their design and explains that what is used in the learning environment should directly be relevant and appropriate to the local community. This means that any technology used should reflect what exists in the learner‟s immediate environment. The authors also hold the view that instructional technologies will enhance students‟ learning if a well-balanced preparation is made for a particular task. This is likened to prescribing the correct medication and dosage to suit a particular medical problem.

Agun and Imogie (1988) noted that unless the teaching strategy which is appropriate at a given stage requires imparting information or knowledge in a mode beyond the natural capacities of the teacher, instructional technologies are unlikely to be of value to the lesson. They indicate that aside the importance associated with the use of instructional technologies, there are certain things instructional technologies cannot do either directly or indirectly, even though they can help in a number of ways.

Since effective teaching depends upon the success of communication between teachers and their students, it is critical that teachers adopt more creative ways to ensure that all the students in their classrooms understand what is taught them. By inference, learning will be more effective for all students if teachers at all levels can make innovative changes in their teaching methods and classroom practice so that they become "helpers" and "supervisors" who creatively manage the learning situation to achieve the aims of their lessons instead of acting in their conventional role as "fountains of knowledge".

By creatively administering and controlling the type of instructional resources used, the teacher is more likely to achieve the difficult task of combining class control with sustained students‟ level of concentration to optimize teaching and learning objectives. For this reason, the use of instructional technologies can aid interpretation by focusing attention to imagery or objects that represent and explain the words used and thereby creating a firm understanding of the situation and promoting retention of such information.

2.8 Disadvantages of Technologies Use

In spite of the advantages associated with the use of instructional technologies, Agun and Imogie (1988) indicate that there are some difficulties associated with their use. These include the following:

a) Bureaucracy and delay at the Ministry of Education in providing the needed financial and technical resources to provide technologies in educational institutions. This leads to lack of sufficient materials to use.

b) Not many teachers see the need for technology use in the classroom.

c) Lack of adequate personnel to train teachers to use technologies in schools.

d) Lack of enough patronage from heads and supervisors of educational institutions for technology usage.

e) The impression that new technology would replace teachers makes some teachers to see instructional media as threats.

f) Lack of flexible curricular to incorporate the appropriate teaching and learning materials.

It could be deduced from the discussion that though the use of instructional technologies positively affects teaching and learning, the characteristics of the learner should be looked at so that individual learning differences could be addressed. Although it cannot be said that every school is endowed with all the technological tools, it is possible for teachers‟ at all educational levels to endeavour to use whatever resource is available in their classrooms and school environment to give concrete meaning to their lessons.

This however, depends on the schools being adequately stocked with these resources and teachers being trained to acquire the technical skills and knowledge needed for appropriate use of both the low-and high-technology media, and also monitored to effectively adapt whatever is available to them to bridge the gap between teaching and learning, and thereby enhance the academic achievement of the students and prepare them for the job market.

2.9 Adaptation to Change

For tutors in the colleges of education to start using instructional technologies in their teaching, they need to appreciate how helpful the technologies are to themselves as well as to the students. This appreciation and the desire to start using the technologies demand a degree of change in the teachers‟ perceptions and attitudes towards use of technology. It is, therefore, important to highlight how this change process can be implemented.

Change affects the setting of the organization or the institution in its leadership, resources and culture. It also affects the attitudes, values and beliefs of the people who are the change agents (Hope, 1997). Weller (1996) viewed change as a process to transform people‟s knowledge, attitudes, and behaviour about the value of embracing something new or achieving something more beneficial. Unfortunately, when change is proposed, “there are forces which both support and resist the change” (Weller, 1996, p. 25). The advent of technology in education has been received with mixed feelings by teachers, some of whom are still comfortable with the old traditional ways of teaching, while to others technology is a challenge worth meeting head-on.

However, a decision to change comes after a serious scrutiny of the situation is done. As Bennett and Bennett (2003) observed:

"When one is confronted with new technology, he or she goes through an adoption decision process in which he or she gathers information, tests the technology, and then considers whether it offers sufficient improvement to warrant the investment of time and energy that is required to add it to his or her repertoire of skills." (p. 55-56)

For this scrutiny to occur and for change to take place, Weller (1996) suggested that four elements must be present:

a) external conditions (having adequate resources and the dedicated commitment of top management);
b) internal conditions (subordinates seeing the need, being willing to change);
c) triggering events (external or internal pressures to change caused by dissatisfaction, innovations, or organizational renewal); and
d) A well-designed change strategy (a comprehensive plan delineating the transformation process which includes the participation of the key subordinates). (p. 25)

It is well known that when resources are available and the administrators/management is committed to implementation, change effects can be noticed. Runkel and Schmuck (1994) remarked that demonstrated commitment on the part of the principal facilitates the change process and makes change easier to accept. More seriously is the willingness of the subordinates to participate in the change process. Even when the resources are available or the management shows its commitment, if the implementers do not see the

need or are not willing to participate, no change can take place. It is not only the perceptual and attitudinal aspects of the participants, for example their confidence and readiness to persist through frustrations, that must be addressed but also these must be coupled with good planning procedures in order to bring about change (Weller, 1996).

2.10 Five Instructional Technologies

The survey in the science colleges of education has concentrated on five instructional technologies, i.e., chalkboard (whiteboard), flip charts, projected aids, video and computers. This section aims at elaborating on these technologies regarding what they are and their use.

2.10.1 The chalkboard

Types include movable chalkboards, wall chalkboards (fixed), the roller or pulley systems and glass boards made of asbestos sheet in different colours. The roller or pulley system could be used without cleaning the previous one. Movable chalkboards consist of punk plywood boards to stand on easels which can either be used indoor or outdoor. Wall chalkboards are usually painted walls which are part of the wall facing the class and made with cement. The board should be cleared with renovator at least twice a year.

The chalkboard is considered one of the oldest, cheapest and to a great extent the most used of all visual aids in Ghanaian schools. It is useful for building up graphs, diagrams, maps and other scheme of a lesson as it unfolds. A word or sentence recorded on the board helps provide an emphasis which may be lacking in the lesson. It must be noted

that, the size of the chalkboard should be large enough for clarity. Williams (1991) elaborated the advantages of using the chalkboard:

a) they are freely available in the classroom
b) they need no power (except in the case of electronic white boards)
c) they are user friendly (if you chalk or marker)
d) they can display a large range of colours
e) they can be used with a variety of other materials for a broad range of teaching strategies.

Wankat and Oreovicz (2001) also added that chalkboards are excellent for recording permanent information such as assignments, notices, and outline of the present class. In Majed‟s survey on student teachers‟ use of instructional media, one of the questions he wanted to find out was the frequency of use of instructional media. Results showed that chalkboards were used extensively as compared to other instructional media.

2.10.2 Flip charts

They are pads containing large sheets of paper that can be easily turned over, mounted on a stand and used in sequential presentations. Wankat and Oreovicz (2001) looked at flip charts as helpful to students when they are organizing their group ideas for presentations to the whole class.

Since flip charts are placed in front of the class, they enable teachers to maintain eye contact with students, which help teachers observe students‟ reactions and thus make it possible to change teaching strategies during a presentation. The teacher is able to control

the charts, and can write or draw on them as the explanation is in progress. Recording of students‟ comments on the flip charts helps students to build their ideas in the lesson. Just like overhead transparencies, flip charts can be prepared in advance, can be written on during the lesson, and can be stored for future use.

2.10.3 Projected aids

They are devices for transmitting photographic and other images in an enlarged form onto a viewing screen. They employ a light source and a lens system. Traditional aids in this group include motion pictures, filmstrips, and slides of various sizes. The use of motion pictures and filmstrips has probably declined due to more user friendly media such as video. Aside from the chalk or marker board, the overhead transparency and projector are one of the most convenient and cost effective instructional materials. These can be used to display moving or still pictures. Still projectors include filmstrip, micro-projector, overhead projector, cine projector. Its effectiveness depends on the quality of the projected image. Projected aids consist of three types, namely LCD projectors, opaque projectors, overhead projectors

One of the emanating instructional media gaining some popularity is the overhead projector which can project excellent images. It must be noted that, the overhead projector like other media, remains an aid to presentation and does not at any stage in its use, take over the lesson.

Teachers need to use overhead projectors since there are advantages for both the teacher and the students. The judicious use of overheads in presentations is essential to captivate

the audience and improve their perceptions of what the speaker is saying. Just like the flip chart, the overhead is placed in front of the students, giving teachers eye contact with students and enabling teachers to check students‟ reactions and change the presentation pattern. The teacher can write or draw on the transparency, thus enabling development of ideas as the lesson is in progress.

The projector does not require special skills, and since it is easy to use, the teacher is able to control it. Students can also be involved by filling in blank spaces on the transparencies or to present their work in class. Use of transparencies saves time in that they can be prepared well in advance; they can be used as a quick reference, and also easily stored for future use (Williams, 1991).

2.10.4 Use of video

Video is one of the resources that can be used for teaching and learning purposes. Williams (1991) noted, it all begins when someone sees a need for a (video) programme on a particular topic and has some ideas on how that need might be met. He continued by posing questions that must be considered when deciding to produce a video programme, such as, for whom is the programme being made? How old are they? What do they know already? Do you want specific feedback during the programme or at the end? (William, 1991).

In the colleges of education, videos can be used when tutors want to show students various teaching strategies and skills. For example, video-taping demonstrations of micro-teaching and video-taping of specific lesson skills of introduction, questioning, reinforcement, explanation, and closure/conclusion can be done in the ideal situations of what the student teachers are expected to do. These skills can be shown to the students followed by discussions on the skills viewed before they practice them with their peers and at the primary demonstration schools.

2.10.5 The use of computers

Computers are widely used for a variety of operations, such as writing through word processing, class presentations, data analysis, retrieving of information and communications. In a survey of teachers‟ perceptions of the effects of technology on students‟ performance, the respondents indicated strong agreement with the fact that technology had had a positive effect on the students‟ performance (Hurley & Mundy, 1997). It is interesting, however, to note that, even in the developed countries despite the noted effectiveness of technology, not all teachers are competent and willing to infuse technology in their classes. Also some universities still use traditional methods of teaching while others have seen the need to respond to the changing world and are using the new technologies in their instruction.

It should be noted that currently tutors in the colleges of education in Ghana, even those who know how to operate the computers, have not yet used them for instructional purposes. However accessibility to this technology, allowing the tutors to type tests, record grades, create handouts and transparences and printed materials is a crucial first step

in the [tutors] use of technology in the classroom. In all situations, it is necessary to provide computer training within a social support network and to encourage teacher empowerment over a period of time. Such training will help enhance teachers‟ comfort level with computers.

2.11 Computers in Education: Issues and Challenges

A review of the literature indicates that the main issues associated with the use of computers and related technology in schools and school curricula are the attitudes and perceptions of administrators and teachers, community participation and involvement, teacher training, the financial costs of the technology and leadership.

2.11.1 Attitudes and perceptions of administrators and teachers

Hennessy, Ruthvem and Brindley (2005) researched the attitudes of in-service teachers towards the pedagogical use of Information and Communication Technologies (ICTs) in mainstream public schools in England. This study particularly examined teachers‟ perceptions towards the successful use of computer based tools in subjects such as English, Mathematics and Science. Computer based tools were defined as software applications such as Microsoft Office that could enhance learning. Seven themes emerged from this study

a. effecting working processes and improving production

b. supporting processes of checking trialing and refinement

c. enhancing the variety and appeal of classroom activity

d. fostering pupil independence and peer support

e. overcoming pupil difficulties and building assurance

f. broadening reference and increasing currently of activity

g. focusing on overarching issues and accentuating important features.

The themes indicated that computer based tools do have a positive effect on students irrespective of subject area.

Hennessy *et al*. (2005) indicated that students were thrilled by their ability to receive immediate feedback, and with regards to grammar and spelling both teachers and students acknowledged that the computer based tools improved their spelling and vocabulary. Teachers also expressed the ability of computer based tools to expedite the learning processes and enhance learning, and this was particularly popular with math and science teachers who expressed the ease with which they organized and analysed data using spreadsheets. In addition, teachers were of the perception that computer based tools promoted and fostered student dependence and collaboration with each other.

The perception of the teachers" role in the classroom with computers is another factor that could affect their use of computers for instruction (Wang, 2002). Wang (2002) investigated the perceptions of pre-service teachers in Alabama, USA of their role in a computer rich classroom. Central to this research was; what was expected of teachers or what teachers were expected to do with computers. The role of the teacher was conceptualized in terms of either being teacher-centered or student centered. Teacher centeredness defined the role of the teacher as the person who planned everything in the classroom. The teacher is viewed as the main source of information that would transfer the knowledge to the students. A student centered role viewed the teachers collaborating

with students in a learning process. Although no significant difference was found between a student centered or teacher centered role in a classroom with computers, the pre-service teachers expressed the need for a balance between the two roles.

Wang (2002) pointed out that the indifference to the student or teacher centered approach to the use of computers is attributed to the uncertainty of the teacher‟s role in a classroom with computers. However, the findings revealed that teachers were more inclined towards a teacher centered role due to the type of computer training they had received. A student-centered role required more management skills, development of evaluation methods and the design of curriculum related materials. Therefore, teachers did not feel comfortable in student- centered roles because they perceived such a role to require more skills and training that they had not been prepared for. Similarly, Goodison (2002) found that teachers in the United Kingdom were of the perception that students who had computer training out of the schools undermined their instruction, especially, when the students became aware of the teachers‟ anxiety and lack of knowledge of computers.

The anxiety that teachers experience in the use of computers in the classroom has been a topic of concern by various authors (Chou, 2003). They examined the implication of computer anxiety on professional development and also studied the cyber phobia (computer anxiety) of rural and urban in-service teachers in public schools in Queensland, Australia. The teachers were required to identify their cyber phobia and suggest possible ways of reducing cyber phobia through professional development.

Irrespective of teaching environment (rural or urban), the teachers had similar concerns. First, was access to computers? The teachers stated that increased access would result in an increase in the use of computers in the classroom. Teachers in the rural schools were particularly concerned about the obsolete computers they had.

The second concern was the competency in the use of computers. Most of the teachers expressed that computer terminology sounded foreign to them and that their skills were limited to word processing. Third, were professional development opportunities? Teachers were critical of the professional development opportunities at their disposal because it was limited and inadequate in facilitating their skill and knowledge acquisition. Also, teachers did not agree with having to pay for their professional development.

They emphasized the necessity for government to pay for such professional development since it was the government that usually wanted to implement computer use in educational curricula. Asan (2003) investigated the perceptions of Turkish pre-service teachers on their experience in multimedia environments. The teachers were placed into two groups; traditional teacher centered environments and, multimedia situational learning and learner centered environments. The pre-service teachers were required to fill a survey, conduct observations in their teaching practice schools and keep a log and report on their experiences each week. Their reports were blindly reviewed by independent graders who were unaware of the differences in teaching approaches of the two groups. This investigation found that the pre-service teachers in the multimedia class

expressed a better understanding of the classroom environment than those in traditional classrooms. Also, those in the multimedia classroom gave more detail and understood the concepts better (Asan, 2003).

The type of training that teachers have often has an impact on their perceptions about the use of computers in schools. A study by Cossa and Cronje (2004) on the introduction of computers and the Internet in Mozambiquan schools, addresses the issue of teacher training on the use of instructional tools. In order for teachers, to adjust their teaching methods to include technology, they need support from school administrators. Irrespective of the knowledge, competence and training of teachers, the use of computers in schools will not be successful without the leadership of the principal (Dawson & Rakes, 2003). Dawson and Rakes (2003) also indicated that through training, principals became more adept with technology and the improved skills of principals led to an increase in the use of technology tools in the schools.

Teachers‟ perceptions of principals and their role in the leadership of the school is yet another important factor when considering using computers in schools. A study by Demetriadis *et al.* (2003) indicated that teachers perceived school principals as an important aspect of the school. The principals were considered to have both negative and positive attitudes towards the use of computers. Some principals supported computer initiatives whereas others were reluctant to use it in their schools. Principals that supported technology efforts were more favoured by teachers than those who had negative attitudes (Baylor & Ritchie, 2002; Demetriadis *et al.*, 2003).

Teacher training in the effective use of technology for instruction is more critical than the acquisition of hardware and software (Sayre & Wetterlund, 2002). Teachers who lack basic computing skills and knowledge are less likely to use computers for any aspect of their teaching. In the case of the science colleges of education, it is doubtful whether some form of computer training had been organized for the science tutors.

Various studies by Sayre and Wetterlund (2002) suggested some form of training programme as a way of improving computer use for instruction. They suggested after the initial teacher training programme that includes a course in computer instruction should go with periods of continuous in-service training for the upgrade of skills and knowledge. Also teacher training is an ongoing programme therefore it is important to attune courses to the rapid changes that are made in hardware and software infrastructure. In the same regard, Sayre and Wetterlund (2002) propose a train-the-trainer model.

The above model was based on the training of highly skilled teachers who in turn conducted workshops in their regions. Although their model was intended to improve teacher use of ArtConnectEd resources for the classroom, it can be modified and applied to various contexts. In service training has been found to decrease anxiety and increase competency and knowledge in computer use. Therefore, without a teacher training programmes to enable teachers‟ master computer skills, efforts to effectively integrate technology in schools will be hampered.

2.11.2 Financial costs of computer education

The cost of networking and wiring, sustainability of technology programmes and training of educators are factors that need to be considered in any attempt to integrate computer and related technology in education, especially in rural settings.

Given the initial costs, schools also have to make provision for in-service training of teachers and sustainability due to the dynamic nature of computer technologies. Consequently, it is important to research the financial needs of computer integration in rural schools in Ghana, if such projects are to be successful, in order to ensure that the technology needs and skills of rural school children are at par with national standards. In most African countries including Ghana, the infrastructure for such projects is either not available or barely adequate.

In Ghana, the funding of schools is largely dependent on central government financing. Most rural communities do not have the infrastructure; electricity, telephones and building to support such initiatives. Such schools often receive old computers that either cost a fortune to refurbish or are no longer compatible with the current technologies. Also, most of such technologies have to be imported which adds additional costs to the implementation of educational technology in school curricula.

Confronted with such enormous challenges of meeting the cost of integrating technology in rural schools in a country like Ghana, there is a need for research to investigate and derive strategies for addressing the issues of infrastructure and funding. In the United States, there is a trend to have at least a ratio of one computer to three students in rural

schools but this is currently not possible in developing countries. Kahn (1998) suggested that schools that do not have the resources could opt for a one-computer classroom. Such classrooms could have one computer and a projector for all students to see, follow instructions and demonstrations, and students could either work on exercises collectively or in teams that take turns to input answers into the computer.

In 2001, Ghana participated in the Scan-ICT project (Dzidonu, 2002). At the end of the pilot programme, a report detailing the activities undertaken by the Scan-ICT program in Ghanaian schools from September 2001 to December 2002 was published. This report was based on a nationwide survey conducted in 500 urban and rural primary and secondary schools, 13% of the schools were rural. The report indicated that about 79% of the schools surveyed had an average of 19 computers (Dzidonu, 2002).

In March 2004 Ghana signed a memorandum of understanding with Microsoft Corporation to participate in the Partners in learning programme. This programme is designed to provide Ghanaian schools with subsidized Microsoft products and training. This agreement is recent and therefore, no information was available on the impact on Ghanaian education. The emergence of new technologies and the integration of such technologies in educational institutions is an important issue in the quest to bridge the rural-urban digital divide in Ghana. Norris (2001) defined the digital divide as a "multidimensional phenomenon" with three aspects; the global divide, the social divide and the democratic divide (p. 4). The study of the integration of computers and related technologies in rural school curricula in Ghana falls under the social divide, as identified

by Norris. The social divide is concerned with the gap between the information rich and poor within Ghana, and this is often reflected in the urban rural divide.

The integration of new ideas into established practices has always been challenging for educators. Educators often have to examine the impact of new technologies in the work place, classroom and how it relates to community needs. This is a challenge faced by most educational institutions, and Ghana is no exception. In government publication, Information technology policy framework for Ghana (2001), the government spells out the need to increase and sustain socio-economic development through the implementation of „solid" information technology (IT) program at all educational institutions. Some of the issues the government intends to develop are a „Teach-the- Teachers" program to regularly upgrade the IT knowledge and skills of teachers, and a Computers-for-Schools Scheme to enable every student, teacher or school to purchase computers through attractive financial packages.

In another government publication, the national development policy framework for Ghana (1997), the government argued that Ghana will have to embrace science and technology in order to make sustainable economic and social progress. Global trends in the use of computer technology to execute most official and commercial activities, put pressure on Ghana to introduce computer education in the curriculum of its schools in order to keep up with the trends and improve the lives of Ghanaians through computer technological innovations and education. Educational change occurs through various mechanisms and this research seeks to address the issues that arise as Ghana initiates

structural, human resource, symbolic and political programs to effect the introduction of computer technology in schools.

As illustrated in this chapter, the integration of computers in a school‟s curriculum requires leadership, coordination and situating the technology in the cultural setting of a school or society where the integration is to take place. The studies reviewed on the use of computers and related technologies in Ghanaian schools are descriptive and do not address how computes can be integrated in schools.

2.12 Summary

To give the study a direction and support from other researchers on related studies theoretical framework was discussed. The study reviewed literature on learning through technology and why use instructional technologies. Despite instructional technologies helping to capture pupils' attention and explaining concepts, the literature has shown that it takes the willingness of the teachers to adapt to changes in respect of instructional technologies utilization in their teaching.

However, for those teachers who were ready to use instructional technologies, the literature reported that they faced challenges of lack of adequate training, availability, accessibility and support from peers and administrators (Hope, 1997; Turner, 1996; and Ochs, 1993). Literature on the competence levels of teachers in the use of instructional technologies showed that teachers who are more experienced in the use of technological tools have greater confidence in their ability to use them effectively.

The study also reviewed literature on computers in education, and the issues and challenges associated with the use of computer and related technology in schools. The studies reviewed on the use of computers and related technologies in Ghanaian schools are descriptive and do not address how computes can be integrated in schools. Most of the materials reviewed were from foreign literature. The literature reviewed has indicated that only few works have been conducted in this area of study. This study therefore seeks to fill some of the gap in this area of study.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter depicts the methods that were used in collecting the data needed for this study. It covers the areas of research design, population for the study, the sample and sampling technique. The research instruments, its reliability and validity were also discussed in this chapter. The data collection procedures and the data analysis procedures were also outlined.

3.1 Research Design

This study was to survey science tutors in the colleges of education to determine what instructional technologies are available in the colleges, what technologies tutors used in their lessons, their attitudes towards the use of instructional technologies and their perceived competence in the use of the technologies. The researcher therefore considered the descriptive survey design as the most appropriate design for this study.

A descriptive survey is concerned, among other things, with conditions or relationships that exist, beliefs, views or attitudes that are held and effects that are being felt. This usually does not involve the manipulation of any variable (Cohen, Mannion & Morrison, 2007), and involves mainly the use of questionnaire to collect data. This descriptive design was adopted to enable the researcher sample the views of a wide variety of research subjects on the problem investigated.

3.2 Population for the Study

There are thirty- eight (38) colleges of education in Ghana. Out of these, fifteen (15) of them are classified as colleges of Mathematics and Science Education. At least one (1) of such colleges is established in each of the ten (10) regions of Ghana. The target population for the study therefore consisted of all science tutors in the 15 Science Colleges of Education in Ghana.

3.3 Sample and Sampling Techniques

Out of the target population, the researcher sampled 4 Science Colleges of Education using purposive sampling technique. The colleges were; 'P' College of Education and 'K'

College of Education (pseudonyms) in the Eastern Region while 'F' College of Education and 'A' College of Education (pseudonyms), from the Volta Region of Ghana.

The respondents comprised all the science tutors in the four Science Colleges of Education. Table: 1 shows the number of science tutors per college.

Table1: Number of Science Tutors per College

College	Number of Science Tutors
„F" College of Education	10
„P" College of Education	9
„A" College of Education	7
„K" College of Education	6
Total	**32**

The purposive sampling technique was employed by the researcher because the researcher"s place of work and home are both close to the selected regions. According to Cohen *el al*. (2007), in the purposive sampling technique, the sample is chosen for a specific reason. The reason assigned above is the specific reason for this study.

3.4 Instruments for Data Collection

The researcher developed three (3) different instruments to collect data for this study. These were questionnaire, interview and observations. The questionnaire was used because the respondents were at a wide coverage area. According to Center for Continuing Education, UCC (2005), the merits of using questionnaire include reach ability where many respondents can be reached more easily. Again, the results of the

questionnaires can usually be quickly and easily quantified by either a researcher or through the use of a software package. The questionnaire was designed for the tutors who teach science in the colleges of education. The researcher developed the questionnaire (Appendix A) which contains five sections. The first section, which is 'A' was to collect information on the respondents biographical data. Apart from sections 'B', which had some items on Yes/ No responses, every other section was communicated on a Likert-type scale.

Section 'B' contained fifteen (15) items that solicited information from the respondents regarding availability of instructional technologies in the colleges of education such as projectors and flip charts. The frequent uses of these technologies in teaching by tutors were also captured. Tutors were expected to respond either "Yes" or "No" to the first eight items. The remaining seven items had a four-point Likert scale measuring the frequency of use of instructional technologies with a scale 1= never, 2= rarely, 3= occasionally and 4= always.

Section „C" had eight (8) items. This section which measured the importance of selected factors on influencing tutors' use of instructional technologies, had a four-point Likert scale with a rating of 1 representing " Not important", 2 representing " Slightly important", 3 representing "Moderately important" and 4 representing "Very important". With the expert advice from the researcher's supervisors, the questionnaire was developed to gather information for this study.

Section 'D' was made up of ten (10) items which sought to collect information on the attitudes of science tutors towards the use of instructional technologies. This part also had a four-point Likert scale, measuring participants‟ (1= strongly disagree, 2= disagree, 3= agree and 4= strongly agree) agreement levels with statements regarding their attitudes towards the use of instructional technologies.

The final section which is „E‟ had nine (9) items. This section communicated on a five-point Likert scale type. The researcher sought to gather information concerning science tutors‟ competence levels in use of instructional technologies. Here, participants reported on their perceived level of competence in using the selected technologies with the rating of 1= incompetent, 2= slight competent, 3= moderately competent, averagely competent and 5= very competent.

The interview was used to determine any inconsistency in the responses to the questionnaire. In particular, a semi-structured interview was employed. The interview was used in order to obtain useful information that could not be obtained only from observation and responses of the questionnaire. Creswell (2002) stated that although semi-structured interviews have structured questions, the order can be modified based upon the interviewer‟s perception of what seems most appropriate, thereby allowing for the omission of inappropriate questions. Thus, semi-structured interviews have the advantage of supplying large volumes of in-depth information based on the respondents‟ opinions, beliefs and feelings about the situation in their own words (Ary, Jacobs & Razavieh, 2002).

In semi-structured interviews, the predetermined questions can be modified in order to remain as open and adaptable as possible to the interviewee‟s nature and priorities. Consequently, semi-structured interviews should be tightly focused to elicit the kind of information the researcher wants to get. These interviews allowed the researcher to further probe into tutors‟ use of instructional technologies during science lessons. Participants were verbally assured by the researcher that there would be confidentiality in the handling of any data or information obtained from them.

The researcher prepared an interview schedule (Appendix B) for the science tutors which had six (6) items. Items 1 and 2 sought information on the types and usefulness of instructional materials that are available for the teaching of science. Items 3 and 4 demanded information on the use of instructional materials by both tutors and students during lesson delivery. Item 5 requested for the difficulties encountered in the use of the materials by tutors and item 6 sought to find out the support given by their administration regarding the provision of instructional technologies to the science department.

Lastly, an observation was employed by the researcher as a means of confirming the data gathered from the questionnaire and the interview. Observation is a systemic method of data collection that relies on a researcher's ability to gather data through watching the behaviour of a group of people or an event in a certain place for a specified length of time (Gomm, 2008).

The non-participant observation technique was used. The researcher developed an observation checklist (Appendix C) that guided in the class observation process. For the non-participatory observation, the researcher did not participate but remained an outside observer in the lessons that were delivered.

3.5 Validity of the Instruments

The validity of an instrument is justified if the instrument measures what it is supposed to measure (Cohen *et al.*, 2007). In the quest of the researcher to ensure validity of the instruments, the items on the questionnaire, the interview guide and observation check-list were first vetted by the researcher, followed by colleagues and later the researcher's supervisors who read through and critiqued the items. Based on their recommendations, some items were modified while others which were found to be unsuitable were discarded. This was done to improve the face validity. To ensure content validity of the instruments, the content of the questions addressed the research questions specifically.

3.6 Reliability of the Instruments

The reliability of an instrument is the degree to which items in an instrument generate consistent responses even when different respondents respond. It measures the dependability of the items used in collecting data (Cohen *et al.*, 2007). It is worth mentioning that it is possible to have questionnaire that is reliable because the responses are consistent, but may be invalid because it fails to measure the concept it intends to measure, (Fraenkel & Wallem, 2000).

The reliability of the questionnaire was established through test-retest approach. Test-retest reliability method is one of the simplest ways of testing the stability and reliability of an instrument over time. The researcher was interested in the stability of the questionnaire, hence the test-retest approach.

The questionnaire was administered to four tutors from Mount Mary College of Education. This college was not part of the selected colleges for the research. Five days later, the questionnaire was again given to the same tutors to answer in order to check for the stability of the questionnaire items. Their responses were analysed using Pearson‟s Product Moment Correlation Formula (See Appendix D). This yielded a correlation coefficient of 0.88. According to Coolican (1999) a correlation coefficient should be 0.75 and above to be classified as reliable. The result of 0.88 proves the reliability of the questionnaire.

The test-retest was done in a real-world condition (Sudman & Bradburn, 1982) because the participants resemble those that would be in the main study. The questionnaire items were straight-forward and did not require elaborate responses from respondents. Participants were given an opportunity to offer comments on the structure of the questions, i.e. clarity, relevance, level of difficulty, and length of the survey. The test-retest provided information concerning ambiguities within the questionnaire thus dealing with the issue of content validity. The reliability of the instrument was determined from the results of the test-retest where sources of response error in the instrument were identified and corrected.

3.7 Data Collection

An introductory letter (Appendix E) was taken from the Head of Science Education Department, University of Education, Winneba, to the Principals of the various colleges where the research was conducted. When permission was granted by the principals of the institutions, the participants from the selected colleges of education were personally contacted. Data concerning instructional technologies and resources were collected through a questionnaire, semi- structured interviews and observations.

3.7.1 Questionnaire

There are several ways by which a questionnaire can reach respondents for completion. A researcher can contact respondents who are scattered by mailing the questionnaire to them and wait for their responses. In this study the researcher administered the questionnaire in person, i.e. moved from one college to the other. Despite the time and expense to be incurred, this approach helped the researcher to have a high response rate (Ary, Jacobs, & Razavieh, 2002), since the questionnaires were collected immediately after completion. Another advantage was that since the respondents were clustered at their working places, it was possible to get almost all respondents at the same time and allow them to fill in the questionnaires at the same time. In addition, the presence of the researcher helped because she was able to go through the completed surveys and where a respondent forgot or skipped an item, he/she was asked to fill in the missing information, and hence all items in the questionnaire were responded to and had no missing data.

The fear expressed by Rea and Parker (1997) that administering surveys in person confronts the researcher with a strange environment was not relevant because most of the respondents in the colleges of education are people with whom the researcher works from time to time through the Japan International Cooperation Agency (JICA) and the Ghana Education Service.

3.7.2 Semi- structured interviews

An interview is a process in which a researcher and participant engage in a conversation focused on questions related to a research study. In qualitative research, open-ended questions are asked so that participants can voice out their experiences without any constraints placed on them by the researcher (Creswell, 2002). These types of questions represent the most frequently used form of interviewing in qualitative studies, which allow the participant to create response possibilities.

Conducting interviews in order to make data has both advantages and disadvantages. They provide useful information that cannot be obtained from observations, and allow participants to describe detailed personal information and experiences. One disadvantage is that they may be "filtered" (Creswell, 2002, p. 205) through the perspective the participant wants the researcher to hear.

During the study period, the researcher interviewed the four (4) HODs from the selected colleges. The HODs were selected and interviewed because they are in charge of the department and all equipment and materials are supposed to be under their care. The interview was crucial to the study because it provided useful information that could not

be obtained only from the responses of the questionnaire and observation. The semi-structured discussion format was used to enable the participants engage in conversation and freely to express themselves in a relax way. Beatty (1995) also contended that interviewers should allow interviewees to narrate their views in a relax manner. The questions were focused primarily on the availability of instructional technologies; the usefulness of these technologies in teaching and the difficulties encounter when using those technologies. Each interview session lasted for about fifteen (15) minutes. The interviews were audio-taped and then transcribed after permission has been sought from the respondents.

3.7.3 Class observations

Observations maximize the research as instrument allowing one to document spoken claims with what participants do as part of their daily routines. Within the context of this investigation, observational data allowed the researcher as observer to see things firsthand and use her own knowledge and expertise in interpreting what was observed rather than relying upon once-removed accounts from interviews (Merriam, 2001).

In all, four science lessons were observed during the study period, one lesson from each College of Education. The observation identified the types of instructional technologies being used in the lessons, tutors attitude and their competence levels in the use of the technologies. The observation enabled the researcher to observe the impact the technologies used had on students‟ learning and how they responded to the lesson.

3.8 Data Analysis Procedures

Data concerning the use of instructional technologies were collected using questionnaire, interview and observation. The questionnaire responses were analysed using descriptive statistics which included percentages and frequencies of responses.

In order to analyse the interviews, the tape-recorded responses of the interviewees were transcribed and analysed using content analysis. Lastly, the classroom observation was analysed by taking note of the counts of the check-list themes and analysing classroom behaviour of the tutors.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Overview

This survey research used a sample of 31 out of 32 science tutors from four Science Colleges of Education in the Eastern and Volta Regions of Ghana. The purpose of this study was to give a descriptive analysis of the use of instructional technologies by science tutors in science colleges of education in Ghana. This was based on what technologies were available, their frequency of use and factors that would influence the tutors‟ use of instructional technologies. Also the tutors‟ attitudes and competence levels towards the use of instructional technologies were ascertained. This chapter focuses on the analysis of

the data collected from the questionnaire as well as interviews and observations from the four Colleges of Education.

4.1 Data Presentation by Research Questions

The data collected were presented based on the research questions formulated for the study.

Research Question 1: Which types of instructional technologies are in the science colleges of education?

Research question 1 was answered by the respondents using the items on part I of section „B‟ of the questionnaire. In 'F' College of Education, technologies in the science department according to the questionnaire responses include chalkboards (whiteboards), flip charts, LCD and overhead projectors, computers and video projection equipment. Opaque projectors were not available.

With regards to „P‟ College of Education, the following technologies were available; chalkboards, flip charts, overhead and LCD projectors and a computer. There were no, opaque projectors and video projection sets available at the science department.

Responses gathered from „A‟ College of Education show that, instructional technologies available in the science department were not many and include chalkboards, LCD and overhead projectors and a computer. Tutors also specified making use of local resources

such as improvised measuring beakers, litmus papers, beam balance and charts. No flip charts, opaque projectors and video projection sets were available.

In the last college which is „K" College of Education, instructional technologies available in the science department include chalkboards, flip charts, LCD and overhead projectors and a computer. There were no opaque projectors and video projection sets available.

Research Question 2: How often do the science tutors use Instructional technologies in their lessons?

Research question 2 was answered by the respondents using the items on parts II and III of section „B" of the questionnaire. Data in Table 2 shows the frequency of use of instructional technologies by the tutors in 'F' College of Education.

Table 2: Frequency of Use of Technologies ('F' College of Education)

Technology	Never		Rarely		Occasionally		Always	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Chalkboard	0	0	0	0	0	0	9	100
Flip chart	2	22.2	2	22.2	5	55.5	0	0
Overhead Projector	4	44.4	3	33.3	2	22.2	0	0
LCD Projector	4	44.4	3	33.3	1	11.1	1	11.1
Opaque Projector	9	100	0	0	0	0	0	0
Video	8	88.8	1	11.1	0	0	0	0
Computer	4	44.4	2	22.2	3	33.3	0	0

N= 9; Freq. = Frequency

The responses indicate that all of the tutors used the chalkboard (white board) always. About half (5 of 9) of the tutors occasionally used the flip charts, and more than two-thirds of the tutors (7 of 9) reported never using or rarely using overhead projectors or any of the projected aids. The hardly ever used technologies were video projection equipment, with 8 of the tutors reporting that they never used them in teaching. One third (3 of 9) of the tutors reporting occasionally using computers.

According to part III of section „B" of the questionnaire, 6 out of 9 tutors were not using overhead projectors because of lack of training in their use while over half (6 of 9) did not use videos because they were not available, and 55.56% of tutors also did not use computers due to unavailability. Two out of 9 did not use LCD projectors because they were limited is supply. These responses revealed that the chalkboard (white board) and flip charts were the most frequently used technologies among the tutors in ' F' College of Education.

In „P" College of Education, the responses indicate that, all the tutors (9 of 9) used the chalkboard always and one third (3 of 9) of them used flip charts occasionally (see Table 3). In spite of video projections being unavailable as per the questionnaire, videos were used occasionally by 2 of the tutors, implying that when the videos are available their use was occasional. On the other hand, 6 out of 9 tutors either rarely used or never used overhead projectors. More than half of the tutors (6 of 9) occasionally used computers.

Table 3: Frequency of Use of Technologies ('P' College of Education)

Technology	Never		Rarely		Occasionally		Always	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Chalkboard	0	0	0	0	0	0	9	100
Flip chart	5	55.6	1	11.1	3	55.5	0	0
Overhead Projector	5	55.6	2	22.2	2	22.2	0	0
LCD Projector	3	33.3	3	33.3	2	11.1	1	11.1
Opaque Projector	9	100	0	0	0	0	0	0
Video	6	66.7	1	11.1	2	0	0	0
Computer	2	22.2	1	11.1	5	33.3	1	0

N= 9; Freq. = Frequency

Section „B" part III of the questionnaire focused on reasons for not using technologies, and (8 of 9) of participants did not use videos because they were not available. This agreed with the data gathered from the survey on the availability of technologies, which showed that there was no video projection equipment. Over half of the tutors (7of 9) cited either lack of training or accessibility as reasons for not using computers and overhead projectors.

The data in Table 4 indicates how frequently tutors in „A" College of Education use technologies available at the department.

Table 4: Frequency of Use of Technologies ('A' College of Education)

Technology	Never	Rarely	Occasionally	Always

	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Chalkboard	0	0	0	0	0	0	7	100
Flip chart	6	85.71	0	0	1	14.29	0	0
Overhead Projector	4	57.14	2	28.57	1	14.29	0	0
LCD Projector	3	42.86	2	28.57	2	28.57	0	0
Opaque Projector	7	100	0	0	0	0	0	0
Video	6	85.71	1	14.29	0	0	0	0
Computer	4	57.14	1	14.29	2	28.57	0	0

N= 7; Freq. = Frequency

The responses show that all the participants used the chalkboard always in their teaching. On the other hand, almost all (6 of 7) of the participants either rarely or never used flip charts. This agreed with the unavailability of the charts as per the survey instrument. The reported use of the other technologies was similarly low: all never or rarely used videos, which are also not available. Almost all (6 or 7) never or rarely used overhead projectors, and 5 tutors never or rarely used computers.

The part of section „B" that dealt with tutors" reasons for not using technologies, responses from the participants showed that tutors did not use flip charts (6 of 7) and opaque projectors (7 of 7) because they were not available. Overhead projectors and videos were also not used by over half of the respondents because they had no training in the use of those technologies. This agreed with the information gathered from the survey, which showed that flip charts were not available.

In the last college which is „K" College of Education, the data in Table 5 indicates how frequently tutors use the technologies available at the department during lessons.

Table 5: Frequency of Use of Technologies ('K' College of Education)

Technology	Never		Rarely		Occasionally		Always	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Chalkboard	0	0	0	0	2	33.3	4	66.7
Flip chart	1	16.7	1	16.7	3	50.0	1	16.7
Overhead Projector	3	50.0	2	33.3	1	16.7	0	0
LCD Projector	3	50.0	1	16.7	2	33.3	0	0
Opaque Projector	6	100	0	0	0	0	0	0
Video	6	100	0	0	0	0	0	0
Computer	3	50.0	1	16.7	2	33.3	0	0

N= 6; Freq. = Frequency

Responses of participants reveal that all the tutors used the chalkboard either occasionally or always. Two thirds (4 of 6) the tutors reported either occasionally or always using flip charts. However, almost all of the tutors (5 of 6) reported either never or rarely used LCD and overhead projectors. All the tutors (6 of 6) reported either never used videos and opaque projectors. Two-thirds of the tutors (4 of 6) either rarely or never used computers.

Responses concerning reasons for not using the technologies, almost all the tutors (5 of 6) did not use projectors because of lack of training for their use and over half of the tutors (4 of 6) representing 66.67% did not use videos because they were unavailable. Participants also indicated „inaccessibility" (50%) as a reason for not using computers

Majority of the respondents in all the colleges indicated "unavailability" as a reason for not using the technologies. Hope (1997) emphasized this point: "For technology to be exploited in an environment, it must first exist" (p. 3). Just as Majed (1996) also remarked, "… decision makers in the Ministry of Education do not emphasize the importance of instructional media in schools … due to tight budgets… instructional media do not come in their priorities, or that they do not know the importance of instructional media in the teaching/learning process" (p. 65). Such a lack of emphasis is unfortunate given that research demonstrates the positive impact technology has on learning.

Research Question 3: What do science tutors consider as important factors in influencing their use of instructional technologies?

Research question 3 was answered with items on section „C" of the questionnaire by the respondents involved in the study. Table 6 shows responses to section „C" of the questionnaire by tutors in „F" College of Education.

Table 6: Factors that Influence the Use of Technologies ('F' College of Education)

Item	Not important		Slightly important		Moderately important		Very important	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Availability of resources	0	0	2	22.2	3	33.3	4	44.4
Administrative support	0	0	1	11.1	2	22.2	6	66.7

Training	0	0	0	0	3	33.3	6	66.7
Access to resources	0	0	0	0	4	44.4	5	55.6
Personal interest in instructional technology	0	0	2	22.2	3	33.3	4	44.4
Peer support	0	0	2	22.2	4	44.4	3	33.3
Workshops and seminars	0	0	3	33.3	3	33.3	3	33.3
Frequent use of items	0	0	4	44.4	3	33.3	2	22.2

N = 9; Freq. = Frequency

Responses from majority of the participants indicated that they valued the items; access to resources, training in the use of items, availability of resources and personal interest as being either moderately important or very important factors that could influence them to use technologies in their lessons.

Seven of the tutors chose peer support (7 of 9) and workshops and seminars (6 of 9) as either moderately important or very important in influencing the use of technologies for instruction.

The data in Table 7 shows how science tutors in „P" College of Education responded to section „C"of the questionnaire which focused on factors that influence tutors" use of technologies.

Table 7: Factors that Influence the Use of Technologies ('P' College of Education)

Item	**Not important**		**Slightly important**		**Moderately important**		**Very important**	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Availability of resources	0	0	0	0	0	0	9	100

Administrative support	0	0	2	22.2	2	22.2	5	55.6
Training	0	0	0	0	1	11.1	8	88.9
Access to resources	0	0	0	0	1	11.1	8	88.9
Personal interest in instructional technology	0	0	1	11.1	2	22.2	6	66.7
Peer support	1	11.1	2	22.2	3	33.3	3	33.3
Workshops and seminars	0	0	1	11.1	4	44.4	4	44.4
Frequent use of items	1	0	3	33.3	3	33.3	2	22.2

N = 9; Freq. = Frequency

Their responses showed that all the participants (9 of 9) rated the following factors: training, availability of resources, access to resources, personal interest in instructional technologies, and workshop and seminars as either moderately important or very important in enhancing students‟ learning. Peer support as a factor in using technologies was rated lower in importance than other items.

In response to Research question 3, respondents in the „A‟ College of Education ticked almost all the items as being important factors that influence the use of technologies. Responses in Table 8 show that all the participants rated the following items; availability of resources, access to resources, training, personal interest in technology use, frequent use of technologies and administrative support as being either moderately important or very important. Peer support as a factor in using technologies was rated lower in importance than other items just as in College 'P ' College of Education.

Table 8: Factors that influence the use of Technologies ('A College of Education)

Item	Not important		Slightly important		Moderately important		Very important	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Availability of resources	0	0	0	0	0	0	7	100
Administrative support	0	0	0	0	2	28.57	5	71.43
Training	0	0	0	0	1	14.29	6	85.71
Access to resources	0	0	0	0	0	0	7	100
Personal interest in instructional technology	0	0	0	0	1	14.29	6	85.71
Peer support	0	0	3	42.86	2	28.57	2	28.57
Workshops and seminars	0	0	0	0	2	28.57	5	71.43
Frequent use of items	0	0	0	0	4	57.14	3	42.86

N = 7; Freq. = Frequency

Responses from participants in „K" College of Education show that high percentages of the tutors valued all items as being very important with "training" and "availability" as the most highly rated. The only exception was the value placed on "peer support" which was rated important by 2 of the 6 respondents (See Table 9).

Table 9: Factors that Influence the Use of Technologies ('K' College of Education)

Item	Not important		Slightly important		Moderately important		Very important	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Availability of resources	0	0	1	16.7	1	16.7	4	66.7
Administrative support	0	0	2	33.3	2	33.3	2	33.3

Training	0	0	1	16.7	1	16.7	4	66.7
Access to resources	0	0	0	0	3	50.0	3	50.0
Personal interest in instructional technology	0	0	1	16.7	2	33.3	3	50.0
Peer support	0	0	4	66.7	1	16.7	1	16.7
Workshops and seminars	0	0	2	33.3	2	33.3	2	33.3
Frequent use of items	0	0	2	33.3	1	16.7	3	50.0

N = 6; Freq. = Frequency

In all the four colleges, the responses from majority of the respondents indicated that they value "training on the use of the items" as a factor. This agrees with what Ochs (1993) said on the need for training, that "…good training courses are almost always superior because they effectively drill concepts into a format that is easy to master" (p.105).

The need for access to technologies expressed by participants was also emphasized by Yildirim (2007) who said, "Access to technological resources is one of the effective ways to teachers" pedagogical use of technology in teaching" (p.180).

Brace and Roberts (1996) also emphasized this point: "Faculty requires hands-on experience [through] workshops and orientations that are offered at convenient times" (p. 327).). The need for support system for technology use as expressed by respondents was also emphasized by Hope (1997) who said, "Leadership must foster an environment where teachers are encouraged to be creative and to explore new innovations like technology. Without leadership with a vision, technology cannot reach its potential in schools" (p. 3).

Research Question 4: What are the attitudes of the college science tutors towards the use of instructional technologies?

Research question 4 was answered with items on section „D" of the questionnaire by the respondents involved in the study. Responses from the science tutors in „F" College of Education to section „D" of the questionnaire shown in Table 10, reveal that all the tutors either agreed or strongly agreed with the statements that indicated the use of the chalkboard / white board as being important (9 of 9) and teaching materials help to elaborate difficult concepts (8 of 9).

Table 10: Attitudes towards Use of Technologies ('F' College of Education)

Item	Strongly Disagree		Disagree		Agree		Strongly Agree	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Using the chalkboard is very important.	0	0	0	0	0	0	9	100
Producing teaching and learning materials require too much time.	2	22.2	2	22.2	4	44.4	1	11.1
Teaching and learning materials help to elaborate difficult concepts.	0	0	1	11.1	3	33.3	5	55.6
Using computers in teaching is very difficult.	2	22.2	4	44.4	2	22.2	1	11.1
Teaching and learning materials	0	0	0	0	3	33.3	6	66.7

enhance students understanding of concepts.								
The use of flip chart in teaching is very challenging.	5	55.6	2	22.2	2	22.2	0	0
Overhead projectors are easy to operate.	1	11.1	2	22.2	5	55.6	1	11.1
Video recordings are very difficult to use in the classroom.	2	22.2	5	55.6	1	11.1	1	11.1
Local resources are a good substitute for some commercial teaching materials.	2	22.2	1	11.1	4	44.4	2	22.2
The use of instructional materials in teaching is time consuming.	2	22.2	3	33.3	3	33.3	1	11.1

N = 9; Freq. = Frequency

More than half of the tutors also agreed or strongly agreed with the statements "overhead projectors are easy to operate" (6 of 9). Two-thirds (6 of 9) of the tutors either disagreed or strongly disagreed with the statement " using computers in teaching is very difficult," while more than half of them (7 of 9) either disagreed or strongly disagreed with the statement " videos recordings are difficult to use in the classroom". These expressed views by the tutors were an indication that tutors believed that given a chance to learn how to use the computers and videos, they could do it.

In „P" College of Education, responses in Table 11 indicate that almost all the respondents (8 of 9) either agreed or strongly agreed with the statements, "using the

chalkboard is very important" and "local resources such as pictures and charts are a good substitute for some commercial teaching materials."

Table 11: Attitudes towards Use of Technologies ('P College of Education)

Item	Strongly Disagree		Disagree		Agree		Strongly Agree	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Using the chalkboard is very important.	0	0	1	11.1	1	0	7	77.8
Producing teaching and learning materials require too much time.	2	22.2	0	0	2	22.2	5	55.6
Teaching and learning materials help to elaborate difficult concepts.	0	0	0	0	1	11.1	8	88.9
Using computers in teaching is very difficult.	7	77.8	2	22.2	0	0	0	0

Teaching and learning materials enhance students understanding of concepts.	0	0	0	0	1	11.1	8	88.9
The use of flip chart in teaching is very challenging.	6	66.7	1	11.1	2	22.2	0	0
Overhead projectors are easy to operate.	0	0	1	11.1	5	55.6	1	11.1
Video recordings are very difficult to use in the classroom.	5	55.6	3	33.3	2	22.2	0	0
Local resources are a good substitute for some commercial teaching materials.	0	0	2	22.2	1	11.1	7	77.8
The use of instructional materials in teaching is time consuming.	6	66.7	1	11.1	1	11.1	1	11.1

N = 9; Freq. = Frequency

All the tutors (9 of 9) either agreed or strongly agreed that "teaching materials help explain difficult concepts" and "teaching and learning materials enhance students" understanding of concepts". Seven of the 9 tutors agreed or strongly agreed that "producing teaching materials takes too much time."

However, all tutors (9 of 9) either disagreed or strongly disagreed with the statement "using computers in teaching is very difficult," while almost all (7 of 9) either disagreed or strongly disagreed with the statements "the use of flip charts in teaching is very challenging" and "video recordings are very difficult to use in the class." Such responses

may indicate that tutors just need to be given the opportunity to learn more about these technologies.

One attitude that appears problematic is the belief that productions of teaching materials require too much time, an attitude held by more than half of the tutors. Yet, they also expressed unanimity about the importance of teaching materials in helping to explain difficult concepts.

The responses according to Table 12, shows that almost all tutors in „A" College of Education either agreed or strongly agreed that the following statements were important or very important: "using the chalkboard is very important", "teaching and learning help to elaborate difficult concepts", and "local resources such as the use of plastic bottles as beakers are a good substitute for some commercial teaching materials" (5 of 7).

Table 12: Attitudes towards Use of Technologies ('A' College of Education)

Item	Strongly Disagree		Disagree		Agree		Strongly Agree	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Using the chalkboard is very important.	0	0	1	14.29	1	14.29	5	71.43
Producing teaching and learning materials require too much time.	1	14.29	4	57.14	2	28.57	0	0
Teaching and learning materials help to elaborate difficult concepts.	0	0	0	0	2	28.57	5	71.43
Using computers in teaching is	2	28.57	4	57.14	1	14.29	0	0

very difficult.								
Teaching and learning materials enhance students understanding of concepts.	1	14.29	1	14.29	1	14.29	4	57.14
The use of flip chart in teaching is very challenging.	3	42.86	4	57.14	0	0	0	0
Overhead projectors are easy to operate.	1	14.29	4	57.14	2	28.57	0	0
Video recordings are very difficult to use in the classroom.	2	28.57	4	57.14	1	14.29	0	0
Local resources are a good substitute for some commercial teaching materials.	1	14.29	1	14.29	4	57.14	1	14.29
The use of instructional materials in teaching is time consuming.	4	57.14	2	28.57	1	14.29	0	0

N = 7; Freq. = Frequency

Almost all the tutors (6 of 7) also either disagreed or strongly disagreed with the statement, “using computer in teaching is very difficult". All the tutors (7 of 7) disagreed or strongly disagreed that using flip charts in teaching is very challenging although they are unavailable in the college. More than half (5 of 7) disagreed or strongly disagreed that video recordings are very difficult to use in the classroom. These responses suggested that tutors would welcome opportunities to learn to use these technologies. Half of the respondents (4 of 7) reported either incompetent or slightly competent in “producing

teaching and learning materials using local resources" and "operating a video when teaching".

In „K" College of Education, the data in Table 13 show that all tutors (6 or6) either agreed or strongly agreed with statements that indicated "using the chalkboard is very important"; "teaching materials help to elaborate difficult concepts" and "teaching and learning materials enhance students understanding of concepts". Over half of the participants (4 of 6) either agreed or strongly agreed with the statements, "overhead projectors are easy to operate"; "producing teaching and learning materials require too much time" (4 of 6) and they also believed that "local resources are a good substitute for some commercial teaching materials" (4 of 6).

Table 13: Attitudes towards Use of Technologies ('K' College of Education)

Item	Strongly Disagree		Disagree		Agree		Strongly Agree	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Using the chalkboard is very important.	0	0	0	0	0	0	6	100
Producing teaching and learning materials require too much time.	1	16.7	1	16.7	2	33.3	2	33.3
Teaching and learning materials	0	0	0	0	2	33.3	4	66.7

help to elaborate difficult concepts.								
Using computers in teaching is very difficult.	2	33.3	2	33.3	2	33.3	0	0
Teaching and learning materials enhance students understanding of concepts.	0	0	0	0	1	16.7	5	83.3
The use of flip chart in teaching is very challenging.	3	50.0	2	33.3	1	16.7	0	0
Overhead projectors are easy to operate.	0	0	2	33.3	2	33.3	2	33.3
Video recordings are very difficult to use in the classroom.	2	33.3	2	33.3	1	16.7	1	16.7
Local resources are a good substitute for some commercial teaching materials.	1	16.7	1	16.7	2	33.3	2	33.3
The use of instructional materials in teaching is time consuming.	2	33.3	1	16.7	2	33.3	1	16.7

N = 6; Freq. = Frequency

Almost all the participants (5 of 6) either disagreed or strongly disagreed with the statement, “the use of flip charts in teaching is challenging”. More than half of the tutors (4 of 6) either agreed or strongly agreed with the statements, “using computer in teaching is very difficult” and “video recordings are very difficult to use in the class”. One attitude that appears problematic is the belief that production of teaching materials requires too much time, an attitude held by more than three quarters of the tutors. Yet, they also

expressed unanimity about the importance of teaching materials in elaborating difficult concept.

Research Question 5: What perceptions do college science tutors hold of their competence levels in using instructional technologies?

Research question 5 was answered with items on section „E‟ of the questionnaire by the respondents involved in the study. Table 14 shows responses to section „E‟ of the questionnaire by tutors in „F‟ College of Education.

Table 14: Competency Levels ('F' College of Education)

Item	Incompetent		Slightly Competent		Moderately Competent		Averagely Competent		Very Competent	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Use chalkboard/ whiteboard in my teaching……	0	0	0	0	0	0	1	11.1	8	88.8
Operate a projector when	4	44.4	2	22.2	0	0	2	22.2	1	11.1

teaching……										
Prepare flip charts for use in class…	2	22.2	0	0	2	22.2	2	22.2	3	33.3
Use flip charts during lesson presentations…….	2	22.2	0	0	1	11.1	3	33.3	3	33.3
Show a video clip during my teaching…..	5	55.6	2	22.2	1	11.1	1	11.1	0	0
Use computer to assist in class teaching (eg. Power Point, Excel)…	3	33.3	1	11.1	2	22.2	2	22.2	1	11.1
Use computer for personal work…	2	22.2	0	0	2	22.2	2	22.2	3	33.3
Produce teaching and learning materials using local resources…	0	0	0	0	2	22.2	5	55.6	2	22.2
Using teaching and learning materials produced during lesson presentations….	0	0	2	22.2	4	44.4	2	22.2	1	11.1

N =9; Freq. = Frequency

Responses show that all tutors reported either average competent or very competent in the use of the chalkboard, and most of the items. Over half (7 of 9) of the tutors produced teaching materials using local resources. It should, however, be noted that 2 tutors reported incompetent in preparing flip charts and using them during lesson presentations. Over half of the tutors (7 of 9) were either incompetent or slightly competent in showing videos when teacher.

On the other hand, 4 tutors contended that they were incompetent in the use of computers to assist in class teaching, while 2 others said they were incompetent in using computers

for personal work. This indicated that there were more tutors using computers for personal work than for class work.

Responses from the science tutors in „P" College of Education to section „E" of the questionnaire shown in Table 15 indicate that all participants (9 of 9) reported very competent in the use of the chalkboard. Approximately two thirds of them expressed averagely or very competent in the preparation and use of flip charts (6 of 9) and in the production of teaching materials using local resources (6 of 9).

On the other hand, over half of the tutors (7 of 9) reported incompetent or slightly competent in the use of computers to assist in class teaching and showing videos during teaching (8 of 9) while 4 of them expressed slightly competent or incompetent in the use of computers for personal work. Two thirds of the respondents (6 of 9) reported incompetent or slightly competent in operating projectors when teaching. The differences in the competence levels on the use of the computers indicate that many tutors were able to use a computer for personal work as compared to using a computer to prepare materials for class work.

Table 15: Competency levels ('P College of Education)

Item	Incompetent		Slightly Competent		Moderately Competent		Averagely Competent		Very Competent	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Use chalkboard/ whiteboard	0	0	0	0	0	0	0	0	9	100

in my teaching……									
Operate a projector when teaching……	2	22.2	4	44.4	0	0	2	22.2	1	11.1
Prepare flip charts for use in class…	2	22.2	1	11.1	1	11.1	4	44.4	2	22.2
Use flip charts during lesson presentations…….	0	0	2	22.2	1	11.1	3	33.3	3	33.3
show a video clip during my teaching…..	7	77.8	1	11.1	1	11.1	0	0	0	0
use computer to assist in class teaching (eg. Power Point, Excel)….	4	44.4	3	33.3	1	11.1	1	11.1	0	0
Use computer for personal work…..	2	22.2	2	22.2	1	11.1	2	22.2	2	22.2
Produce teaching and learning materials using local resources……	0	0	1	11.1	1	11.1	5	55.6	2	22.2
Using teaching and learning materials produced during lesson presentations…..	0	0	1	11.1	2	22.2	4	44.4	1	11.1

N =9; Freq. = Frequency

Table 16 shows how tutors in „A" College of Education responded to research question 5. The Responses show that all respondents were very competent in the use of the chalkboard. Almost all (6 of 7), were either averagely competent or very competent in using teaching materials produced during lessons; and more than half (5 of 7) in using computer for personal work.

Table 16: Competency levels ('A' College of Education)

Item	Incompetent	Slightly	Moderately	Averagely	Very

	Competent		Competent		Competent		Competent		Competent	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
Use chalkboard/ whiteboard in my teaching……	0	0	0	0	0	0	0	0	9	100
Operate a projector when teaching……	1	14.29	3	42.86	1	14.29	2	28.57	0	0
Prepare flip charts for use in class…	1	14.29	3	42.86	1	14.29	1	14.29	1	14.29
Use flip charts during lesson presentations…….	3	42.86	2	28.57	0	0	1	14.29	1	14.29
show a video clip during my teaching…..	3	42.86	1	14.29	2	28.57	1	14 29	0	0
use computer to assist in class teaching (eg. Power Point, Excel)….	2	28.57	3	42.86	0	0	1	14.29	1	14.29
Use computer for personal work…..	0	0	1	14.29	1	14.29	3	42.86	2	28.57
Produce teaching and learning materials using local resources……	2	28.57	2	28.57	2	28.57	0	0	1	14.29
Using teaching and learning materials produced during lesson presentations…..	0	0	1	14.29	0	0	4	57.14	2	28.57

N = 7; Freq. = Frequency

It should be noted that, over half (5 of 7) of the participants were either incompetent or slightly incompetent in using flip charts during lesson presentation. Unavailability was the problem. More than half reported incompetent or slightly competent in using computers to assist with class work and 4 of 7 were incompetent or slightly competent in showing a video during teaching. This can be attributed to the failure to use the

technologies due to lack of training and inaccessibility, hence having no or less competence in using them.

In „K" College of Education, tutors responses showed that they all (6 or 6) believed they have either average competent or very competent in using the chalkboard for teaching. Almost all the participants (5 of 6) were either averagely competent or very competent in producing teaching and learning materials using local resources and using them during lesson presentations. (See table17)

Table 17: Competency levels ('K' College of Education)

Item	Incompetent		Slightly Competent		Moderately Competent		Averagely Competent		Very Competent	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%

Use chalkboard/ whiteboard in my teaching……	0	0	0	0	0	0	2	33.3	4	66.7
Operate a projector when teaching……	2	33.3	2	33.3	1	16.7	1	16.7	0	0
Prepare flip charts for use in class…	0	0	2	33.3	3	50.0	1	16.7	0	0
Use flip charts during lesson presentations…….	0	0	1	16.7	1	16.7	3	50.0	1	16.7
show a video clip during my teaching…..	3	50.0	2	33.3	0	0	1	16.7	0	0
use computer to assist in class teaching (eg. Power Point, Excel)….	3	50.0	1	16.7	0	0	2	33.3	0	0
Use computer for personal work…..	1	16.7	1	16.7	3	50.0	1	16.7	0	0
Produce teaching and learning materials using local resources……	0	0	1	16.7	0	0	2	33.3	3	50.0
Using teaching and learning materials produced during lesson presentations…..	0	0	1	16.7	0	0	2	33.3	3	50.0

N = 6; Freq. = Frequency

On the other hand, almost all the tutors (5 of 6) reported either incompetent or slightly competent in showing videos during teaching. Two thirds of the respondents also rated themselves as incompetent or slightly competent in the use of computer to assist in class work and to operate projectors when teaching. The number of tutors (4 of 9) who reported either never using or rarely using the computer in table 5 agreed with the lack of competence for the same (table 21), which was attributed to lack of training by more than half of the tutors.

4.2 Interview

The researcher used interviews to determine any inconsistency in the responses of the questionnaire (survey). As a result, the HODs of science department for selected colleges of education were interviewed. During the interview with the HOD of science for 'F' College of Education, it came to light that the department does not have much of the instructional materials which attested to the data gathered from the questionnaire (survey) administered earlier. As a result, some of the tutors had resorted to the use of local materials such as charts, pictures and real objects where applicable.

In response to the question on how to use any of the materials in a lesson, the HOD said, “the use of instructional materials in teaching and learning are very paramount to quality". He described how to use video recording in a lesson whereby the concept being taught can be played back for further understanding. He also stated that the use of video in a lesson provided visuals, saves time, gets students' attention and enhances knowledge retention. According to the HOD, the department is not receiving any support from the administration in the provision of instructional materials despite several requests made to that effect. Despite the fact that instructional technologies are very useful to both tutors and students, their limited supply in the department do not allow for effective utilization as far as teaching and learning is concerned.

The responses from the HOD of science in 'P' College of Education during an interview, was in line with the responses of the questionnaire. To the types of technologies available, he listed the following: flip charts, chalkboard, overhead and LCD projectors

and a computer. Apart from these technologies, tutors also used locally available materials such as charts, models and real objects where necessary, He explained further that, there were no felt pens and transparencies to be used for the overhead projector.

On the question of how useful these materials are to the tutors, the HOD listed the importance of using technologies in teaching and learning as; enhances the understanding of concepts being taught; makes both tutors and students work to be more practical and bring about participatory approach in the lesson delivery.

In describing how to use any of the technologies in a science lesson, he cited the use of the flip charts as an example. He said, “though quite expensive, the information written on them during the lesson delivery remains permanent, and can be referred to in future unlike the chalkboard where the information is rubbed immediately after the lesson". According to the HOD, the involvement of students in the teaching and learning process is very crucial since they are the beneficiaries. Students are sometimes involved in the collection of materials to be used in a lesson where they are readily available and also assigned them specific tasks in groups to research on.

The HOD lamented on the difficulties encountered in the use of instructional materials. He mentioned inadequate supply of materials and lack of requisite skills in the use of some of the materials by members of the department. He said the administration does not support the department in the provision of instructional materials and that the few materials available were donated by DFID some 15 years ago.

Interview with the HOD of „A" College of Education confirmed the available technologies as tutors responded to on the questionnaire. According to the HOD, the technologies are very useful and make teaching and learning very practical. In describing how to use any of the materials in any lesson, he described how the computer can assist in class teaching. To him, it can be used in power point presentations, excel, Microsoft word, internet, etc. He explained that when such technologies are used in teaching, students become actively involved in the lesson making it learner centered and this brings about quality teaching and learning, but the technologies are not enough for students to have hands- on experience.

On the issue of difficulties encountered in the use of the technologies, he said their main challenge is lack of training in the use of the item, availability and sometimes unstable power supply in the laboratory and classrooms. As to whether the department received any support from the administration in the provision of technologies, the response from the HOD was no, and that maintenance of the few available technologies is also a problem. The situation is not different from the other colleges.

Flip charts, projectors (LCD and overhead), chalkboard and computers were the technologies available in the department according to the HOD of „K" College of Education. However, the projectors were not in good condition and there were no transparencies. On the usefulness of technologies, he said that, "the use of teaching and learning materials bring about better and quality lesson delivery". He continued to admit

that the use of technologies in lesson delivery is a key factor to students‟ understanding and assimilation of concepts.

As to how he uses any of the technologies in teaching, he said, “because most of the technologies are not functioning well, tutors have resorted to the use of local resources such as tutor-made diagrams and real object, and that the chalkboard is the most commonly used”. The frequent breakdown of some of the technologies due to lack of proper maintenance was a challenge that the HOD complained about. Little or no support is received from the administration in the provision of instructional technologies.

4. 3 Observation

An observation was employed by the researcher as a means of confirming the data gathered from the questionnaire and the interview. The non-participant observation technique was used. One of the lessons observed in college 'F' as part of the instruments used in data collection on the utilization of instructional technologies revealed that the tutor did not use any other technology apart from the chalkboard. The topic observed was on "the internal structures of the stem" which the tutor could have used variety of technologies to enhance students' understanding of the concept being taught. Students‟ involvement in the lesson was minimal since the strategies used made the students passive learners. As a result, the tutor's competency in the use technologies could not be assessed.

It was also observed in the laboratory that, technologies available were not enough and out of the two computers, only one was working. Also, some of the sockets in the laboratory were vandalized, making it impossible to use equipment that requires electricity. Maintenance was another problem, as some of the technologies were not in good conditions. This problem had no doubt affected the use of some of these technologies.

A lesson on "Living and Non-living things" was observed in a first year class in 'P' College of Education. The tutor used flip chart and other local materials such as plants, stones, bottles and some preserved animals during the presentation. The tutor's attitude towards the use of the materials and the competence level was very high. Students were involved in the lesson by working in groups and presented their ideas using the flip chart for class discussions. The tutor was very skillful in handling the technologies as he systematically used them in the lesson delivery.

A lesson was observed on the "Human Respiratory System" in one of the second year classes in „A" College of Education. The tutor who delivered the lesson used an overhead projector, prepared transparencies as well as charts in explaining the system to the students. It was one of the most interesting lessons observed as students were much involved in the lesson. His attitude and competence level were very high as he showed mastery over the use of the technology, indicating frequent use of the technology.

The last lesson was also observed in „K" College of Education on 'Balancing of Chemical Equations' in a first year class. The situation was not different from that of 'F' college since the tutor did not use any other technology apart from the chalkboard. From the approach of the tutor, it was obvious that he did not prepare for the lesson. Students were passively involved in the lesson.

4.4 Perspectives across the Colleges of Education

This section focused on the main issues common to all the four colleges of education pertaining to the utilization of instructional technologies. Based on the data presented in this chapter, it was observed that the instructional technologies were not being utilized to the fullest in all the four sampled colleges of education.

The researcher categorized these technologies into two types namely technologies that need source of electrical power to operate, for example projectors, videos, and computers and those that do not need any source of power that is chalkboard and flipcharts. The chalkboard is readily available and flip charts are occasionally used by the tutors. The power operated technologies (projectors, videos, and computers) are electronically manufactured and require training in their use and frequent maintenance. During the period of study, the data collected showed that the power operated technologies are not commonly available and frequently used by the tutors in all the four colleges.

It was evident that almost all the colleges had similar technologies. This might be as a result of the fact that all the colleges are being funded by the central government. If they

were self-sufficient financially, there is the likelihood that different technologies could have been observed rather than being similar. All the colleges sampled had no opaque projectors. 'P' and 'K' Colleges do not have video projection equipment in addition to the opaque projectors while 'A' College of Education also had no flip charts.

The responses of the questionnaire also revealed that, tutors sometimes used local resources such as models, tutor-made diagrams and improvised beakers during lesson delivery. These resources are mainly produced using locally available materials. Some could easily be picked from the environment and used directly without any transformation while others need tutors to create them. For example to construct a beam balance for measuring mass of objects requires pieces of wood, nails, lids of Milo tins and thread. The responses generally indicated that the production of teaching materials using locally available resources is both difficult and time consuming. This could be the reason why some of the tutors in the colleges were unable to produce teaching materials from local resources for teaching.

There were issues that cut across all colleges as far as training, availability, and challenges were concerned. The lack of training was one of the factors which made many tutors not to use these technologies, which have specific operations that need hands-on experience to be able to use them. The non availability of some of the technologies were also factors that affected the use of the technologies by tutors. This agrees with what Hope (1997) said on the availability of technology, that “for the technology to be exploited in an environment, it must first exist” (p. 3).

Maintenance was an identified challenge, as some of the technologies were not in good condition in some of the colleges. This problem had no doubt affected the use of some of the technologies.

During the interview and observation in the colleges, it was basically realized that the tutors' approach to teaching, lesson organization and general classroom delivery procedures, the use of teaching and learning materials, students' involvement and methods employed were similar.

It was also observed that the colleges did not have well-trained technicians to maintain the equipment when problems were identified and as such some of the equipment were lying idle. Another challenge which was identified was a problem with the purchasing and production of transparencies and other accessories for the projectors. Such lack meant that tutors were unable to use these technologies.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Overview

The study was conducted to investigate the use of Instructional technologies in the teaching of science in Science Colleges of Education in Ghana. This study sought answers to the following research questions:

1. Which type of instructional technologies are in the science colleges of education?
2. How often do science tutors use instructional technologies in their lessons?
3. What do science tutors consider as important factors in influencing their use of instructional technologies?
4. What are the attitudes of the college science tutors towards the use of instructional technologies?
5. What perceptions do college science tutors hold of their competence levels in using instructional technologies?

To get answers to the research questions, four science colleges of education in two regions, namely Eastern and Volta were sampled. Questionnaires, interviews and classroom observation protocol were used to gather data for the study. Four HODs and twenty-seven science tutors were involved in the study.

The questionnaire responses were analysed using descriptive statistics which included percentages and frequencies of responses. The tape-recorded responses of the interviewees were transcribed and analysed using content analysis and the observations were analysed by taking note of the counts of the check-list themes and analysing classroom behaviour of the tutors. This chapter contains the summary of the key findings of the study, conclusions based on the outcome of the study and the recommendations.

5.1 Summary of the key findings

The quest for quality teaching and learning remains crucial in the educational system of Ghana. This has resulted in the implementation of so many educational interventions to improve the quality of education in the country. Beside these interventions, there are still a number of challenges militating against the provision of quality education especially at the pre-tertiary level. Some of these challenges include inadequate supply of educational materials to schools and the teacher‟s factor. The teacher factor deals with the Content Knowledge (CK) and Pedagogical Content Knowledge (PCK). The CK is knowing your subject matter while the PCK is how to impart that information to your students in the most effective manner. Lack of in-depth knowledge in both affect the quality of lesson delivery.

The use of instructional technologies has proved to be very important in facilitating the teaching and learning process. As the tutors use these technologies in their teaching, they are at the same time acting as role models to their student teachers, who will in turn copy the practice and use instructional technologies during teaching practice and in their own classes after completing college.

However, despite instructional technologies having a positive impact on the teaching and learning process, data in this study have exposed that tutors in the science colleges of education use more of the chalkboard in their teaching than any other instructional

technologies. This finding clearly shows that tutors are more dependent on chalk and talk in their instruction while student teachers listen.

Research Question 1 was on the types of instructional technologies available in the four science colleges. Responses gathered from the tutors showed that the most common technologies available were chalkboards and computers while the least available ones were flip charts, videos, and projectors.

Research Question 2 of the study requested how often tutors used instructional technologies in their teaching. Results of the analysis showed that there was more use of the chalkboard and flip charts than computers, projectors and videos.

In spite of the use of these technologies, the interview conducted revealed that the management of the colleges does not support the department in the provision of instructional materials.

Research Question 3 focused on factors that positively influence the use of instructional technologies by tutors. Respondents rated almost all the items on training, availability, accessibility, administrative support and workshops and seminars, as very important. Peer support was also rated "slightly important" by some respondents. This finding is an indication that several factors play an important role in enabling tutors to use the technologies.

Research Question 4 concerned the tutors‟ attitudes towards the use of instructional technologies. The analysis showed that they agreed on the importance of using the technologies, in spite of the teaching materials helping to elaborate difficult concepts, the tutors agreed that producing some of them requires too much time, which to some extent threatens the availability of these self-produced teaching materials. On the other hand, the tutors were eager to learn how to use the power operated technologies. This was evidenced by their disagreement with the statements “using computers in teaching is very difficult,” and “video recordings are very difficult to use in the classroom.” This finding clearly shows that they need the training to be able to use the technologies

Research Question 5 focused on the competence levels of the tutors. The competence levels were high in the use of the chalkboards, preparation and use of flip charts, and use of local resources. On the other hand, competence levels were low in the use of the video, projectors, and computers. The lack of the competencies was attributed to lack of training, unavailability and inaccessibility of these technologies. It is anticipated that if these essentials technologies were put in place, the tutors would be much more likely to use them.

5.2 Conclusion

This study was to provide a description of the use of instructional technologies in Science Colleges of Education in Ghana. Realizing that the use of instructional technologies

enhances teaching and learning, this study attempted to define the reasons for the inclusion or omission of instructional technologies by tutors in their instruction in the selected colleges.

The research into the utilization of instructional technologies by tutors in the four Science Colleges of Education from the Easter and Volta Regions of Ghana has revealed the technologies that are available, the trend of usage of these technologies by tutors and their competences in the use of the technologies. Despite instructional technologies having a positive impact on the teaching and learning process, data in this study have exposed that tutors in the colleges of education use more of the chalkboard in their teaching than any other instructional technologies. The study also found that, the power operated technologies such as videos, computers and projectors are not commonly available and frequently used by the tutors in all the four colleges.

Lack of training was one of the factors which made many tutors not to use these technologies, which have specific operations that need hands-on experience to be able to use them. Non availability and inaccessibility of some of the technologies were also factors that affected the use of the technologies by tutors. The study again revealed that, even though tutors demonstrated high confidence levels in the use of chalkboards, preparation and use of flip charts, they lack competences in the use of videos, projectors and computers.

The study has also shown that the management of the colleges does not support the department in the provision of instructional materials for effective teaching and learning.

Maintenance was an identified challenge, as some of the technologies were not in good condition in some of the colleges. This problem had no doubt affected the use of some of the technologies.

It was concluded that the use of instructional technologies for science lessons was not effectively carried out as expected in the selected colleges of education. This is highly unsatisfactory since colleges of education are tertiary institutions. This apart, the teacher trainees are very likely to be influenced by the instructional approaches adopted by their tutors.

5.3 Recommendations

The study has outlined some recommendations which when considered would go a long way to improve the teaching of science in the Colleges of Education. To increase the use of basic instructional technologies in the colleges and to promote higher academic achievement for teacher trainees, the following recommendations are being put forward for consideration and implementation:

i. The use of more advanced technologies such as computers, videos and projectors needs to be used by the tutors in addition to the traditional chalkboards (white boards) and flip charts. Management should provide funds to support local production of instructional materials by the tutors.

ii. Since factors such as training, availability, accessibility and workshop and seminars positively influence tutors‟ use of instructional technologies, the

researcher recommends that In-Service Education and Training (INSET), workshops and seminars should be organized continuously to update the competence levels of tutors in the use of instructional technologies.

iii. For tutors to be able to use the advanced technologies, there is the need for the management of the colleges, Ministry of Education and the Ghana Education Service to mount training for the tutors to become familiar with the use of these technologies. It is therefore recommended that the Ministry of Education should take pragmatic measures in the provision of instructional materials.

iv. Even though tutors demonstrated high confidence levels in the use of chalkboards, preparation and use of flip charts, they lack competencies in the use of videos, projectors and computers. The researcher therefore recommends that constant training must be organized and such high technological facilities must be made available and accessible to the tutors all times.

v. The colleges must also develop the culture of maintenance so that the few instructional materials that are available would be functional all the time.

5.4 Areas for Further Research

The results of the current study suggested a number of directions for further study. Firstly, there is the need to conduct a study on the impact of using instructional

technologies in teaching science in the colleges of education as the availability and usage of these technologies are not in isolation.

A research can also be conducted in comparing the availability and usage of instructional materials in Science and Non-Science Colleges of Education as the Non-Science Colleges are also teaching Integrated Science.

Furthermore, a research can also be conducted on the use of instructional technologies by student trainees during the out programme component of their training.

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APPENDIX A

The Utilization of Instructional Technologies in Selected Science Colleges of Education in Ghana.

QUESTIONNAIRE FOR SCIENCE TUTORS

This research is being conducted to look at how instructional technologies are being utilized by science tutors in the science colleges of education in Ghana. It would

therefore be appreciated if you would respond to this questionnaire. This is purely an academic exercise and your confidentiality is assured.

Instructions

Please, fill in the space provided with the required information. Tick (√) where applicable and write in the spaces provided if necessary.

SECTION A

1.0 Biographic Data

1.1 Gender: Male ( ) Female ( )

1.2 Tick the range of your age: a 22- 30 ( ) b. 31- 36 ( ) c. 37- 42 ( ) d. 43- 50 ( ) e. 51 or more ( )

1.3 Please identify your highest academic qualification.

a. Bachelors degree ( ) b. Masters degree ( ) c. Ph.D ( ) d. Other ( ) specify ……

1.4 Are you a professional science education teacher? Yes ( ) No ( )

1.5 How long have you been teaching science in a college of education?

a. 0- 4 years ( ) b. 5-8 years ( ) c. 9- 12years ( ) d. 13- 16 years ( ) e. 17- 20 years ( )

SECTION B

PART I

2.0 Types and frequency of use of instructional technologies

Are the following instructional technologies available for use by science tutors in your college?

2.1. Chalkboards / Whiteboards a. Yes ( ) b. No ( )

2.2. Flip charts a. Yes ( ) b. No ( )

2.3. Overhead projectors a. Yes ( ) b. No ( )

2.4. LCD projectors a. Yes ( ) b. No ( )

2.5. Opaque projectors a. Yes ( ) b. No ( )

2.6. Videos a. Yes ( ) b. No ( )

2.7. Computers a. Yes ( ) b. No ( )

2.8. Others (specify) ----------

PART II

Frequency of use of technologies

How frequently do you use the listed technologies in your lessons?

2.9. Chalkboard: a. Never ( ) b. Rarely ( ) c. Occasionally ( ) d. Always ( )

2.10. Flip charts: a. Never ( ) b. Rarely ( ) c. Occasionally ( ) d. Always ( )

2.11. Overhead projectors: a. Never ( ) b. Rarely ( ) c. Occasionally ( ) d. Always ( )

2.12. LCD projectors: a. Never ( ) b. Rarely ( ) c. Occasionally ( ) d. Always ( )

2.13. Opaque projectors: a. Never ( ) b. Rarely ( ) c. Occasionally ( ) d. Always ( )

2.14. Videos: a. Never ( ) b. Rarely ( ) c. Occasionally ( ) d. Always ( )

2.15. Computers: a. Never ( ) b. Rarely ( ) c. Occasionally ( ) d. Always ( )

PART III

3.0 What may be the possible cause(s) of science tutors not using these technologies?

Item	Lack of training for its use	Item not available	Item in limited supply	Item not accessible to tutors
3.1.Chalkboard				

3.2.Flip charts 3.3. Overhead projectors				
3.4. LCD projectors 3.5. Opaque projectors 3.6. Videos				
3.7. Computers				

SECTION C

4.0 Factors that positively influence the use of instructional technologies by tutors

How do you rate the importance of the following factors in influencing your use of instructional technologies?

Scale: 1=**Not Important, 2=Slightly Important, 3= Moderately Important, 4=Very Important.**

Please tick the appropriate column

Item	**Not Important**	**Slightly Important**	**Moderately Important**	**Very Important.**
4.1 Availability of resources				
4.2 Administrative				

support				
4.3 Training				
4.4 Access to resources				
4.5 Personal interest in Instructional technology				
4.6 Peer support				
4.7 Workshops and seminars				
4.8 Frequent use of items				

SECTION D

5. Attitudes towards the use of instructional technologies

Identify your opinion as to what extent you either agree or disagree with the following statements by **circling** only one answer. **1=strongly Disagree (SD), 2=Disagree (D), 3=Agree (A), 4=strongly Agree (SA).**

5.1. Using the chalkboard is very important.

a. Strongly Disagree ( ) b. Disagree ( ) c. Agree ( ) d. Strongly Agree ( )

5.2. Producing teaching and learning materials requires too much time

a. Strongly Disagree ( ) b. Disagree ( ) c. Agree ( ) d. Strongly Agree ( )

5.3. Teaching and learning materials help to elaborate difficult concepts

a. Strongly Disagree ( ) b. Disagree ( ) c. Agree ( ) d. Strongly Agree ( )

5.4. Using computers in teaching is very difficult

a. Strongly Disagree ( ) b. Disagree ( ) c. Agree ( ) d. Strongly Agree ( )

5.5. Teaching and learning materials enhance students understanding of concept

a. Strongly Disagree ( ) b. Disagree ( ) c. Agree ( ) d. Strongly Agree ( )

5.6. The use of flip chart in teaching is very challenging

a. Strongly Disagree ( ) b. Disagree ( ) c. Agree ( ) d. Strongly Agree ( )

5.7. Overhead projectors are easy to operate.

a. Strongly Disagree ( ) b. Disagree ( ) c. Agree ( ) d. Strongly Agree ( )

5.8. Video recordings are very difficult to use in the classroom

a. Strongly Disagree ( ) b. Disagree ( ) c. Agree ( ) d. Strongly Agree ( )

5.9. Local resources are a good substitute for some commercial teaching materials.

a. Strongly Disagree ( ) b. Disagree ( ) c. Agree ( ) d. Strongly Agree ( )

5.10. The use of instructional materials in teaching is time consuming

a. Strongly Disagree ( ) b. Disagree ( ) c. Agree ( ) d. Strongly Agree ( )

SECTION E

6. Competent levels in the use of instructional technologies

Please indicate your competence level by circling the corresponding numbers using the following scale: **1=Incompetent (IC), 2=Slightly Competence (SC), 3=Moderately Competence (MC), 4=Averagely Competent (AC), 5= Very Competent (VC)**

Item	(Please circle one)
5.1 Use chalkboard/ whiteboard in my teaching……..	IC SC MC AC VC
5.2 Operate a projector when teaching……	IC SC MC AC VC

5.3 Prepare flip charts for use in class……	IC SC MC AC VC
5.4 Use flip charts during lesson presentations…….	IC SC MC AC VC
5.5 Show a video clip during my teaching……	IC SC MC AC VC
5.6 Use computer to assist in class teaching (eg. Power point, Excel , internet)…..	IC SC MC AC VC
5.7 Use computer for personal work…….	IC SC MC AC VC
5.8 Produce teaching and learning materials using local resources…….	IC SC MC AC VC
5.9 Use teaching and learning materials produced during lesson presentations…..	IC SC MC AC VC

THANK YOU FOR YOUR TIME AND PARTICIPATION.

APPENDIX B

INTERVIEW GUIDE

This interview is being conducted as part of a research being conducted in connection with the teaching of science in the colleges of education.

1. List the types of instructional technologies (instructional materials) you have in the science department.
2. How useful are these materials to you as a science tutor?
3. Describe how you use any of the materials in any particular science lesson?
4. How do you involve students in the teaching of any science lesson as far as the teaching of science is concerned?
5. What difficulties do you encounter when you use the instructional materials for your lessons?
6. Does the science Department receive any support from the college administration in the provision of instructional technologies?

b. Describe such support if any?

APPENDIX C

CLASS OBSERVATION CHECKLIST

1. Types of technologies being used by the tutor
2. Tutor‟s attitude
3. Tutor‟s competence
4. Students‟ involvement
5. Skillful handling of technologies by the tutor

APPENDIX D

CALCULATION OF PEARSON'S PRODUCT MOMENT CORRELATION

RESULTS OF FIRST TEST (X)

ITEM IN QUESTIONNAIRE	RESPECTIVE NUMBER OF RESPONSES (X)
1. Availability of Instructional Technology	„Yes" Responses = 6
2.Frequency of Usage of Instructional Technology	„Never" Responses = 5
3.Possible Causes of Non-Usage	„Lack of Training" Responses = 6
4.Factors for Usage	„Very Important" Responses = 5
5.Attitudes Towards Usage	„Strongly Agree" Responses = 8
6.Competency Levels	„Very Incompetent" Responses = 7

RESULTS OF SECOND TEST (Y)

ITEM IN QUESTIONNAIRE	RESPECTIVE NUMBER OF RESPONSES (Y)
1.Availability of Instructional Technology	„Yes" Responses = 6
2.Frequency of Usage of Instructional Technology	„Never" Responses = 5
3.Possible Causes of Non-Usage	„Lack of Training" Responses = 6
4.Factors for Usage	„Very Important" Responses = 6
5.Attitudes Towards Usage	„Strongly Agree" Responses = 7
6.Competency Levels	„Very Incompetent" Responses = 7

X	6	5	6	5	8	7

Y	6	5	6	6	7	7

$$\sum X = 37,\ \sum Y = 37,\ (\sum X)^2 = 1369,\ (\sum Y)^2 = 1369,$$

$$\sum X^2 = 235,\ \sum Y^2 = 231\ \sum XY = 232$$

$$r = \frac{n(\sum XY) - (\sum X)(\sum Y)}{\sqrt{[n\sum X^2 - (\sum X)^2][n\sum Y^2] - (\sum Y)^2}}$$

$$r = \frac{6(232) - (37)(37)}{\sqrt{[6(235) - 1369][6(231) - 1369]}} = \frac{23}{26} = 0.88$$

APPENDIX E

UNIVERSITY OF EDUCATION, WINNEBA
DEPARTMENT OF SCIENCE EDUCATION

Our Ref. No.SD/M.Phil/Vol.1/124

November, 2013

TO WHOM IT MAY CONCERN

LETTER OF INTRODUCTION –MS GRACE AGYEMAN DUAH

The bearer of this letter, Ms Grace Agyeman Duah is a Master of Philosophy (Science Education) student of University of Education, Winneba. She is conducting a research in "The Utilization of Instructional Technologies in selected Science Colleges of Education in Ghana". Your college has been selected as a part of her sampling area.

I hope you will assist her to do a good thesis write-up.

Thank you.....

HEAD
SCIENCE EDUCATION
UNIVERSITY OF EDUCATION
WINNEBA

Dr. K.B. Taale
Head of Department