

UNIVERSITY OF CAPE COAST

THE IMPACT OF INSTRUCTIONAL TECHNOLOGY ON STUDENT  
COMPREHENSION AND RETENTION LEVELS:  
A STUDY OF TRADITIONAL AND NON-TRADITIONAL STUDENT  
POPULATIONS IN THE KUMASI METROPOLIS

BY

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Dissertation submitted to the Centre for Continuing Education of the Faculty of Education, University of Cape Coast, in partial fulfillment of the requirements for award of Master of Education Degree in Information Technology

JUNE 2010

## DECLARATION

### CANDIDATE'S DECLARATION

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

Signature: ..... Date: .....

Name: Bernard Wiafe Akaadom

### SUPERVISOR'S DECLARATION

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

Supervisor's Signature: ..... Date: .....

Name: Mr. Paul Ahiatrogah

## **ABSTRACT**

The purpose of this study was to determine the impact of instructional technology on student comprehension and retention levels for traditional and non-traditional student populations. The subjects in this study consisted of two teacher colleges of education and three senior high school students who had been exposed to instructional technology during at least one of the courses taken at their secondary/postsecondary institution. The sample consisted of 90 males and 56 females. The sample contained 50 male and 30 female traditional students, as well as 40 male and 26 female non-traditional students.

Respondents responded to a single research instrument, divided into two parts; a demographic data collection portion, and a portion which measured the subject's impressions of the impact that instructional technology they had been exposed to had on their comprehension and retention levels. Additional data captured in Section B of the instrument included anecdotal content and observations of apparent instructor comfort and ability to use the technology.

Results of the data from the two groups indicated that while there was little difference between the two studied groups in terms of impact on their learning and retention, a difference did clearly define the separation in the areas of past computer use and exposure in education.

## **ACKNOWLEDGMENTS**

I would like to express my deepest thanks to my father, Joseph Kwame Asare Akaadom, and brother, Augustine Kofi Akaadom for helping me to understand and appreciate the importance of learning and for their gift that enabled me to complete this degree.

I would also like to thank my family for providing me so much support and for their patience and understanding during the trying times and late nights of studying and writing.

To Melody E. Botchway, I say thank you very much for your encouragement and the time you spent in typing the work.

Finally, I would like to thank my supervisor and friend, Paul Ahiatrogah for planting the educational seed of dissertation writing and encouraging me to this degree.

## TABLE OF CONTENTS

	<b>Page</b>
DECLARATION	ii
ABSTRACT	iii
ACKNOWLEDGMENTS	iv
LIST OF TABLES	viii
LIST OF FIGURES	ix
CHAPTER	
<b>ONE INTRODUCTION</b>	<b>1</b>
Background to the Study	2
Statement of the Problem	3
The Purpose of the Study	4
Research Questions	4
Hypothesis	4
Significance of the Study	5
Limitation	5
Delimitation	6
Definitions of Terms	6
<b>TWO REVIEW OF RELATED LITERATURE</b>	<b>8</b>
Introduction	8
Learning Styles	9
Educational Multimedia	13
ICT and Students' Attainment	15
School, Learning and Computers	17
Supporting Knowledge Construction	19

ICT Integration in Learning Environment	20
The Impact of ICT on “when” and “where” students learn	22
The Effect of ICT on Learning	26
Tutorial, Drill and Practice	33
Technology in Education	35
Summary	36
<b>THREE METHODOLOGY</b>	<b>37</b>
Introduction	37
Research Design	37
Target Population	38
Data and Sources	39
Sample Size for the study	39
Sampling Technique	41
Research Instrument	42
Data Processing and Analysis	43
Ethical Issues	43
<b>FOUR RESULTS AND DISCUSSION</b>	<b>45</b>
Introduction	45
Biographic Data	45
Research Question 1	50
Research Question 2	58
Testing of Hypothesis	63
Implications	67
<b>FIVE SUMMARY, CONCLUSIONS AND RECOMMENDATIONS</b>	<b>68</b>
Introduction	68

Summary	69
Main findings	70
Conclusion	71
Recommendations	71
Research for future studies	72
<b>REFERENCES</b>	<b>73</b>
<b>APPENDICES</b>	
A Letter of introduction	80
B Survey Questionnaire	81

## LIST OF TABLES

<b>Table</b>		<b>Page</b>
1	Distribution of Subjects by Groups	46
2	Distribution of Subjects by Institution and Gender	47
3	Distribution of Subjects by Years of Education	48
4	Distribution of Subjects by Computer Experience	49
5	Distribution of Subjects by Employment Type	49
6	Students' assessment on how technology helped enhanced their learning	51
7	Students' assessment on how technology helped them made better grades	52
8	Ability to remember information presented using Technology	53
9	Using instructional technology to meet learning Styles	54
10	Course content and material is clearer when presented using technology	56
11	Differences in how groups are impacted by instructional technology	58
12	T-test values for independent groups	63
13	Independent t-test analysis of differences in in students' perception on understanding and retaining information using instructional technology between traditional and non-traditional students	64



## LIST OF FIGURES

<b>Figure</b>		<b>Page</b>
1	Distribution of participants' age	46

## **CHAPTER ONE**

### **INTRODUCTION**

Instructional technology is the theory and practice of design, development, utilization, management and evaluation of processes and resources for learning.

Instructional Technology involves:

1. designing instruction (including all the phases of activity from needs assessment to evaluation)
2. applying learning theory to instructional design
3. selecting delivery systems and designing techniques for a given delivery system
4. assessing human characteristics
5. conducting process and product evaluation
6. managing change and adopting innovations
7. integrating instruction with other factors that influence human performance
8. implementing delivery to reach learners when they need it
9. using technology in support of the development and delivery of instruction. (Stefl-Mabry,1999).

Instructional Design seeks to teach how to plan, develop, evaluate and manage the instructional process effectively to ensure improved performance by learners. It must be noted that Instructional technology's goal is to

understand how people learn and how best to design instructional systems and instructional materials to facilitate learning. We also use appropriate technology to aid us in the design and delivery of the instruction.

Today's world has been described as the computer age where almost everything is being done by the use of computers. Thus, it becomes imperative that learners also benefit from the use of the computer as a learning tool.

### **Background to the study**

Pervasive technologies for interactive multimedia and other technology uses in education and training have become a commonplace in schools. From the interactive video disks of the late 1970s to the virtual reality training of today, technology uses in the classroom have been on the increase for some years now. Many claims have been made as to the effectiveness of multimedia as a teaching tool (Slawson, 1993) but only recently have authors and educators begun the process of evaluating this assertion.

Capabilities of commercially available hardware and software tools are making development issues a problem of the past. However, the purchase and use of technology for technology's sake has become a widespread problem in educational institutions. Much attention has been given to the latest and greatest technologies, cost-benefit models, and technology obsolescence, but there appears to be very little information available on the real impact of these technologies on student comprehension and retention levels.

While much research has been conducted on the effects of hypermedia on learning outcomes (Chen & Ford, 2001), there have been few conclusive studies providing empirical evidence demonstrating the benefits of technology

in educational environments (Stefl-Mabry, 1999). In addition, there appears to be very little being studied on the impact that technology in the classroom has on learning styles.

### **Statement of the problem**

Institutions are increasing the amount of technology available as a standard configuration in their classrooms. Their high-tech approach is being modelled as one that facilitates communication and the learning experience. Limited research appears to have been conducted targeting the specific effects of instructional technology on the learning styles of adult students. Even less information seems to be available on the impact of differences between age groups. If the use of instructional technology is becoming a normal part of teaching in today's world, the impact of those technologies must be researched and studied. Too often in the past, educators and trainers have implemented "new and improved" methods for teaching only to discover that some factor was overlooked that impacted the end result.

To be able to bring advanced technologies on-board, most institutions have failed to address one issue that is perhaps the most important. The issue is "what is the impact that this technology is having on the learning styles and capabilities of the students exposed to it?" There has been a recent abundance of research involving the problems associated with teachers attempting to apply technology. Much is also being studied about how to teach the teacher how to adapt technology in the classroom. The student, however, has been left out of the loop in most cases (Well-Strand, 1991). To effectively do this, there is the need to know the learner or student's preconceived idea about the use of

instructional technology. Furthermore, there is the need to determine if there exists at all, a relationship between students' performance and the use of instructional technology. Research is the key to survival and fast changing technologies demonstrate this. It was against this backdrop that the researcher wanted to undertake this study to ascertain the impact of instructional technology on the comprehension and retention levels of students who benefit from its use and those who do not.

### **Purpose of the study**

The study sought to investigate the impact of instructional technology on students' comprehension and retention levels by using traditional and non-traditional students in secondary and post-secondary institutions.

### **Research questions**

Specifically, the research was designed to answer the following questions:

1. Does instructional technology have an impact on the amount of information a student understands and retains when compared to traditional teaching tools and methods?
2. How are groups (traditional and non-traditional students) impacted differently by technologies in the classroom?

### **Research hypothesis**

There are no differences in the way traditional and non-traditional students perceive the impact of the use of instructional technology on their understanding and retention.

### **Significance of the study**

Due to the growing demands on teachers to use technology in their classroom, there was the need to investigate strategies and factors that will enhance technology use by teachers. This study focused on the comprehension and retention levels through the use of instructional technology and therefore demanded the change in practices of computer use by classroom teachers subsequent to a series of professional development activities. The findings from this study may assist professional development planners in preparing future professional development training activities.

This study provided information that will assist tutors to plan their lessons in a manner that will suit a lot of students' learning styles. Also, it provided teachers with an unambiguous roadmap through the instruction. Moreover, this study intended to identify pedagogical strategies that will assist teachers to utilize ICT for teaching and learning.

The study also helped to identify training needs for effective teacher professional development using instructional technology and also, identify that content mastery and understanding of student comprehension make ICT use more effective.

### **Limitations of the study**

It was not the purpose of this study to assess every form of instructional technology. Additionally, it is outside the scope of this research to analyze or validate the curriculum being taught at the schools. Also, the involvement of all post-secondary schools in the metropolis was not possible because of time and financial constraints. Purposive sampling method was

therefore used. The study was limited to a few selected institutions in the Kumasi metropolis. The present study was undertaken in an environment where issues such as ICT, the knowledge economy and digital divide and their implications for education and development were not well known and understood. Such circumstances limited access to information from respondents during the study. The implications were restricted sample sizes, limited response rates resulting in reduced generalisability. Under normal circumstances this study should have covered all the schools in the Kumasi metropolis. However, because of time constraints and lack of resources, it was not possible to cover the entire metropolis.

### **Delimitation**

This study confined itself to the use of instructional technology in school and its impact on students' comprehension and retention levels. It did not look at other areas of ICT such as comprehensive use of multimedia, drills, computer based tutorials, school network, school database management system and school websites. Due to lack of resources such as time and logistics, the study was restricted to some selected schools in the Kumasi metropolis.

### **Definition of terms**

Unless otherwise noted, all definitions provided here are the researcher's definitions.

**Traditional student:** A learner who does not receive instruction from a tutor who uses computers in his/her teaching/delivery.

**Non-traditional student:** A learner who receives instruction from a tutor who uses computers in his/her teaching/delivery.



## **CHAPTER TWO**

### **REVIEW OF RELATED LITERATURE**

#### **Introduction**

The problem of the study was to determine the impact of instructional technology on learning styles of traditional and non-traditional students attending secondary/post-secondary education institutions.

As the impact of technology takes hold in institutions across the globe, there is a shift that is beginning to take place within the teaching profession. This change is one of moving teachers from that of the traditional “stand and deliver” instructor to one of a facilitator, guide and coach. This change has begun to place emphasis on students as active participants in the discovery of knowledge.

Technology is fast allowing students to become part of a learning community where they can collaborate to discover information from a variety of sources (Smith, 1997). Technology is beginning to add choices as to how, when, and where students access learning opportunities. As a result, barriers are coming down that used to prevent many people from attending school. Illness and personal crises no longer prevent students from attending classes, and the age-old problem of no time available is becoming an excuse of the past (Smith, 1997).

## Learning Styles

Kolb 1991 theorized that people use processes in their development of learning styles as they do in an attempt to developing any other sort of style (management, leadership, supervision, etc.) Individual learners should understand the different categories of the experimental learning model, and be able to identify their style to understand the value of their learning inventory (Clark, 1999).

Clark (1999) further states that Kolb found that the four combinations of perceiving and processing determine the four learning styles. Clark states that according to Kolb, the learning cycle involves four processes that must be present for learning to occur:

- i. Activist - Active Experimentation (simulations, case study, homework).  
Training approach - Problem solving, small group discussions, peer feedback, and homework all helpful; trainer should be a model of a professional, leaving the learner to determine his or her own criteria for relevance of materials.
- ii. Reflector - Reflective Observation (logs, journals, brainstorming). E.g. I'd like time to think about this. Training approach - Lectures are helpful; trainer should provide expert interpretation (taskmaster/guide); judge performance by external criteria.
- iii. Theorist - Abstract Conceptualization (lecture, papers, analogies). How does this relate to that?

Training approach - Case studies, theory readings and thinking alone helps; almost everything else, including talking with experts, is not helpful.

- Pragmatist - Concrete Experience (laboratories, field work, observations).

How can I apply this in practice? Training approach - Peer feedback is helpful; activities should apply skills; trainer is coach/helper for a self-directed autonomous learner.

In a study conducted by Davidson (2000), the researcher attempted to determine if the type of teaching method used significantly affected the declarative knowledge and procedural skill level of students in a spreadsheet unit of computer applications, if students' learning styles significantly affected the declarative knowledge and procedural skill level, and if an interaction existed between teaching methods and students' learning styles. The findings showed that there were no significant differences between guided-practice and supervised-practice teaching methods, and that no significant interactions were found between teaching methods and student learning styles. A significant relationship was found between students' learning styles and the declarative knowledge and procedural skill level in the spreadsheet unit. Students classified as field independent learners performed significantly better than students classified as field dependent.

An exploration of the possible relationship between the learning styles of students and preferred instructional technology was studied by Bertrand-Hines (2000). Students at the University of New Mexico were surveyed to determine the results. The statistical analysis of the study showed that there was no significant relationship between the learning style and preferred instructional technology method.

In the quest for combining the uniqueness of learning styles with new teaching methods, the impact of the technology is seldom considered. O'Connor (2001) perhaps stated it best:

“It is a truism in media that people first tend to use new technology the same way they used to using older technology. In this context, the tendency is to use computing technology to deliver the same kinds of instruction and testing that are currently offered in the traditional college classrooms. We assume that the same time patterns, the same content-centeredness, the same student-relations, and the same tasks (repeating known-answers) should be electronically replicated. Eventually, applications of computing technology will challenge these assumptions and free us from the need to stay trapped in older college paradigms.” (p.5).

Gilbert and Han (1999) state that “given a specific instruction method or environment, some people will learn more effectively than others due to their individual learning styles”. Hoisington (2000) attempted to determine whether there was a relationship between the learning styles, computer/internet experience, and age of selected nursing students, and their comfort in using the Internet/WWW in a traditional course in Nursing Pharmacology. The results of the study showed no significant difference in students’ learning styles and results. However, a relationship was found between students’ results on the comfort of the instrument and their learning styles or their age. A statistically significant relationship was found ( $\alpha = .05$ ) between students’ comfort and their experience using the Internet and computers.

In another study conducted by Haggerty (2000), a group of Southern Louisiana college students, aged 18 to 36, enrolled in a freshman level general biology course, were studied to determine whether teaching them the skills of self-directed learning and engaging them in self-directed activities would increase their preference for learning by self-direction. The study found that there was no statistically significant correlation between age and change in preference for self-directed learning. At the conclusion of the study, however, 33% of the subjects preferred self-directed learning compared to an initial 6% who wanted did not.

In a study of different learning styles and the impact of Computer-Aided Learning (CAL) on individuals, Ross (1996) concluded that educators must be cognizant of the inherent differences that exist between learners. Results from his study indicated that some learners may have difficulty adapting to CAL. There have been some questions involving the impact of whether or not an individual has knowledge of the type of learning style one has. This was studied by Ehrhard (2000) when she sought to determine whether self-knowledge of learning styles accompanied by prescriptive study strategies would make a difference in the academic achievement of adult graduate-level interactive television students. Ehrhard found that students who knew their learning style preferences and were assisted with study strategies did not academically performed better than those students who did not know their preferences.

## **Educational Multimedia**

As the 1990s gave way to ever increasing technology advances, multimedia began to supercede the traditional text-based approach to learning. Many claims were made as to the effectiveness of multimedia as a teaching tool, but the apparent over-application of Computer Based Tutorials (CBT) and other educational multimedia as an accepted alternative to traditional instruction had its own impact.

Riley (1995) describes the problem of overuse of Computer Based Tutorial at the US Air Force Special Operations Aircrew Training school at Kirtland Air Force Base, New Mexico. When a complete curriculum conversion was made to self-paced learning, student retention and knowledge levels began to decrease significantly. This was attributed to the fact that no formative study was completed during the transition. The conversion of the curriculum was made solely for the purpose of “bringing the school into the 20<sup>th</sup> century”.

Stemler (1997), in a review of literature, notes several promising attributes of multimedia applications in education. Stemler suggests that with multimedia the learning process becomes active rather than passive. “True interactivity implies that the learning process is, in some degree, modified by the actions of the learners” (p. 340). Interaction between learner and content is perhaps the major difference between traditional instruction and multimedia instruction (Schwier & Missanchuk, 1988).

Abrams (1996) notes that humans are primarily visual learners and suggests that one of the strengths of multimedia is its ability to integrate pictures, video and animation with text and sound. Abrams suggests that this

multi-sensory approach helps different students learn in different ways. Riley (1996) supported Abrams' assertion by stating the importance of the methods in which multimedia are integrated into curriculum. In a study on emerging technologies in training and development, Riley noted that considerations beyond the simple use of video, text, and audio be made when developing curriculum. In a chapter titled "Evaluating Interactive Multimedia", Reeves 1990 outlines the educational benefits of multimedia; "IMM (Interactive Multimedia) can be designed to present a focal event or problem situation that serves as an "anchor or focus for learners' efforts to retrieve and construct knowledge" (Gayeski, 1993 p.105). Reeves 1990 claims that multimedia may help to construct knowledge situated or anchored in meaningful and relevant contexts and thereby helps learners to construct useful rather than inert knowledge.

The interactive and multimedia nature of modern computer systems has provided the opportunity for software developers to create increasingly more stimulating features. Many studies have found that students like to use computers and are likely to develop more positive attitudes towards their learning and themselves when they use computers (Réginald Grégoire inc., 1996; Schacter, 1999). Computer systems do provide the opportunity to create a wide range of interesting learning experiences (Committee on Developments in the Science of Learning, 2000). This is likely to help to maintain students' interest and interest a wider range of students (Cradler & Bridgforth, 2002). The interactive and multimedia features within software can be used to help students grapple with concepts and ideas (Committee on Developments in the Science of Learning, 2000). Students can more readily be provided with

similar information and experiences within a variety of contexts (Committee on Developments in the Science of Learning, 2000) which supposes that students can be given a wider scope of experiences to learn from.

Other suggested benefits of multimedia include increased motivation and individualized learning (Abrams, 1996). “By allowing students to interact with and control the flow of information, multimedia distinguishes itself from older multiple-media formats such as books and video” (Stemler, 1997 p. 343). Stemler further stated that interactivity also offers the possibility of immediate feedback for learners allowing them to shape the educational experience to their own needs.

As the use of multimedia in the classroom continues to grow, the need for evidence for supporting these claims and others becomes essential. It is the effectiveness of the multimedia as a teaching tool and its impact upon user behaviour and attitudes that much of the experimental research is currently directed towards (Abrams, 1996; Stemler, 1997).

### **ICT and students’ attainment**

Six studies show statistical evidence that ICT can enhance attainment in subjects. United Kingdom’s (UK) largest impact study shows a rise in subject performance through ICT use in English, science and design, and technology (Burnett, 1994). Also specific ICT uses, such as interactive whiteboards in the UK, had a positive effect on pupils’ performance in literacy, mathematics and science tests compared to students in other schools.



ICT use especially improved the performance of low achieving pupils in English and impact was greatest on writing.

Another large impact study in the UK, which looked at ICT impact from an economic angle, confirms ICT investment impacts positively on educational performance in primary schools, particularly in English and less so on science but not in mathematics. On an international level, the analysis of the OECD PISA results indicates that longer use of computers by students is related to better results in mathematics in PISA results. As regards better results in national test, two other UK studies show that ICT can make a difference.

Broadband internet access in classrooms is one necessary condition to benefit from new technologies for learning. It results in significant improvements in pupil's performance in national tests taken at age 16. Overall, evidence from the UK studies reviewed shows that attainment improves as a result of embedding ICT into teaching and learning (Clark, 1999). Schools with higher levels of e-maturity demonstrate a more rapid increase in performance scores than those with lower levels.

Most opinion based studies investigating ICT impact on students' performance, such as the e-learning Nordic study, (2006), gave a positive picture with teachers being convinced that pupils' subject related performance and basic skills (calculation, reading and writing) as well as educational achievements improved (Clark, 1999).

An overwhelming majority of studies confirmed wider positive benefits of ICT on learning and learners, such as motivation and skills, concentration, cognitive processing, independent learning, critical thinking

and teamwork. Increased motivation goes together with a positive learning attitude and leads for example to more attention during lessons with students being more involved in the learning activities (Cowles, 1997). The fact that ICT enhances a more student-centred learning approach is often cited as among its most important benefits. ICT can also benefit academically strong and weak students as well as students with special needs. Studies also reveal that the benefits cannot only remain technology driven but should be more intentionally exploited following a pedagogical approach. Case studies show, for example, that teamwork does not automatically mean increased collaboration (Davidson, 2000). Many tasks which teachers called collaborative merely involved pupils working alongside one another rather than jointly addressing a problem.

ICTs by their very nature are tools that encourage and support independent learning. The use of ICT in educational settings, by itself acts as a catalyst for change in this domain. Students using ICTs for learning purposes become immersed in the process of learning and as more and more students use computers as information sources and cognitive tools (Reeves & Jonassen, 1996), the influence of the technology on supporting how students learn will continue to increase.

### **Schools, learning and computers**

Any discussion about the use of computer systems in schools is built upon an understanding of the link between schools, learning and computer technology. When the potential use of computers in schools was first mooted, the predominant conception was that students would be 'taught' by computers

(Mevarech & Light, 1992). In a sense, it was considered that the computer would 'take over' the teacher's job in the same way as a robot computer may take over a welder's job. Collis (1989) refers to this as "a rather grim image" where "a small child sits alone with a computer" (p. 11).

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

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

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

### **Supporting knowledge construction**

The emergence of ICTs as learning technologies has coincided with a growing awareness and recognition of alternative theories for learning. The theories of learning that hold the greatest sway today are those based on constructivist principles (Duffy & Cunningham, 1996). These principles posit that learning is achieved by the active construction of knowledge supported by various perspectives within meaningful contexts. In constructivist theories, social interactions are seen to play a critical role in the processes of learning and cognition (Vygotsky, 1978).

In the past, the conventional process of teaching has revolved around teachers planning and leading students through a series of instructional sequences to achieve a desired learning outcome. Typically, these forms of teaching have revolved around the planned transmission of a body of knowledge followed by some forms of interaction with the content as a means

to consolidate the knowledge acquisition (Vygotsky, 1978). Contemporary learning theory is based on the notion that learning is an active process of constructing knowledge rather than acquiring knowledge and that instruction is the process by which this knowledge construction is supported rather than a process of knowledge transmission (Duffy & Cunningham, 1996).

The strengths of constructivism lie in its emphasis on learning as a process of personal understanding and the development of meaning in ways which are active and interpretative. In this domain, learning is viewed as the construction of meaning rather than as the memorization of facts ( Lebow, 1993; Jonassen & Reeves, 1996). Learning approaches using contemporary ICTs provide many opportunities for constructivist learning through their provision and support for resource-based, student centered settings and by enabling learning to be related to context and to practice (Berge, 1998; Barron, 1998). As mentioned previously, any use of ICT in learning settings can act to support various aspects of knowledge construction and as more and more students employ ICTs in their learning processes, the more pronounced the impact of this will become.

### **ICT Integration in Learning Environments**

A critical component of theories of constructivism is the concept of proximal learning, based on the work of Vygotsky (1978), which posits that learning takes place by the learner completing tasks for which support (scaffolding) is initially required. This support may include a tutor, peer or a technology such as the applications of computers. This has led to the use of the term computer supported learning. Computer supported learning

environments are those in which computers are used to either maintain a learning environment or used to support the student learner in the Vygotskian sense (DeCorte, 1990; Mevarech & Light, 1992).

This implies technology is used to help create the types of learning environments and the types of support for learning that are known to be ideal, that Glickman (1991) argues have been ignored or failed to be implemented widely in the past. The aim is to create learning environments centered on students as learners and a belief that they learn more from what they do and think about rather than from what they are told. If the aim is to offer new learning opportunities, or to improve the way in which current learning activities are implemented, then the overall effectiveness of learning environments and episodes is of paramount concern, not whether they are more effective with or without computers. It is important that the ever changing nature of computer-based technology not overshadow the enduring nature of learning and the solid and ever increasing base of knowledge about learning. This knowledge is not superseded by new technologies; rather, it can inform the use of new technologies when applied to learning. Therefore, in implementing computer support for learning it is necessary to start by deciding what a student, teacher or school wants to achieve. To achieve these outcomes, teachers can then rely on long traditions of educational theory, their own experience and knowledge of the educational situation (e.g., student attributes) to make decisions about what the learning environment should look like, and what inputs into the learning process are required.

Finally, teachers can identify what problems are associated with providing these environments and inputs, and tailor computer and other

support to provide solutions. In essence, the judgement of teachers and their support structures are relied upon to choose appropriate strategies. This approach ends with decisions concerning computer support rather than starting with traditional approaches to teaching students (Campione et al., 1990).

### **The impact of ICT on when and where students learn**

In the past educational institutions have provided little choice for students in terms of the method and manner in which programmes have been delivered. Students have typically been forced to accept what has been delivered and institutions have tended to be quite staid and traditional in terms of the delivery of their programs. ICT applications provide many options and choices and many institutions are now creating competitive edges for themselves through the choices they are offering students. These choices extend from when students can choose to learn to where they learn.

The concept of flexibility in the delivery place of educational programmes is not new (Moore & Kearsley, 1996). Educational institutions have been offering programs on distance basis for many years and there has been a vast amount of research and development associated with establishing effective practices and procedures in off-campus teaching and learning. The use of technology, however, has extended the scope of this activity and whereas previously off-campus delivery was an option for students who were unable to attend campuses for tuition. However, in recent times, many students are able to make this choice through technology-facilitated learning settings (Dumestre, 1999). The scope and extent of this activity is demonstrated in some of the examples below.

In many instances, traditional classroom learning has given way to learning in work-based settings with students able to access courses and programmes from their workplaces. The advantages of education and training at the point of need relate not only to convenience but include cost savings associated with travel and time away from work, and also situation and application of the learning activities within relevant and meaningful contexts. The advantages are many. Some of them are as follows:

1. The communications capabilities of modern technologies provide opportunities for many learners to enroll in courses offered by external institutions rather than those situated locally. These opportunities provide such advantages as extended course offerings and eclectic class cohorts comprised of students of differing backgrounds, cultures and perspectives.
2. The freedom of choice provided by programmes that can be accessed at any place are also supporting the delivery of programmes with units and courses from a variety of institutions (Clark 1999).

There are now countless ways for students completing undergraduate degrees for example, to study units for a single degree, through a number of different institutions, an activity that provides considerable diversity and choices for students in the programmes they complete.

In agreement with geographical flexibility, technology-facilitated educational programmes also remove many of the temporal constraints that face learners with special needs ( Moore & Kearsley, 1996). Students are starting to appreciate the capability to undertake education anywhere, anytime and any place. This flexibility has heightened the availability of just-in-time



learning and provided learning opportunities for many more learners who previously were constrained by other commitments (Young, 2002). Some of the geographical advantages of using computers in learning is as stated below:

1. Through online technologies, learning has become an activity that is no longer set within programmed schedules and slots. Learners are free to participate in learning activities when time permits and these freedoms have greatly increased the opportunities for many students to participate in formal programmes.
2. The wide variety of technologies that support learning are able to provide asynchronous supports for learning so that the need for real-time participation can be avoided while the advantages of communication and collaboration with other learners is retained.
3. With the idea of learning at anytime, teachers are also finding the idea of teaching at any time to be an opportunity which they used to their advantage. Mobile technologies and seamless communications technologies support "24x7" teaching and learning. Choosing how much time will be used within the "24x7" period and what periods of time are challenging moments that will face the educators of the future is the problem now (Young, 2002).

While there is no direct link between using ICT and student learning, the weight of evidence now clearly shows that indirectly there can be a significant positive impact. Over the past 30 years, there has been an increasing amount of research conducted to investigate this impact with increasingly clearer findings of positive impacts when ICT is used appropriately. On average, students who used computer-based instruction

scored at the 64<sup>th</sup> percentile on tests of achievement compared to students in the control conditions without computers who scored at the 50th percentile. (Schacter, 1999). This is a clear indication that students who use computers in their study are most likely to score higher grades than those who do not. West Virginia's Basic Skills/Computer Education program was more cost effective in improving student achievement than (1) class size reduction from 35 to 20 students, (2) increasing instructional time, and (3) cross age tutoring programs (Mann, 1999). Differences in attainment associated with the greater use of ICT were clearly present in more than a third of all comparisons made between pupils' expected and actual scores (Becta, 2002). Given the right conditions for access and use, significant gains in student learning are recorded with ICT (Laferrière, Breuleux & Bracewell, 1999).

Since learning is mediated through the components of the learning environment and particularly the curriculum (pedagogy and content), it is therefore useful to start with a consideration of the impact of ICT on the curriculum. The continued and increased use of ICTs in education in years to come, will serve to increase the temporal and geographical opportunities that are currently experienced. Advancements in learning opportunities tend to be held back by the ICT capabilities of the lowest common denominator, namely the students with the least access to ICT. As ICT access increases among students so too will these opportunities.

## **The effect of ICT on learning**

Education in Ghana is approaching the point at which Information and Communication Technology (ICT) plays a part in nearly all phases of the educational process. They are commonly used in school settings, in the home, and in social settings. Children are using computers both at home and in school for educational and recreational purposes (Facer, Sutherland, Furlong & Furlong, 2001). Many resources that were once distributed to individuals in hard copy are now available on the internet, including newspapers, magazines, and scholarly journals. In this age and time, computer knowledge is a must.

The computer networks these days have a powerful impact on the ways which individuals, private organisations can communicate with each other. ICT currently provides a growing range of tools to manipulate digital data, as well as access to the vast range and variety of content. This perception underpins the introduction of computers and the internet in all educational institutions in Ghana. The application of Information and Communication Technology (ICT) in schools is perceived as a means for transforming teaching and learning processes, and has thus been met with significant enthusiasm. Ghana recognises ICT as a tool that will promote socioeconomic, political and sustainable development.

Education policymakers in Ghana have hailed the introduction of Information and Communication Technology (ICT) in Ghanaian schools as a remarkable step that will contribute to knowledge production, communication and information sharing among students and teachers in the school system. This perception stems from assertions in the literature about the benefits that come with ICT literacy in schools (Mucherah, 2003; Hakkarainen, 2000).

Hakkarainen (2000) points out that ICT is a transformative tool and its full integration into the school systems is necessary to prepare students for the information society they will inherit (Dankwa, 1997; Parthemore, 2003). Parthemore (2003) points out that many secondary schools in Ghana can now boast of computer labs through which students are gaining basic computer literacy. A number of these schools have internet capabilities which enable students to deepen their connection to the outside world. Although this is encouraging information, extensive review of documents of Non-Governmental Organisations (NGOs) that are spearheading ICT implementation in Ghanaian schools reveals that most secondary schools now benefiting from ICT are either located in urban areas or are classified as premier secondary schools (Dankwa, 1997; Hawkins, 2002; Parthemore, 2003). According to Parthemore (2003), computer literacy education in Ghana has been concentrated in major urban areas. A few better schools in outlying areas have attempted to "catch up" with their urban counterparts by contracting private companies to provide computer education. The costs for private computer training are prohibitive and it is rarely the case to see that all students have access. Other schools have taken part in the Ghana Education Service sponsored scheme where for every hundred textbooks they purchase from a private firm, they receive one computer system.

Contrary to the promising notion of ICT as a means of knowledge production, numerous scholars have highlighted the need to address the numerous problems that the introduction of ICT will bring. These issues include: a lack of adequate planning for implementation of ICT (Mooij & Smeets, 2001); inadequate teacher training (Webb, 2002); inequalities in ICT

distribution (Nachmias, Mioduser & Shemla, 2001; Sutherland-Smith, Snyder & Angus, 2003); lack of information regarding the distribution of ICT; low levels of literacy in general, and lack of relevant content and technology applications to meet the needs of diverse societies (ETS, 2001; Hakkarainen et al, 2000). The literature identifies the tendency for ICT to lead to a difference between urban and rural schools (Hartviksen & Akselsen, 2002) in the use of ICT.

A review of the available literature reveals significant inequity in the implementation of ICT in Ghanaian schools. The literature (Dankwa, 1997; Parthemore, 2003) reveals that ICT provision in schools is skewed in favor of schools categorized as premier schools and schools in urban areas. Unfortunately, this is not a new trend. Since the introduction of formal schooling in Ghana, educational resources have been unequally distributed in the school system (Folson, 1995; Foster, 1965; Graham, 1971; McWilliam & Kwamena-Poh, 1995). It is critical that policy makers ensure that ICT does not become another tool for perpetuating educational inequalities in Ghana's school system. Educational policy makers, non-governmental organizations (NGOs), bilateral and multilateral donor organizations, and school administrators are making the collective efforts to promote ICT in Ghanaian schools.

Recently, the government reiterated its commitment to extend computers to all schools in the country in the news media. The government also emphasized its commitment to promote equitable ICT in the school system so that all students will equally benefit from ICT regardless of their geographical location. The successful implementation of such a policy would

be a great achievement in the educational system. However, existing inequality, poor infrastructure and the nation's present economic situation is likely to pose a challenge to implementing equitable ICT in the school system.

Accessibility of ICT in schools also interconnects with other development issues, such as accessibility and connectivity to electricity and telephone grids. The themes that emerged from the policy arena challenges to ICT in rural schools are lack of telecommunication and resources (finance, infrastructure, personnel and their training, software, and textbooks). Since 1998, the government of Ghana has extended electricity to many rural communities in the country. However, many rural communities are yet to be connected to the electricity grid. Most rural communities that have secondary schools do not currently have access to electricity and telephone services. In such localities, the idea of promoting the use of computers in classrooms will require more financial backing, and a considerable amount of time, considering the pace of development in Ghana. In a recent Ghanaian case study (Ismail, 2002), it became apparent that the absence of electricity and telephone services are major setbacks to providing ICT in rural areas in Ghana. Students enrolled in premier schools like the Wesley Girls School, Achimota School, and Prempeh College and those in urban areas who have easy access to computers and Internet cafés have already made a considerable increase in the use of computers and the Internet do not face such challenges. On the contrary, most students enrolled in rural secondary schools have never set eyes on a computer. While students in urban areas can now boast of their proficiency in the use Internet and basic computer programmes, the silent majority of their colleagues in the rural secondary schools do not have a clue

as to how to click a mouse.

Availability of an appropriate environment for ICT facilities is another issue that will determine accessibility of ICT for rural schools. Some schools have successfully implemented ICT projects because they have the infrastructure to accommodate ICT equipment donated by benevolent organizations. Inadequate infrastructure is a problem facing many rural secondary schools. The infrastructure of most rural schools lacks the appropriate environment and the needed security for storing ICT equipment, even if they provided. Such concerns are also setbacks to ICT implementation in rural schools.

There are many potential uses of computers in the learning process. In some situations, changes in relevant industries make computer use in schools imperative. For example, to provide courses in music, technical drawing, statistics, and business which do not incorporate computer use reduces the relevancy of the courses to the real world. Here the rationale cries out from the work place but needs to be responded to with carefully constructed learning experiences. How much of our curriculum is made up of historical solutions to past problems? The curriculum needs to be updated continually to take account of the technology prevalent in society.

Any rationale for the use of computers in the large proportion of schooling devoted to 'general' education, such as: mathematics, social science, science, communication and language, requires much more critical examination. Consider the teaching area of mathematics and the problems associated with student learning. Mathematics has tended to be very abstract

while most students tend to operate on a concrete level. The use of concrete materials in some lessons is useful but often not convenient.

The computer can provide experiences with virtual concrete materials. In approaching problems associated with remedial and extension, students' computer use can provide appropriate material and overcome classroom management problems. However, a computer solution is not necessarily the best solution. The problems associated with student learning are most often discipline and even teacher specific. Therefore, each teacher needs to consider the problems associated with student learning in his/her subject area and be aware of computer solutions.

While it would be convenient to be able to make a direct connection between the use of ICT and learning outcomes, most reputable educational researchers today would agree that there will never be a direct link because learning is mediated through the learning environment and ICT is only one element of that environment. Studies that have tried to identify this mediated impact of ICT on learning have found it impossible to entirely remove the effects of other elements of the learning environment.

There is little purpose in attempting to compare the cognitive outcomes when using computers, with using a textbook or some other resource. Salomon (1994) supports this view by arguing that it is not possible to study "the impact of computer use in the absence of the other factors" nor to assume that "one factor impacts outcomes independently of the others" (p. 80). The educational aim is to embed the computer support in the learning environment (DeCorte, 1990), rather than to try to isolate its effect on learning. Using computers in learning is concerned with methods of using the technology to create



environments and learning situations. There have been many decades of solid educational research, not necessarily related to using computers, on which to base decisions about appropriate applications of computers to learning. For example, Mevarech and Light (1992) suggest that the relationships between student characteristics, learning environments, behaviours and schooling outcomes are crucial and need further research, yet there has been much research which has considered these relationships in other contexts than educational computing.

Rieber and Welliver (1989) criticise media comparison studies, claiming that they were of no value applied to research into the use of educational television and therefore many questioned their value to educational computing research. They quote from a 1984 USA government educational task force report which suggested that one of the four important points for improving the use of educational technology in schools was the “identification of instructional problems and development of realistic solutions” (p. 22). As a result, they argue that media selection should be the final step in instructional design, not the first, because “different learning situations call for different instructional elements and certain media have the ability to utilize certain features much more readily than other media” (p. 26). They suggest that the identification of educational problems should be the first step. They cite LOGO as an example where there was “no systematic plan for incorporating this new thinking technology into the schools” (p. 26) and as a result, failed.

If the aim is to offer new learning opportunities or to improve the way in which current learning activities are implemented then the overall

effectiveness of learning environments and episodes are of paramount concern, not whether they are more effective with or without computers. Therefore, in implementing computer applications it is necessary to start by deciding what a student, teacher or school wants to achieve. To achieve these outcomes, teachers can then rely on long traditions of educational theory, their own experience and knowledge of the educational situation (e.g. student attributes) to make decisions about what the learning environment should look like and what inputs into the learning process are required. Finally, teachers can identify what problems are associated with providing these environments and inputs and tailor computer and other support to provide solutions. This approach ends with decisions concerning computer support rather than starting with such decisions (Campione et al., 1990).

### **Tutorial, Drill and Practice**

Tutorial applications are designed to present specific content typically presented using a variety of media, allowing the user some interaction with the information (navigation). High quality tutorial packages include features such as assessment of prior learning and preferred learning style to direct students to the best sequence (Committee on Developments in the Science of Learning, 2000, p. 218).

Good quality tutorial applications are expensive to produce and have limited application, usually only relevant to use once with a student. Drill and practice applications provide students with environments in which to practice skills by responding to stimuli. Often gaming environments with graphics and sound are used to provide additional motivation. With the drill and practice

environment, it is assumed that the content has been previously encountered but needs consolidation. Most packages allow students to operate at an appropriate level of difficulty. Many also maintain databases of student performance and/or responses. The emphasis in tutorial, drill and practice applications is upon individualised instruction, revision and evaluation with more interesting environments than alternative strategies and the computer as a more patient tutor. The computer can provide a variety of response situations and provides positive feedback. This allows teachers to give consideration to the individual needs of students which traditionally has been a problem with large numbers of students and very little time. The computer takes on part of the instructional role of the teacher with the teacher managing the instruction. The software needs to be matched to the curriculum and therefore is typically content or skills based. There are many educators who feel that this is a trivial or inappropriate use of a computer. However, such software may be used in the development and maintenance of lower level skills (sub-skills) necessary for later progress. There is a danger that such applications focus on student memory of content, although they can be developed to focus on student understanding. These applications are usually easy for teachers to integrate with the curriculum and implement in the classroom.

While it appeals to the public imagination (computers teaching students), even the best tutorial package cannot adequately replace an average teacher. Tutorial software may be useful as supplementary material for some students for enrichment and remedial situations. Some research has shown improvements in skills such as reading, language arts and mathematics of up to 30% when computer-based tutorial and drill and practice software are used

(Mann, 1999). These applications have become increasingly sophisticated with the higher quality packages implementing strategies based on many years of educational research, for example, expert systems and cognitive tutors and apprentices (Committee on Developments in the Science of Learning, 2000).

The computer has the role of tutor with the students responding and the teacher facilitating or supporting the interaction between the student and computer. The main interaction is between the student and the computer with the computer dominating this interaction. The student is relatively passive although controls the pace of interaction and may have some navigational control. The teacher is concerned with managing the computer system and students. This involves selecting appropriate computer applications and ensuring the students have adequate access. The selection of applications involves integrating the computer instruction into the curriculum and matching it to the individual needs of students. In many cases, it is not appropriate to rely solely on computer instruction, other forms of instruction and revision should be used in conjunction with the computer application.

### **Technology in Education**

Means (1993) states that technology is rapidly emerging as an important component of teaching and learning in American schools. However, technology is often promoted as the solution for improving learning before teaching and learning needs are even identified. In order to effectively use technology to support teaching and learning, it is necessary to engage in planning at the state, school district, school, and classroom level.

According to Burnett (1994), educational technology comes in many forms, from pre-packaged games to word processing and graphics packages, complex multimedia systems, and telecommunications networks such as the Internet. Students and teachers are introduced to technology via stand alone computers in the classroom, or via the World Wide Web through the Internet that can connect them to users both across the country and around the world

### **Summary**

Technology is here to stay. It has become as much a part of our daily lives as our homes or vehicles, and many people have taken it for granted. It has made our lives easier, but it has also challenged school learners and teachers to view the world differently. After reviewing the literature, it is fair to state that the technological impact on colleges and universities is huge. Not only has the impact cut deep into budgets and administration, but it appears to be revolutionizing the whole teaching process. New methods for applying innovative teaching to accommodate assorted learning styles are being discovered every day. Pedagogical studies have found that we are beginning to teach children more with less computer use, with the expectation of more retention.

## **CHAPTER THREE**

### **METHODOLOGY**

#### **Introduction**

This chapter outlines the research procedures and the methods that were used in the collection of data and data analysis. It covers the study area, study design, target population, data and sources, sampling technique, research instruments, data processing and analysis, and ethical issues.

#### **Study design**

The study adopted the mixed method design. This method involved triangulating both quantitative and qualitative methods to collect and analyse data in a single study. Creswell (2003), and Tashakkori and Teddlie (2003), support the use of mixed method design because the technique has become increasingly popular as a legitimate research design in all disciplines. According to Creswell (2003), there are three forms of mixed method design where data are collected simultaneously. These are concurrent triangulation, concurrent nested, and concurrent transformative. The study will use the concurrent triangulation design.

In concurrent triangulation design, quantitative and qualitative data are collected and analyzed at the same time. Priority is usually equal and given to both forms of data. Data analysis is usually separate, and integration usually

occurs at the data interpretation stage. Interpretation typically involves discussing the extent to which the data triangulate or converge. These designs are useful for attempting to confirm, cross-validate, and corroborate study findings. To Mertens (2003), the application of multiple sources of evidence in a single study is the best because it helps to enrich the study and also helps one to have a better understanding of the research problem by converging numeric trends from quantitative data and specific details from qualitative data.

### **Target population**

The target population for the study consists of students of the following colleges and schools:

1. Wesley College
2. St Loius College
3. Prempeh College
4. Technology Senior High
5. Armed Forces Senior High School
6. Four heads of department

The students were involved in the study because they were considered as the direct beneficiaries of instructional technology. Their inclusion in the study helped in getting information about how technology in teaching enhances their understanding of the various programmes they are currently studying, the challenges they face in their studies and if possible suggest the way forward.

Heads of departments were included in the study because they are the mouth piece of the school's administration at the departmental level. They also monitor teaching and learning at the various departments.

### **Data and sources**

Data for the study were obtained through two main sources. These were through primary and secondary sources. Data from the primary sources were collected through field survey.

Secondary data were obtained from school records, books, journals, newspapers, articles, reports, the internet, as well as conference and working papers that concern themselves with the topic under investigation.

### **Sample size for the study**

In order to get a representative sample size of the study, the Fisher, Laing, Stoeckel and Townsend (1998) formula for determining sample size was employed. This formula is given as:

$$n_f = \frac{n}{1 + \frac{n}{N}}$$

Where:

$n_f$  = the desired sample size (when population is less than 10,000),

$n$  = the desired sample size (when population is greater than 10,000),

$N$  = the estimate of the target population size.



In order to get “n” Fisher et al. (1998) provided another formula, which is

$$n = \frac{z^2 pq}{d^2}$$

Where:

n = the desired sample size (when the population is greater than 10000)

z = the standard normal deviation, usually set at 1.96 which corresponds to 95 percent confidence level;

p = the proportion of the target population have particular characteristics;

q = 1.0-p; and

d = the degree of accuracy desired, this is usually set at 0.05

With (z) statistic being 1.96, degree of accuracy (d) set at 0.05 percent and the proportion of the target population with similar characteristic (p) at 80 percent which is equivalent to 0.80, then “n” is:

$$n = \frac{(1.96)^2 (0.80) (0.20)}{0.05^2}$$

A calculated n=246 was obtained. According to the administrations of Wesley College, St Loius College, Prempeh College, Technology Senior High and Armed Forces Senior High schools, the number of students who are directly involved in the study are 360.

Putting this (360) and the calculated figure of “n” (246) into the formula, the sample size for the study was calculated as follows:

$$n_f = \frac{246}{1 + \frac{246}{360}}$$
$$= 146$$

A calculated sample size of 146 students was obtained. In order to cater for non response, wrongful answering of questionnaire and other unforeseen circumstances, 10% of the calculated “n” which is 15 respondents was added. In all, a total of 161 respondents were used for the study even though; the actual needed sample size was 146.

### **Sampling technique**

The systematic sampling technique was employed to select the respondents from the various schools which the respondents lived. Based on the listed schools and colleges, a sample size of 161 was distributed proportionally among the groups. The sample size was obtained by dividing the total number in each school or college by the entire number of people in the five schools and colleges. The result was multiplied by the sample size which was 161.

<b>School/College</b>	<b>Population</b>	<b>Sample size</b>
Wesley College	72	32
St Louis College	51	23
Prempeh College	73	33
Technology Senior High	93	41
Armed Forces Senior High	71	32
<b>Total</b>	<b>360</b>	<b>161</b>

### **Research instruments**

In consonance with the mixed method design, questionnaire and interview guide were developed to collect the primary data from the field. These instruments were chosen because they were the most appropriate. Questionnaires were administered to the students while interview guide was used to conduct in-depth interviews (IDIs) for the heads of department. The IDIs were flexible and they allow for the exploration of emerging themes and ideas. In other words, IDIs provide some scope for asking for more relevant information through additional questions often noted when it prompts the interviewer.

### **Data processing and analysis**

The data that will be collected from the field will first be cross-checked and edited to ensure that there are no mistakes in the responses and the information given is relevant. The data will then be coded and entered into the computer. The Statistical Product for Service Solutions (SPSS version 16) will be employed to process and analyse the questionnaires. The IDIs will be analysed manually. The data from the IDI's will be transcribed, categorised under specific themes and used for the analysis. Frequencies, percentages, averages, proportions and diagrams shall be used to present the results.

### **Ethical issues**

Ethical issues that will be involved in the study will include the following:

#### **Informed consent**

Under this ethical issue, the researcher will identify his/herself to the respondents to avoid all kinds of false impression that might be created in the minds of respondents. In addition to this, the purpose of the study or the reason why the research is being conducted will be explained to the respondents for them to get clear understanding of the study. Lastly, the nature of the questionnaires and in-depth interviews will be made known to the respondents for them to have clear picture and idea about how to provide answers to the instruments and participate fully in the study.

### Anonymity

All forms of identification including respondent names, addresses and telephone numbers on the questionnaires and interview guides will be avoided during the field survey.

### Confidentiality

With reference to this ethical issue, respondents shall be informed and promised that the information given by them will solely be used for the purpose of the study but not other matters. Furthermore, respondents will also be informed that the information that they will give will not be made available for other people for any reason.

### Privacy

Respondents' right to privacy will also be respected during the administration of the questionnaires and the in-depth interviews. Questions relating to respondents private matters will be avoided. Respondents shall also be given the liberty to and not to answer some questions that they think are personal to their lives.

## **CHAPTER FOUR**

### **RESULTS AND DISCUSSION**

#### **Introduction**

This chapter presents and discusses findings of the research. The main purpose of the study was to determine the impact of instructional technology on students' comprehension and retention levels. It presents the general description of biographic data of respondents followed by the results of the data analysis relating to each of the research questions. Each question/statement is presented and the quantitative data summarized. The qualitative data (anecdotal information) provided by the participants above the scale data collected is also presented.

#### **Biographic data**

This part of the chapter deals with the demographic characteristics of respondents. It is important to know the background characteristics and experiences of respondents in order to make informed decisions about how they see the impact of instructional technology on their comprehension and retention levels. The surveyed sample consisted of 146 subjects: 90 males and 56 females. The age group breakdown is shown in Fig. 1.

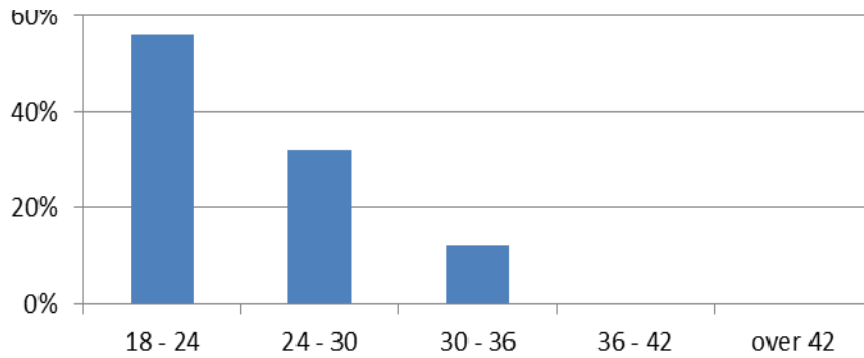


Fig.1: A bar graph showing distribution of respondents' by age.

Figure 1 shows that 56% of the respondents fell between the age range of 18-24 while 32% between 24-30. Twelve percent made up the 30-36 year old group. The average number of years of schooling for the entire group was 15.87. For males the average was 16.06 and females averaged 15.68 years of schooling. The group averaged 11.59 years of computer experience.

The table below provides the distribution of subjects by groups i.e. Traditional and Non-Traditional students in their respective age groups from the sample.

Table 1

**Distribution of Subjects by Groups**

Age	Traditional students		Non-Traditional students	
	Frequency	Percent (%)	Frequency	Percent (%)
18 – 24	48	32.9	28	19.1
25 – 30	32	21.9	23	15.8
31 – 35	0	0	15	10.3
36– 42	0	0	0	0
Over 42	0	0	0	0
<b>Total:</b>	<b>80</b>	<b>54.8</b>	<b>66</b>	<b>45.2</b>

The data in Table 1 shows that the majority of the respondents were traditional students (54.8%). Although equal numbers of traditional and non-traditional students were contacted and asked to complete the questionnaire, only 45.2% were from the non-traditional group.

The distribution of the subjects used for the study and the institution from which they were drawn is shown in Table 2.

Table 2

**Distribution of subjects by Institution and Gender**

Institution	Traditional students		Non-Traditional students		Total	Percent (%)
	Male	Female	Male	Female		
Wesley College	12	8	7	3	30	20.55
St. Louis College	0	13	0	14	25	17.12
Prempeh College	13	0	14	0	27	18.49
Technology Senior High School	18	6	9	5	36	24.66
Armed Forces Senior High School	10	5	10	4	29	19.18
<b>Total:</b>	<b>50</b>	<b>30</b>	<b>40</b>	<b>26</b>	<b>146</b>	<b>100.00</b>

Table 2 shows that 36 (24.66%) of the respondents were from Technology Senior High School while 25 (17.12%) were from St. Louis College. A total of 30 responded from Wesley College representing 20.55% while a total number of 29 responded from Armed Forces Senior High School representing 19.18%. The highest number of female participants were from St. Louis College (25, 48.21%) and that of male participants were from Prempeh



College (27, 32.22%). This is as a result of the fact that they are single-sex schools. While St. Louis College is a female institution, Prempeh College is a male institution.

Table 3 presents the distribution of subjects by their years of education for both traditional and non-traditional student groups.

Table 3

**Distribution of Subjects by Years of Education**

Years	Traditional students		Non-Traditional students	
	Frequency	Percent (%)	Frequency	Percent (%)
12 - 14	40	27.4	35	24.0
14 – 16	21	14.4	20	13.7
16 – 18	8	5.5	11	7.5
More than 18	11	7.5	0	0
Total:	80	54.8	66	45.2

From Table 3, it can be seen that majority (27.4%) of respondents were from the 12 to the 14 years of education in the traditional student group. A total of 8 respondents representing 5.5% were from the 16 to 18 years of education group. The non-traditional group recorded 35 respondents representing 24% with none from the more than 18 years of education.

Respondents were also asked to indicate their computer experience by way of the number of years they have been interacting with computers. The result is presented in Table 4.

Table 4

**Distribution of Subjects by Computer Experience**

Years	Traditional students		Non-Traditional students	
	Frequency	Percent (%)	Frequency	Percent (%)
1 - 3	17	11.6	28	19.2
4 – 6	6	4.1	18	12.3
7 – 9	19	13.0	13	8.9
10 – 12	30	20.5	9	6.2
More than 12	8	5.5	2	1.4
Total:	80	52.2	66	47.8

It can be seen from Table 4 that a majority of the students with the highest number of computer experience (10 – 12 years) were from the traditional group (20.5%) with just 2 (1.4%) from the non-traditional group. On the whole, traditional students had more experience (52.2%) than their non-traditional counterparts (47.8%).

Table 5 below indicates the distribution of responses provided by respondents when asked to indicate their employment type.

Table 5

**Distribution of Response to Employment Type**

Field	Traditional students		Non-Traditional students	
	Frequency	Percent (%)	Frequency	Percent (%)
None	0	0	6	4.1
Technical	0	0	11	7.5
Professional	17	11.4	17	11.6
Administrative	21	14.4	14	9.5
Other	42	28.8	18	12.3
Total:	80	54.6	66	45.4

Of the subjects surveyed, 7.5% classified themselves as being employed in a technical field from the non-traditional group. Other (or those classifying themselves as having no employment but are students) comprised 28.8% and 12.3% from the traditional and non-traditional student respondents respectively. Professionals made up 11.4% of the traditional group, while administrative were 14.4% and none were 0%. From the non-traditional group, professionals made up 11.6% and people from the technical group constituted 7.5%.

### **Research Question 1**

Does instructional technology have an impact on the amount of information a student understands and retains when compared to traditional teaching tools and methods?

The essence of this question was to find out whether or not instructional technology has an impact on the amount of information a student understands and retains when compared to traditional teaching tools and methods. To answer this question, the responses to items 6,10,11,12 and 14 on the questionnaire were used.

Respondents were also asked to indicate how technology has helped them then enhance their learning process in their course of study. The result is presented in Table 6.

Table 6

**Students' assessment of how technology helped enhanced their learning process**

Field	Traditional students		Non-Traditional students	
	Frequency	Percent (%)	Frequency	Percent (%)
Strongly Disagree	5	3.4	2	1.4
Disagree	4	2.7	6	4.1
No Opinion	1	0.7	1	0.7
Agree	35	24.0	40	27.4
Strongly Agree	35	24.0	17	11.6
Total:	80	54.8	66	45.2

This question received an overall positive response from both the traditional and non-traditional groups indicating a strong belief that the participants felt the use of technology helped their learning process. Based on the responses to this item in this survey, the majority (54.8%) of traditional students appear to have felt that their learning process was enhanced by the use of instructional students. While 24% of the traditional students strongly agreed that technology did help enhance their learning process, 24% also from the same group felt that the use of instructional enhanced their learning process. Just 0.7% said they had no opinion. From the non-traditional group, 11.6% strongly agreed, 27.4% agreed, 0.7% had no opinion, 4.1% disagreed with 1.4% strongly disagreeing.

Anecdotal comments included “Most definitely it did. I can’t remember a time when I felt as good about learning” and “I think it did pretty well. It seems that since the multimedia made me become more interested in the subject content, I took more time to study it”.

To be able to answer research question one, respondents were asked to indicate how the use of instructional technology helped them in making better grades. This was done to give respondents the opportunity to assess themselves as to whether the use of instructional technology has any effect on the grades they make in the course of study. The result is presented in Table 7 below.

Table 7

**Students' assessment on how technology helped them made better grades**

Field	Traditional students		Non-Traditional students	
	Frequency	Percent (%)	Frequency	Percent (%)
Strongly Disagree	2	1.4	2	1.4
Disagree	3	2.1	6	4.1
No Opinion	1	0.7	1	0.7
Agree	35	24.0	40	27.4
Strongly Agree	39	26.7	17	11.6
Total:	80	54.9	66	45.1

Traditional students felt overwhelmingly that they had better grades, 80 (54.9%) due to the use of technology in their classes. Twenty four per cent of the traditional respondents agreed to the assertion that the use of technology helped them made better grades. Again, 39(26.7%) of the traditional students strongly agreed that technology helped them made better grades. A total of 57(39%) respondents from the non-traditional respondents either strongly agreed or agreed that technology helped them made better grades. Overall, the entire surveyed population of traditional and non-traditional students seem to agree that the use of technology helped them to make better grades.

Anecdotal comments made in response to this question included “I really felt my interest was increased in the content which probably caused me to receive better grades than I otherwise would have” and “I was really able to visualize the information from my classes better by remembering the animations and digital replays from my instructor. This helped me when I studied.” One participant indicated, “I really don’t see the relationship here. Technology has no impact on whether or not I remembered something.” Another commented, “As far as I know, there really was no difference. Content drives desire to learn and remember, not technology.” Still another indicated, “I don’t know how I ever made it through high school without classroom technology. The courses I am taking here are so cool and I can relate to the way that my teachers use the multimedia to teach me.”

Respondents were asked to indicate how well they remember information presented in classrooms using instructional technology than those without the use of instructional technology. The result is presented in Table 8.

Table 8

**Ability to remember information presented using instructional technology**

Field	Traditional students		Non-Traditional students	
	Frequency	Percent (%)	Frequency	Percent (%)
Strongly Disagree	2	1.7	1	0.7
Disagree	2	1.7	3	2.0
No Opinion	1	0.7	2	1.7
Agree	33	22.6	45	30.8
Strongly Agree	42	28.8	14	9.6
Total:	80	55.5	66	44.5

Non-traditional students rated this question at 30.8% in agreement indicating they largely felt that they could remember more information when technology was used. Their traditional counterparts felt a bit less confident overall with a rating of 22.6%. Traditional students also felt strong about their ability to retain more information with a rating of 28.8%. However, 1.7% and 0.7% respectively from the traditional and non-traditional groups strongly disagree with the assertion that the use of instructional technology did not prompt them to remember more information as compared to traditional teaching methods and tools.

Comments provided in response to this question included, “I can reflect back easier” and “content is much easier to visualize.” Other comments were, “it really didn’t make a difference” and “absolutely! I can always associate what I saw with the technology when attempting to recall.”

Question 12 was designed to find out how one particular media method or technology was more advantageous to one’s learning style than others. The results is presented is Table 9.

Table 9

**Using instructional technology to meet learning styles**

Field	Traditional Students		Non-traditional Students	
	Frequency	Percent (%)	Frequency	Percent (%)
Strongly Disagree	11	7.5	8	5.5
Disagree	3	2.0	18	12.3
No Opinion	23	15.8	18	12.3
Agree	25	17.1	7	4.8
Strongly Agree	16	11.0	17	12.1
Total	78	53.4	67	46.6

Table 9 revealed that many students did not have an opinion on this question as reflected by their responses 15.8% (traditional students) and 12.3% (non-traditional students). While some respondents agreed that particular media worked better than others, traditional respondents felt much stronger. Their overall responses of 53.4% ratings supported this observation. Thus, 17.1% of traditional students agreed with 11% strongly agreeing. 5.5% of non-traditional students strongly disagreed and 12.3% disagreed to the assertion that the use of instructional technology met their learning styles.

Comments provided included, “no difference, it’s all good” and “not really, it all works” as well as “it really depends on what the subject matter is. With some stuff it is better to support it with video, while other content needs the web or an animation.” Other comments included, “I really liked the animations better than the static graphics, but that is just my opinion. I’m not sure if it made any difference to the actual learning that took place.” And “Video is always good. Presenting it from Powerpoint was cool, but it was a bit cumbersome. I think it would have been better coming from DVD or a video tape”.

Question 14 sought to find out how course content and testable material was clearer to the respondents when presented using technology than when presented in more traditional manners. The result obtained is presented in Table 10 below.



Table 10

**Course content and material is clearer when presented using technology**

Field	Traditional students		Non-Traditional students	
	Frequency	Percent (%)	Frequency	Percent (%)
Strongly Disagree	6	4.1	5	3.4
Disagree	6	4.1	3	2.1
No Opinion	9	6.1	5	3.4
Agree	32	21.9	22	15.1
Strongly Agree	27	18.5	31	21.2
Total	80	54.7	66	45.3

While most students, both traditional and non-traditional, felt that the content presented seemed clearer to them, some did not. Overall, traditional and non-traditional students gave a percentage rating of 54.7% and 45.3% respectively. Traditional students (32, 21.9%) agreed that technology provided some advantage to them, while non-traditional students (15.1%) also agreed that technology did help. 18.5% of traditional students strongly agreed that technology made content and material clearer while 21.2% of the non-traditional students also strongly agreed. 4.1% and 3.4% respectively from the traditional and non-traditional students strongly disagreed that the use of instructional technology made content and material clearer.

Documented comments in response to this question were varied and included, “the media used really does not dictate the clarity of the content. The method that the instructor uses to present has more of an impact.” Another comment provided was, “as long as the teacher remembers to provide the testable material using the multimedia, I can remember it better.” Additional

anecdotal data included, “I don’t know about testing material, but certainly the content, which resulted in good test scores for me, worked” and “I believe that the teacher has more of an impact on clarity of information explanation than the media used. If the teacher doesn’t know the material, or relies solely on a video to teach for him, then what use is the information as testable information?”

Results from the survey indicated that overall, most students felt that technology did have a positive impact on the amount of information that was learned and retained. As evidenced by the survey question responses, there were apparent differences between generational (traditional vs. non-traditional) students. Burnett (1994) stated that UK’s largest impact study shows a raise in subject performance through ICT use in English, Science and design technology. In this study, it was seen that overall, the entire surveyed population of traditional and non-traditional students agree that the use of technology helped them make better grades.

Most opinion based studies investigating ICT impact on students’ performance such as the Nordic study, published in 2006 gives a positive picture with teachers being convinced that pupils’ subject related to performance and basic skills (calculation, reading and writing) as well as educational achievements improve (Clark 1999). When students were asked to indicate how course content and testable material was clearer to them when presented using technology than when presented in more traditional manners, 54.7% of traditional students responded positively with 45.3% of non-traditional students sharing the same view. Students using ICTs for learning purposes become immersed in the process of learning and as more and more

students use computers as information sources and cognitive tools (Reeves and Jonassen, 1996), the influence of technology on supporting how students learn will continue to increase.

### **Research Question 2**

Does the use of instructional technology impact differently on traditional and non-traditional students? Table 11 shows the distribution of subjects for traditional and non-traditional students. To answer this question, statements 2,3,4,5 and 15 were carefully designed to elicit the views of participants to determine how the various groups, i.e. traditional and non-traditional student groups are impacted differently by the use of instructional technology in the classroom.

Table 11

#### **Differences in how groups are impacted by instructional technology in the classroom**

Item	Traditional Students		Non-traditional Students	
	Percent (%)	Mean	Percent (%)	Mean
Technology was adequate in class(Statement 2)	26.02	3.80	25.34	1.88
Instructor was knowledgeable in using technology (Statement 3)	28.46	3.53	36.30	3.71
Technology was appropriate for media presented (Statement 4)	34.89	3.45	35.62	4.01
Technology was distraction (Statement 5)	14.38	2.03	12.79	1.90
Difficulty of going back to traditional teaching method (Statement 15)	17.80	1.58	12.32	1.80

Question 2 of the survey asked students to assess the impact of the use of technology in their classrooms. The information shown in Table 11 indicates that traditional students rated the impact higher than their non-traditional students. Whereas traditional students rated this at 26.02% (mean:3.8), their non-traditional counterparts rated it at 25.34% (mean: 1.88). In all, 51.36% of the total sample agreed that technology used in their classroom was adequate for the content being presented.

Questions 3 pertained to the ability of the instructor to make appropriate use of the technology. While tutor training was not part of this survey, it may have had an impact on the ratings provided by the students. Also, the students were asked to rate the apparent knowledge level of the instructor in the use of technology. With question 3, twenty eight of the traditional survey participants provided 'disagree' and 'strongly disagree' answers to the question, signifying their belief that the instructor did not appear knowledgeable of the technology. Traditional students rated this item at 28.46% (mean: 3.53) while their non-traditional students rated it at 36.30% (mean: 3.71). This is an indication that students from the non-traditional group did feel the impact of the use of technology much more than their traditional counterparts. The ability of the instructor to make appropriate use of the technology was also examined in this study. While instructor training was not part of this survey, it may have had an impact on the ratings provided by the students.

Question 4 involved the survey participants' assessment of media in the technology-based classrooms. From Table 11, while many non-traditional

students agreed (35.62%) that the media type used was appropriate, quite a similar number (34.89%) of the traditional survey participants also agreed that they shared the same view. This study further indicated that the rating differences between student groups appear to indicate that traditional students (52.2%) had more exposure to technology (Table 4). This could possibly be attributed to the time at which the students had attended their respective secondary/postsecondary institutions. The non-traditional student group may have possibly taken their courses earlier in life, during the period when educational technology was limited. Another factor contributing to the findings of the results may be the courses/subjects of study that students were taking. It is likely that if students were taking standard lecture type courses, educational technology may not have been used simply because of the nature of the course content. Stemler (1997) notes several promising attributes of multimedia applications in education. Stemler suggests that with multimedia, the learning process becomes active rather than passive. "True interactivity implies that the learning process is, in some degree, modified by the actions of the learners" (p. 340). Interaction between learner and content is perhaps the major difference between traditional instruction and multimedia instruction (Schwier & Missachuk, 1988). This study agrees with Stemler's position that with multimedia, the learning process becomes active rather than passive. Some respondents when asked how technology enhanced their learning process said "Most definitely it did. I can't remember a time when I felt as good about learning" and "I think it did pretty well. It seems that since the multimedia made me become more interested in the subject content, I took more time to study it."

Questions 5 involved the impact to learning process in terms of hindrance and enhancement. The vast majority indicated that technology did indeed help their learning process. The correlation of the group mean response for this question indicates the support of technology in enhancing the learning process for both groups. From Table 11, while traditional students mean was 2.03(14.38%), non-traditional students recorded 1.90(12.79%). This finding corroborates Abrams (1996) who noted that humans are primarily visual learners and suggests that one of the strengths of instructional technology is its ability to integrate pictures, video and animation with text and sound. Abrams suggests that this multi-sensory approach helps different students learn in different ways. Riley (1996) supported Abrams' finding by stating the importance of the methods in which multimedia are integrated into curriculum. In a study on emerging technologies in training and development, Riley noted that considerations beyond the simple use of video, text, and audio be made when developing curriculum. In a chapter titled "Evaluating Interactive Multimedia", Reeves outlines the educational benefits of multimedia; "IMM (Interactive Multimedia) can be designed to present a focal event or problem situation that serves as an "anchor or focus for learners' efforts to retrieve and construct knowledge" (Gayeski, 1993 p.105).

Much has been written concerning the ease of use of technology, the enhancement to the curriculum, and the positive presentation of the message and objective. However, this survey focused more on the student's perspective of their own learning in these classrooms. According to Reeves (1990), multimedia may help to construct knowledge situated or anchored in meaningful and relevant contexts and thereby help learners to construct useful

rather than inert knowledge. From this study, questions 10, 11 and 14 provided an insight into the perception of the participants' abilities to recall information that is presented in the technology-based classrooms. The results of all three questions correlate in their response mean ratings. The majority of the participants felt that their ability to retain information was impacted positively through the use of technology in the classroom (Table 13).

Question 15 provides an insight into the perception of the participants as to whether it will be difficult to go back to traditional methods of receiving tuition. The results of the question correlate in their response mean ratings. Participants from the traditional group constituted 17.80% (mean: 1.58) and non-traditional groups constituted 12.32% (mean: 1.80) indicating that it would not be too difficult for them to go back to traditional teaching methods.

The results of this study suggested that students from the non-traditional group were impacted more by the use of technology in the classroom than the traditional students. They seem to enjoy quite a positive learning impact with high levels of adequacy (traditional students: 26.02%, non-traditional students: 25.34%) and appropriateness (traditional students: 34.89%, non-traditional students: 35.62%). Also, it would not be too difficult for participants to go back to traditional teaching methods where instructional technology may be absent (traditional students: 17.80%, non-traditional students: 12.32%).

## Testing of hypothesis

**Hypothesis:** There are no differences in the way traditional and non-traditional students perceive the impact of the use of instructional technology on their understanding and retention.

This hypothesis sought to find out if there are differences in the way traditional and non-traditional students perceive the impact of the use of instructional technology on their understanding and retention of material or content.

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

Table 12

### The t-test value for the independent groups

Group	N	Mean	SD	Mean Difference	T	p
Traditional	80	4.51	2.17	1.40	0.993	0.04
Students Non-traditional	66	3.50	3.57			

\*P<0.05



From Table 12, it can be seen that the mean difference of 1.40 produced a t-value of 0.04. This is less than 0.05 and therefore means there is a statistically significant difference between the two groups.

The group-type related difference on the scales was explored using the instrument. The scale means and standard deviations for the perception scores for traditional and non-traditional students obtained for each of the four CLEI scales were tabulated in Table 13.

Table 13

**Independent t-test analysis of differences in students' perception on understanding and retaining information using instructional technology between traditional and non-traditional students**

Variable	Traditional Students (n=80)		Non-traditional Students(n=66)			
	Mean	SD	Mean	SD	t-value	p
Assistance	4.18	8.718	3.39	4.868	1.026	.048
Making better grades	3.63	6.403	3.44	4.868	0.01	.128
Remembering information	4.04	12.787	4.00	4.207	0.04	.010
Clarity of content and testable material	3.32	9.083	3.92	5.76	0.03	.018

\*p<.05

From Table 13, it can be seen that there is no statistically significant difference between traditional and non-traditional students in terms of making better grades,  $t(146) = 0.01$ ,  $p < .128$ . However, there was a statistically significant difference between traditional and non-traditional

students in terms of assistance,  $t(146) = 1.026$ ,  $p < .048$ ; remembering information,  $t(146) = 0.04$ ,  $p < .010$ ; and clarity of content and testable material,  $t(146) = 0.03$ ,  $p < .018$ . This result shows that there is a statistically significant difference in the way traditional and non-traditional students perceive the use of instructional technology on their understanding and retention of information. The difference is in the mode of remembering information, clarity of content and testable material as well as assistance. The research hypothesis is therefore rejected. According to Riley (1995), there is a problem of overuse of CBT (Computer Based Training) at the US Air Force Special Operations Aircrew Training school at Kirtland Air Force Base, New Mexico. When a complete curriculum conversion was made to self-paced learning, student retention and knowledge levels began to decrease significantly. This was attributed to the fact that no formative study was completed during the transition. The conversion of the curriculum was made solely for the purpose of “bringing the school into the 20<sup>th</sup> century”. A careful look at this study reveals that this is not true.

Examining whether there is a statistically significant difference between traditional and non-traditional students in remembering information presented when using technology gave a value of  $t(146) = 0.04$ ,  $p < .010$ . This is less than the reference value of 0.05 and this suggests that there is a significant difference between the two groups. This comes to buttress the point that information presented using technology is more understandable and is retained for long. The study therefore rejects some earlier ones that say student retention and knowledge levels decrease significantly with the use of instructional technology.

Anecdotal comments made in response to the question of making better grades using instructional technology as compared to traditional teaching methods included “I really felt my interest was increased in the content which probably caused me to receive better grades than I otherwise would have” and “I was really able to visualize the information from my classes better by remembering the animations and digital replays from my instructor. This helped me when I studied.” Another indicated, “I don’t know how I ever made it through high school without classroom technology. The courses I am taking here are so cool and I can relate to the way that my teachers use the multimedia to teach me.” Table 13 shows statistically significant differences in three out of four statements on understanding and retention of information when presented using instructional technology. The study, therefore, accepted the research hypothesis that instructional technology has an impact on the information a student understands and retains when compared to traditional teaching tools and methods.

The study was conclusive on the fact that although a majority of respondents used for the study felt their ability to retain information was impacted positively through the use of technology in the classroom, the influence was quite low. Perhaps this may be due to the fact that they were introduced to technology late in their education and might have some mixed feelings about how they felt about technology use in the classroom.

The above explanations suggest a rejection of the null hypothesis that there are no differences in the way traditional and non-traditional students perceive the impact of the use of instructional technology on their understanding and retention.

## **Implications**

The findings have some implications for the government, PTAs, School Management Committees and the various stakeholders of education in Ghana. First, since students remember and retain information easily using instructional technology, schools that lack ICT tools and equipment might not be able to deliver information to their students to take advantage of the benefits instructional technology brings to students.

Students admit that the use of instructional technology helps them make better grades. This presupposes that students must be given the opportunity to interact with computers to facilitate their learning process.

## **CHAPTER FIVE**

### **SUMMARY, CONCLUSIONS AND RECOMMENDATIONS**

#### **Introduction**

This chapter presents the summary, conclusion and recommendations drawn from the study. It also includes the implications of the study. We find ourselves today, in a classroom full of students as diverse as the world in which we live. Research on the human brain has shown that not all students learn by one particular strategy (Cowles, 1997). Some students do well with the tried and true method of direct instruction, but the majority of students do not. To reach most students, the teacher needs to create a variety of learning experiences. The first and most simplistic way is to use technology to supplement classroom instruction. Technology will help meet these demands by allowing students to interact with information within a different medium.

Students reported a number of benefits of using instructional technology in education. They cited the convenience of having material in one place, the ability to review lectures, to engage in discussions with forums, to use blogs to connect material with current events and to view foreign video clips to demonstrate processes and procedures.

## Summary

Instructional technology has a number of advantages if employed by teachers in the delivery of their lessons. This study was carried out to determine its impact on students' comprehension and retention levels.

This study has its conceptual framework that students must be taught not only by the traditional way but also, by the use of instructional technology so as to satisfy majority of students with different learning styles.

In the main, the study investigated the impact of instructional technology on students' comprehension and retention levels in the Kumasi Metropolis of the Ashanti Region, Ghana. The study was targeted at finding out whether or not instructional technology has an impact on the information a student understands and retains.

On the whole, the surveyed sample consisted of 146 subjects: 90 males and 56 females. The survey covered five schools in the Kumasi Metropolis. The research instrument used in collecting data was a questionnaire. Subjects responded to a single research instrument, divided into two parts; a demographic data collection portion, and a portion which measured the subject's impressions of the impact that instructional technology they have been exposed to have on their comprehension and retention levels. Additional data captured in Section B of the instrument included anecdotal content and observations of apparent instructor comfort and ability to use the technology.

Two research questions and the null hypothesis were formulated to guide the study. The research questions were analysed using frequencies which were converted to percentages. The hypotheses were tested using t-test of independence.

## **Main Findings**

The study revealed that:

1. Majority of respondents accept the fact that instructional technology has an impact on their comprehension and retention of information.
2. Majority of respondents accept that they make better grades if they receive instruction via the use of technology.
3. Majority of respondents accept that they are able to remember and retain information when they receive instruction delivered through the use of technology.
4. There was a statistically significant difference in the use of instructional technology on students' ability to remember more information presented using technology.

In summary, the findings in this study revealed that respondents accept the fact that instructional technology has an impact on the information a student understands and retains when compared to traditional teaching methods and tools.

Most opinion based studies investigating ICT impact on student performance give a positive picture with teachers being convinced that pupil's subject related performance and basic skills (calculation, reading and writing) as well as educational achievements improve with the use of technology. Despite the growing body of evidence on the impact of instructional technology use on learners, whether it will deliver its potential depends to a large extent on how teachers use instructional technology within the teaching and learning process.

## **Recommendations**

In the light of the findings of the study, the following recommendations are made:

1. The Ministry of Education, Ghana Education Service and all stakeholders in education should ensure that computer laboratories are built in all schools to be used by students.
2. Also, the Ministry of Education, the Ghana Education Service and the various School Management Committees should ensure that schools are well stocked and resourced with technology as ICT can benefit academically strong and weak students as well as students with special needs. This is because the use of instructional technology meets a number of learning styles and can go a long way to help majority of students in their pursuit of success in education.
3. Teachers at all levels of education are trained in the proper use of computers and proper presentation of lessons using computers and associated tools and equipment. It, therefore, becomes imperative that the government, PTAs, school management committees and other stake holders should strive hard to train teachers to use technology in their classrooms.

## **Conclusion**

The result of this study supports much of the research previously cited. Based on the findings of this study, it is concluded that technology does have a positive impact on the amount of information a student understands and retains when compared to traditional teaching tools and methods.



### **Research for future studies**

The researcher would like to make some recommendations for further study. Firstly, a more clearly defined survey should be written and used to gather data for another study. Though this study did clearly indicate that technology has an impact on students' comprehension and retention, had the survey been designed to gather a lot more data, the findings could have been more clearly defined.

Secondly, the next study should include the type of subjects/courses and academic majors that the students were taking. This may help determine if technology has an impact only in specific areas of academic study. It is not realistic to state that all areas of academic study are impacted positively by technology until that area is studied.

Lastly, a participant indicated that it is content that drives the desire to learn and not technology. Though this study gathered some information to some extent, further study could be done to ascertain the veracity of this statement.

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APPENDIX A  
**CENTRE FOR CONTINUING EDUCATION**  
(UNIVERSITY OF CAPE COAST)

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University Post Office  
Cape Coast

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

June 11, 2008.

**TO WHOM IT MAY CONCERN:**  
**LETTER OF INTRODUCTION**

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

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

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

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

Thank you.

Yours faithfully,

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

## APPENDIX B

### RESEARCH STUDY QUESTIONNAIRE

The following questionnaire is designed to obtain your feelings about technology in the classroom. Please read each statement/question carefully and provide your answer.

If you have any comments you would like to add, please do so after each applicable statement/question answer has been circled. **No information provided on this form will be released to anybody. Thank you for your participation.**

#### PART A: Demographic Data

1. Age: (please tick one)

18-24

24-30

30-36

36-42

Over 42

2. Gender: (please tick one)

Male  Female

3. Please indicate the name of your school

.....

4. Number of years of education: (please circle one)

12-14

14-16

16-18

More than 18

5. Computer Experience in years (please tick one)

**NOTE:** Computer experience refers to the use of computers and their applications for word processing, internet browsing, etc. and does not infer skills such as programming, hardware maintenance, or other deeper level computer technological skills.

1-3 Years      4-6 years      7-9 years      10-12 years      More than  
                       

6. Employment: None  Technical  Professional   
Administrative

Other: \_\_\_\_\_

**PART B: Content Statements/Comments**

Please provide your answers to the following questions by circling the appropriate number

Where:

1=Strongly Disagree, 2=Disagree, 3=No Opinion, 4=Agree, and  
5=Strongly Agree.

You are welcome to provide additional comments for each answer if needed.

1. During my secondary/postsecondary education, I have been exposed to educational technology in the classroom.

Strongly      Disagree      No      Agree      Strongly  
Disagree           Opinion      Agree

Additional Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

2. I feel that technology used in my classrooms was adequate for the content being presented.

Strongly	Disagree	No	Agree	Strongly
Disagree		Opinion		Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Additional Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

3. Instructor appeared knowledgeable in the use and application of technology I was exposed to.

Strongly	Disagree	No	Agree	Strongly
Disagree		Opinion		Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Additional Comments: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

1. Technology used in my classrooms was appropriate for media being presented. (i.e., video shown on videotape or DVD as opposed to small computer movies)

Strongly	Disagree	No	Agree	Strongly
Disagree		Opinion		Agree

<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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Additional Comments:

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2. Technology used in my classes was a distraction to my learning process.

Strongly	Disagree	No	Agree	Strongly
Disagree		Opinion		Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Additional Comments: \_\_\_\_\_

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3. I felt technology in the classroom helped to enhance my learning process.

Strongly	Disagree	No	Agree	Strongly
Disagree		Opinion		Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Additional Comments:

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4. I would take another class that used technology in the classroom.

Strongly	Disagree	No	Agree	Strongly
Disagree		Opinion		Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Additional Comments:

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5. Instructor did not use technology to the extent it could have been used.

Strongly	Disagree	No	Agree	Strongly
Disagree		Opinion		Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Additional Comments:

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6. I was exposed to instructional technology in at least one course during my primary and/or secondary school years.

Strongly	Disagree	No	Agree	Strongly
Disagree		Opinion		Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Additional Comments:

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7. I find I make better grades in courses I take using technology as opposed to those without.

Strongly	Disagree	No	Agree	Strongly
Disagree		Opinion		Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Additional Comments:

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8. I find I can remember more information presented in classrooms using technology than those without.

Strongly	Disagree	No	Agree	Strongly
Disagree		Opinion		Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Additional Comments: \_\_\_\_\_

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9. I find one particular media method or technology more advantageous to my learning style than others.

Strongly	Disagree	No	Agree	Strongly
Disagree		Opinion		Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Additional Comments: \_\_\_\_\_

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10. I would recommend using technology in all classrooms, regardless of the content being taught.

Strongly	Disagree	No	Agree	Strongly
Disagree		Opinion		Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Additional Comments: \_\_\_\_\_

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11. I find course content and testable material is clearer to me when presented using technology than when presented in more traditional manners.

Strongly	Disagree	No	Agree	Strongly
Disagree		Opinion		Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Additional Comments: \_\_\_\_\_

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12. Having been exposed to technology in a classroom, I feel it would be difficult to go back to more traditional learning.

Strongly	Disagree	No	Agree	Strongly
Disagree		Opinion		Agree
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Additional Comments: \_\_\_\_\_

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