UNIVERSITY OF CAPE COAST

COST IMPLICATIONS OF COMPUTER NETWORKING IN SENIOR HIGH

SCHOOLS IN KUMASI METROPOLIS

FRANCIS CUDJOE

2013

UNIVERSITY OF CAPE COAST

COST IMPLICATIONS OF COMPUTER NETWORKING IN SENIOR HIGH

SCHOOLS IN KUMASI METROPOLIS

BY

FRANCIS CUDJOE

Dissertation submitted to the Centre for Continuing Education of the Faculty of

Education, University of Cape Coast in partial fulfilment of the requirements for

award of Master of Education degree in Information Technology

MARCH 2013

DECLARATION

Candidate's Declaration

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

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

Name: Francis Cudjoe

Supervisor's Declaration

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

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

Name: Dr. Emmanuel Kofi Gyimah

ABSTRACT

The study sought to investigate which Local Area Network (LAN) equipment were affordable to Senior High Schools in Ghana and if some of these equipment were already available for LAN formation. The study also attempted to establish how knowledgeable were users of the LAN with respect to the cost of setting up, the annual cost of operation, and amount of money provided by stakeholders and donor agencies for funding the local area network.

The descriptive survey design was used for the study. Thirty-eight Senior High Schools and 228 research participants were purposively selected from the Kumasi metropolis. The questionnaire was the main instrument and was composed of 36 items. Other sources of data were through the internet, daily news print and journals at libraries. The return rate of questionnaires was 88% or 201 of the 228.

The findings revealed that most hardware equipment and internet connectivity devices were affordable to the schools. This ranged from server computers to LCD projectors and wireless routers. Vacuum cleaner as an optional equipment was the least affordable. Also, most schools were not aware of Ghana Education Service (GES) procurement rules on ICT equipment and services. The study noted that ICT equipment, also known as hardware and software infrastructure and services required for Local Area Network set up and operation were affordable, and most of these equipment were available to the Senior High Schools in Kumasi.

The recommendations made include the adoption of policy guidelines that empower Senior High Schools in Kumasi to generate more funds. These funds should be meant for the establishments of well equipped Local Area Networks.

ACKNOWLEDGEMENTS

My supervisor, Dr. Emmanuel Kofi Gyimah of the Department of Educational Foundations was so meticulous in his scrutiny of this dissertation and his immense contribution has resulted in the production of this final work. He further exhibited a lot of patience, tolerance, love and devotion throughout the process of carrying out this dissertation.

I am similarly grateful to many others for their assistance in varied ways; especially Sister Olivia of Defra-Oliv Publications limited for typing certain parts of the this project work, and Mr. Samuel Assoah of the University of Education, Winneba (Kumasi campus) for his encouragement.

It is also worth mentioning the direct way Mrs. Victoria Adade Yeboah of the Osei Tutu Senior High School at Akropng-Ashanti, read through the entire manuscript for language adequacy. Needless to say, I remain entirely responsible for any error that may be detected in this dissertation.

DEDICATION

To my wife, Mrs. Olivia Cudjoe and our three children: Hee-Jonah, Alfreda and

Cleopas.

TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

INTRODUCTION

Information Communication and Technology (ICT) systems are being used for personal and business purposes in today's changing world. In Ghanaian Senior High Schools, establishing a well equipped networked ICT centres to help the youth acquire skills in information technology and make them active participants in the information and knowledge based economy comes with a major problem. This chapter explains what the problem is and why is important to study it.

Background to the Study

According to Hag and Keen (1996), the rapid development in Information, Communication and Technology (ICT) has made tremendous changes in the 21st century and this has affected the demand of modern societies. Recognizing the impact of new technologies on the work place and everyday life, today's educational institutions try to restructure their educational programmes and classroom facilities, in order to minimize the teaching and learning technology gap between developed and developing countries. The use of ICT in Ghanaian schools and African countries is generally increasing and dramatically growing (Nyarko, 2007).

This restructuring process requires effective diffusion of technologies into existing context in order to provide learners with knowledge of specific subject areas, to promote meaningful learning and to enhance professional productivity

(Tomei, 2005). The government of Ghana has placed strong emphasis on the contribution of ICT on the country's economy. The country's medium-term development plan captured in the Ghana Poverty Reduction Strategy (2009) emphasized the education strategic plan from the year 2003 to 2015, all suggest the use of ICT as a means of reaching out to the poor in Ghana (Government of Ghana ICT Report, 2005).

In 2004, the Ghanaian Parliament passed into law Ghana's ICT for Acceleration Development (ICT4AD) policy, which is currently at the various stages of implementation. Out of this policy, the Ministry of Education produced an ICT in schools policy. It is worth noting that the ICT in education policy for Ghana had a long gestation period. A committee set up by the Ministry of Education, Science and Sports outlined an ICT in education policy framework and produced a document that remained untouched for a long time. Could the delay be caused by cost implications for providing ICTs infrastructure in schools? The major objective of the policy was to ensure that students have ICT literacy skills before coming out at each level of education (Government of Ghana ICT Report, 2005). On the New Educational Reform, the former president Kufuor, said the Reform also acknowledged the mastery of Information Communication and Technology (ICT) as a priority. This is because skills in ICT had become crucial for the survival of the global world. Government would therefore extend the national broadband backbone connectivity throughout the country to facilitate the development of ICT infrastructure in schools for teaching and learning, and to acquire basic ICT literacy.

Funding proposed for education under the reform was projected at ¢12.03 trillion (i.e. GH¢ 1,203,000) annually with a financing gap of ¢2.6 trillion (i.e. GH¢ 260,000) annually as at September 2005 (Government of Ghana ICT Report, 2005). The government white paper on the 2007 Educational Reform in Ghana quoted ¢13.8 trillion (i.e. GH¢ 1,380,000) budgetary support annually for 10 years to build a solid foundation education in the country in order to make Ghana a middle-income country by the year 2015. Out of this amount it was not clear how much should be channeled into ICTs development in education. A well formulated ICTs financing policy at school levels needs to be researched into for adoption and implementation. We cannot pursue any meaningful ICT Policy in our schools without looking into the cost implications.

In the Senior High Schools, a project to set up computer laboratories in all science schools in the country has lead to a significant number of computers being installed across the country. A computer levy of ¢30,000 (GH¢ 3.00) was allowed to be collected in most Senior High Schools (Ghana Country Report, 2005). This levy of GH¢3.00 per student towards ICT development is what is still being collected by most Public Senior High Schools in Ghana despite the high cost involved in setting up local area network or computer networks in the schools for operation. Over the years, since the diffusion of ICT into Ghanaian schools began there have been a lot of assistance from foreign partners to expand the deployment of ICTs or local area network in schools in Ghana and to promote the effective use of these ICTs to achieve Ghana's educational and community development objectives. Funding has been coming from foreign organizations such as UN-ICT

Task Force, HP, Microsoft Corporation, Intel, Oracle, Cisco, School Network Africa, and World Bank Infodev. (Mangesi, 2007).

A consideration of a topic which studies the cost implications of a Local Area Network set up and operation worthwhile. Hence, a study into the topic "Cost implications of computer networking in Senior High Schools in Kumasi". The topic attempts to find out if resources are available to set up and operate Local Area Network in the schools.

Statement of the Problem

Allotey (2003, p.3) stated that:

> We paid the price of not taking part in the industrial revolution of the late eighteenth century because, we did not have the opportunity to see what was taking place in Europe. Now we see that information technology has become an indispensable tool. This time, we should not miss out on this technological revolution.

While this may be true, it appears we have not considered how much it will cost in providing the facilities to promote the use of ICT with respect to Local Area Network, especially in our educational institutions. Available research in the area is scanty. As a third world country with low Gross Domestic Product (GDP) the question the study attempts to answer is: How feasible and affordable is it to implement policy on computer networks or Local Area Networks (LAN) in Senior High Schools in Ghana?

Purpose of the Study

The purpose of the study was to examine how affordable were the equipment and services required to set up a local area network (LAN) with internet connectivity to the Senior High Schools in Kumasi. It was also to ascertain if some of these equipment or infrastructure was already available to the schools. Moreover, the study sought to determine users' knowledge on cost involved in setting up a local area network and the cost of operation per year as well as the sources of funding the local area network in the Senior High Schools in the Kumasi metropolis.

Research Questions

From the objectives of the study, few research questions were posed. The research questions to guide the study were as follows:

1. Which categories of affordable equipment and services are required to set up a local area network (LAN) with internet connectivity?

2. Which equipment or infrastructure are already available to the schools for local area network (LAN) formation?

3. How knowledgeable were users with respect to the cost involved in setting up a local area network (LAN) with internet connectivity for a high populated school?

4. How knowledgeable were users with respect to the cost of operating and maintaining the local area network (LAN) per year?

5. What sources of funding and cost saving strategies are there for the LAN in the schools?

Significance of the Study

The study is significant because it is meant to emphasize the knowledge ICT teachers and school heads have about affordable and available equipment and services required to form local area networks in the Senior High Schools in Kumasi. Enough information about equipment and services is necessary to implement a school network with internet connectivity for teaching, learning and management purposes.

Again, it is to unveil how knowledgeable ICT teachers and school heads are, with respect to the amount of money involved in the setting up of the local area network and its operation per annum. This is meant to establish the cost schools are most likely to invest in the creation of local area network (computer networks) for their large student population. This will facilitate planning and strategies school authorities would have to adopt to generate funds towards the establishment of such network. At the Senior High School level, this provides benefits to students, teachers and administrators.

Furthermore, the study is meant to ascertain the sources of funding and cost saving strategies necessary for local area network formation so as to address the deficiencies that exist in the ICT Policy for Education with regard to funding.

Delimitation of the Study

Delimitations are restrictions or bounds that researchers impose prior to the inception of the study to narrow the scope of a study (Creswell, 2003). In this study, the researcher delimited the study by the participants, instruments used, and the geographical location in order to make the study better and more feasible.

The study did not cover every teacher at the Senior High School, but targeted ICT teachers and school heads who were either males or females. These participants were the subjects of the study because of their frequent dealings with ICT matters in the schools.

In this study, questionnaires were the instrument used to carry out the relevant research since it was effective in collecting the information the researcher needed in order to complete the study. With regards to the geographical location, the Kumasi metropolis was chosen for the study. The aim of the researcher was to look at diverse ICT cultures existing in closely situated communities for sufficient evidence of inference and generalization of the results. Most of the Senior High Schools of this characteristic were clustered in the Kumasi metropolis.

The study was based on local area network facilities' affordability and availability to the Senior High Schools in Kumasi rather than general ICT equipment at the disposals of the schools. It also looked the knowledge ICT teachers and school heads had with respect to cost for setting up and operation, and possible sources of funding the local area network rather than the cost for upgrading and expansion.

Limitations of the Study

A major limitation encountered during the study was that most schools only allowed the researcher to collect data during a certain time of the school year because ICT teachers and school heads were busy with their normal duties. There were therefore time constraint which delayed the study.

A weakness in the research design could be that, facts and figures presented in this study could become outdated very quickly due to the rapid technological

development according to Oppenheimer (2004). This has the tendency to change the generalization of the results sooner than later. In spite of those limitations the findings can be generalized to the study population.

Definition of Terms and Abbreviations

Operating System   This is the software that aids the computer system to run its programmes and operate efficiently. Examples are Windows and Linux.

Internet   A global network of networks used to exchange information using the internet protocol. It allows for electronic mail and the accessing ad retrieval of information from remote sources.

Physical Topology   The physical layout of the network; how the cables are arranged; and how the computers are connected.

GB   Gigabyte or GB is one billion bytes of information.

RAM   (Random Access Memory) - The working memory of a computer where data and programmes are temporarily stored.

L A N   (Local Area Network) - A network connecting computers in a relatively small area such as a school computer laboratory.

I C T   Information Communication and Technology

L C D   Liquid Crystal Display

Organization of the Rest of the Study

The dissertation is organized in five main chapters. The first chapter focuses on the background of the study, statement of the problem, objectives of the study, research questions, significance of the study, delimitation and limitations of the study, and organization of chapters. The second chapter reviews the necessary related literature on the concept and subject matter of the topic. In Chapter Three, the methodology for the research work is examined. The Methodology is made up of the research design, the study area, target population, sample size, sampling procedure, and data collection techniques.

The fourth chapter deals with the presentation, analysis and interpretation of the findings of the study. The summary, conclusions and recommendations of the study as well as the areas for further research is provided in the fifth chapter.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Overview

Before the introduction of Information Communication and Technology (ICT) into the curriculum of the basic and the second cycle schools, a pilot study was done in the tertiary institutions. It was agreed that all students that pursue tertiary education should be computer literate. Then in the 1987 Educational Reform which gave birth to the Junior High School (JHS) and Senior High School (SHS), it was agreed by the proponent of the reform that Information Communication and Technology (ICT) should be introduced into the SHS curriculum but should be an aspect of general science as a policy and practice in the view of Clemm (2006).

This reform came out with what was referred to as Information Communication and Technology (ICT) for Development. This framework laid more emphasis on the development of strong internet backbone infrastructure (school network system) in the country. It is quite clear that the Education Reforms which introduced Information Communication and Technology into the Ghana educational system did not address the cost implications of how ICTs should be diffused into the schools. Literature review on ICTs funding and infrastructure procurement at the Senior High Schools in Ghana is necessary.

Theoretical Framework of the Study

This segment is to diagnose the views on the cost implications of computer networking (Local Area Network) for Senior High Schools (SHS) with regard to how it impacts on teaching, learning, and educational management. In this study, the researcher seeks to cover areas such as the procurement of affordable infrastructure for an effective local area network; the existence of available hardware or equipment used for Local Area Network (LAN); the cost involved in setting up the local area network (LAN); the operational cost for running the local area network (LAN) within a period of one year; and sources of funding the local area network (LAN) in the schools.

The Concept of Information Communication and Technology (ICT)

According to Batanov, Dimmitt and Chookittiful (2002), technology can be used to mean a tool or a process in the world today. The essence of all revolution is the start of a new story in human experience. In this era, the new story is the arrival of technology. This new revolution has brought profound changes in human life. Batanov et al., sensitized that the new technology in human experience has been given many names. These names include Information Revolution, Computer Revolution, Information Technology (IT), Communication Revolution, Information Age, Binary Age, Information Society, Digital Age, Information Communication and Technology (ICT). All these names are used to refer to the tools or equipment that enables humans to generate and transmit information from one point to another according to the views of Hutchingson and Sawyer (1999).

In a more wider sense, Information Communication and Technology (ICT) according to UNDP ICT Report (2006) had been defined to include the full range

10

of electronic technologies and techniques used to manage information and knowledge. Thus, ICT is a technology that merges computing with high-speed communication links carrying data, sound, and video, and also embraces all the machinery and software that are used to generate and transmit information in all human endeavours.

In identifying the components that constitutes ICT, the UNDP ICT Report (2006) failed to mention that these ICT components are being interconnected together to form Local Area Network (LAN) or computer networks to maximise productivity at the work place or in the school, as had been noticed by Darkey (2004). It is therefore not surprising to see many organisations connecting their local area networks to the internet, which has been described as the information super high way (Gokale, 2001). Information Communication and Technology(ICT) systems are necessary for personal and business success in today's changing world

It is in the light of this that the National Youth Policy of Ghana (2010) aimed at providing well equipped community based networked ICT resources in all districts to help the youth acquire skills in ICT and make them active participants in the information and knowledge based economy. By this means educational technology is integrated into teaching and learning. Pinnigton and Edwards (2000) also shared this view. The use of Information Communication and Technology such as a local area network (LAN) or computer networks, especially for schools comes with a price tag and has its associated cost implications (Gokhale, 2001).

The Local Area Network (Computer Network) Formation

According to Castells (1996), in a networked environment, each computer on a network may access and use hardware resources on the network, such as printing a document on a shared network printer. Sharing files, data, and information. Castells stressed that in a network environment, authorized user may access data and information stored on other computers on the network. The capability of providing access to data and information on shared storage devices is an important feature of many networks. Sharing software, users connected to a network may run application programmes on remote computers. Network is also for information preservation and security (Lowe, 1994).

Sheldon (1994) identified common types of computer networks to be defined by their scale. A local area network (LAN) is a network that connects computers and devices in a limited geographical area such as home, school, computer laboratory, office building, or closely positioned group of buildings. Each computer or device on the network is a node. Sasser and McLaughlin (1994) strongly defended that current wired LANs are most likely to be based on Ethernet technology, although new standards like ITU-T G.hn also provide a way to create a wired LAN using existing home wires (coaxial cables, phone lines and power lines). In the computer network environment, all interconnected devices must understand the network layer (layer 3), because they are handling multiple subnets (the different colors). Other topologies such as star, daisy chain and linear topology may be used to connect the local area network according to Sasser and McLaughlin (1994).

For Sasser and McLaughlin (1994) the local area network also comprised network hardware such as switches or hubs or repeaters that receives a signal, cleans it of unnecessary noise, regenerates it, and retransmits it at a higher power level, or to the other side of an obstruction, so that the signal can cover longer distances without degradation. Also, a bridge may be used to interconnect several LANs. The local area network to be connected to the internet needs the hardware called the router, and also firewalls and anti-virus for network security. Kee (2010) asserted that the local area network (LAN) may connect an intranet, extranet, or internet.

Kee (2010) emphasized the methods of connecting computers together to form a local area network to include peer-to-peer networking, client/server networking, and thin-client networking. According to Kee, Peer-to-Peer networking, network computers to allow users share files and resources located on computers in the network, but there is no file server or central computer to manage network activity. One or more of the computers in a peer-to-peer network can provide centralized services such as printing and access to the internet.

With Client/Server networking, Comer and Stevens (1993) had said, as a computer network grows in size and complexity, it may be necessary to shift to a client/server style of network using more advanced network operating software. In these networks, one computer centralizes such functions as storing common files, operating network e-mail delivery, and providing access to applications and peripherals such as printers. According to Gooden (1996), servers were important in computer networks. The school network may need one each for administration, faculty and students with specifications as follows: Administration server could be

Dual Intel Pentium servers with 2 gigabytes of RAM and 4 x 250 gigabytes hard drives. Comer and Stevens (1993) say faculty server could be Dual Intel Pentium servers with 2 gigabytes of RAM and 4 x 250 gigabytes hard drives Server for students may also have Dual Intel Pentium servers with 2 gigabytes of RAM and 4 x 250 gigabytes hard drives. Barron and Orwig (1995) supported the view posed by Gooden (1996), that four hard drives should be specified for the server so that schools can mirror the drives. This adds some fault tolerance to the system. If one drive fails, the others can be activated so that your system will keep running. The failed drive can then be replaced as convenient. The CPU speed should be 3 gigahertz or higher. One gigabyte of RAM is the minimum requirement.

Sheldon (1994) discussed that workstations for the school administration, faculty or computer laboratory's local area network may be intel desktop systems with CRT or LCD monitors, 512 megabytes RAM, 80 gigabytes hard drive, and over 1 gigabyte processor speed. Faculty and Student Workstations may include laptops with builtin wireless capability. The critical component with laptops is good service and support.

Affordable LAN Equipment or Hardware

According to Gooden (1996), ICT and education were two compatible systems and therefore prices of ICT equipment on the market should be an issue of interest. Desktop computers at AFTECH Computers in Accra, deals in used computers from United State of America are of the following brand: Dell, Compaq, IBM, Vilglen and HP. The specifications of the refurbished computers and their prices quoted in Ghana cedis are indicated in the Table 1.

14

Prices quoted in Table 1 are for desktop computers. A set of tower computer attract an additional charge of GH¢ 10.00. All computers are wholesale price for institutions and educational organizations. All Pentium III computers have a discount of GH¢ 10.00. This does not suggest that the computers are underused (Cuban, 2001). It can be viewed from the Table 1 that the price of the computer depends on the computer specification and the type of monitor that come with the computer, depending on whether the computer is a brand new or slightly used.

Table 1: Cost of Refurbished Computers with CRT and LCD Monitors

Computer specification A set of computer comes with 17" monitor, keyboard, mouse, and power cables.			With CRT Monitor (GH¢)	With LCD Monitor (GH¢)
Pentium III	800MHz	(HDD 20GB/256MB)	120.00	270.00
Pentium III	1.0 GHz	(HDD 20GB/256MB)	120.00	300.00
Pentium IV	1.5 GHz	(HDD 20GB/256MB)	160.00	310.00
Pentium IV	1.6 GHz	(HDD 20GB/256MB)	165.00	320.00
Pentium IV	1.7 GHz	(HDD 20GB/256MB)	170.00	330.00
Pentium IV	1.7 GHz	(HDD 40GB/512MB)	190.00	350.00
Pentium IV	2.0 GHz	(HDD 40GB/512MB)	220.00	360.00
Pentium IV	2.4 GHz	(HDD 40GB/512MB)	240.00	380.00
Pentium IV	2.6 GHz	(HDD 40GB/512MB)	250.00	400.00
Pentium IV	2.8 GHz	(HDD 40GB/512MB)	260.00	410.00

Source: (Daily Graphic Advertisement, July 27, 2010, p. 20)

From Table 1, the higher the Pentium of the computer, processor speed, hard disk capacity, and amount of memory for storage, the higher the price. Thus, the higher the computer capacity the higher the price. Ely (1993) disclosed that

average computer price is dropping below $1000 worldwide for brand new computers.

According to the Daily Graphic advertisement, issue of July 27, 2010 and at page 20, Can West Limited, a wholesaler and retailer of computers, computer accessories and electronics offered for sale at their various branches different type of printers, photocopiers, UPS, and air conditions at the following prices: Samsung printer 1640 – GH¢ 190, Samsung printer 2850D – GH¢ 515, Samsung printer 2855ND – GH¢ 750, Samsung printer 315W – GH¢ 480, HP Laserjet 1005 – GH¢ 240, HP Laserjet 1006 – GH¢ 280, HP Laserjet 2055D – GH¢ 650. HP Laserjet P4015N which print up to 55ppm black and white and has duplex printing on both sides of paper sells GH¢ 1976.77. Other HP printers such as HP Laserjet 2035 with black and white printer and 30 pages per minute is selling at GH¢ 600. HP colour Laserjet 1215 with colour printer and 12 pages per minute sells at GH¢ 520.

Also, APC Backup 650VA – GH¢ 140, APC Smart 1000VA – GH¢ 500, APC Smart 2200VA – GH¢ 1250, Click UPS PS 600VA – GH¢55, and Click UPS 800VA – GH¢75. All of these are for power supply backup. At Calvini in Accra, Ablerex UPS of rate 600VA, 800VA and 1500VA cost GH¢ 97.75, GH¢ 175.89, and GH¢ 186.30 respectively.

Split air condition were available in wholesale prices at Can West Ltd. The 1.5 HP costs GH¢550, 2.0 HP costs GH¢750, and 2.5 HP costs GH¢900. At IPMC, Ricoh Photocopier MP 161LN with features of digital copier, 16ppm, duplex and document feeder printer costs less than half of other photocopiers, and sells at GH¢2,868.97 – GH¢ 1750 with one year unconditional warranty.

The Daily Graphic advertisement, issue of July 27, 2010 and at page 20 revealed that TBS Ltd in Accra and Kumasi has external pocket drives available for sale. Pocket drive of capacity 320GB cost GH¢ 180, 500GB cost GH¢ 250, 1000GB (1.0 TB) cost GH¢ 299, 1500GB (1.5 TB) cost GH¢ 399, and 2000GB (2.0 TB) cost GH¢ 450. External hard drive with capacity of 250GB, 320GB, and 500GB sell GH¢ 160, GH¢ 180, and GH¢ 250, respectively. Also available for sale include optima projector with 2800 ANSI lumens, DLP filter-free design and brilliant technology sells at GH¢ 1000.00, Kodak C180 digital camera with 2GB memory card, 10.2mp, 3x optical zoom, face detection, is selling at GH¢ 249. A flat bed scanner is priced at GH¢ 1265. Moreover stabilizers with their power and prices have been quoted as follows: 500w – GH¢30, 1000w – GH¢50, 1500w – GH¢60, 2000w – GH¢ 65, 3000w – GH¢70, 5000w – GH¢85, and 10000w – GH¢100.

ICT Equipment Availability in Senior High Schools

The rapidity with which the world is changing is unprecedented, taking into consideration the relentless advance of technology and diminishing half-life of knowledge. Information double every 5.5 years. Technical information doubles every 2 years. Electronic information doubles every hour (Oppenheimer, 2004).

MOE Survey (2009) information revealed ICT situation in Senior High Schools in Ghana. According to the survey, 13% of Senior High Schools do not have computer laboratory or LAN accommodation. Only 231 representing 46.1% of schools had computers that meet minimum standards. Student/Computer ratio was 33:1 in Volta region. This means that every 33 students use or share 1 computer. Also student/computer ratio in the Northern region was 50:1. Ashanti

region was 40:1. At the school level it ranged from a low of 3:1 to a high of 650:1. This assessment gives the indication that with the student/computer ratio of 650:1, a school of student population of 1300 would have 2 computers only available for use. This student computer ratio in Ghana is far too less compared to student computer ratio in the United States of America according to Ely (1993).

The survey further revealed that only 89 (17.7%) of schools had internet and these were mostly in urban or metropolitan areas. Only 8.3% computers in the school system were connected to the internet nationwide. Moreover, 93.4% of the schools use unlicensed software. With all these, Krampa (2010) claimed that it was still possible to computerize Ghana schools.

In the MOE survey (2009), it was established that 473 schools had printers, 304 schools had photocopiers, 259 schools had scanners, 267 schools had TV, 165 schools had tape recorders, 84 schools had digital cameras, 26 of the schools had LCD projectors, 26 schools used overhead projectors. The total number of schools in 2009 was 1858.

Employee training and development is crucial for any social organization (Noe, 1999). With regard to ICT competencies, the MOE survey (2009) captured 17,953 staff population for schools in Ghana. Out of this number, 7920 (44.1%) had basic ICT skills. 2593 (14.4%) had advance ICT skills, 1686 (9.4%) had ICT integration skills, 1616 (6.5%) had Trouble shooting skills, 531 (3%) had networking skills. Also, 698 (3.9%) had content development skills. Barron and Orwig (1995) had emphasized the need to use multimedia technologies for training The Ministry of Education statistics points to the direction that electronic information through ICT is dwindling many times in Ghanaian Senior High

Schools opposite to what, Oppenheimer (1996) proposed. Mooij and Smeets (2001) stressed on modeling and supporting ICT implementation in secondary schools with computers and other hardware for local area network adoption in education as computer networking for educators is indispensable in the 21st century as viewed by Hag and Keen (1996).

The Cost Involved in Setting up the Local Area Network (LAN)

According to the Australian Council for Computers in the Classroom (1999), modern teaching could not do without computers. In October 2006, the information communication and technology education (ITCE) unit under Ministry of Education (MOE) for Senior High Schools came out with the minimum requirements for setting up a standard school ICT laboratory. The requirements is specified in Table 2 in this section. According to the ICT laboratory requirements, the following equipment were regarded optional: webcam, facsimile machine (fax), video camera, television, video recorder, radio/wireless, telephone, etc. The requirement also specifies that the laboratory should be networked, with cables not being exposed nor crossing each other. Rules and regulations regarding how the lab should be used should be posted at the lab for all users.

The minimum requirements for a standard school ICT laboratory, however, failed to acknowledge the inclusion of router for internet connectivity as well as cable type to be used for LAN connections as had been suggested by Oppenheimer (2004). Also missing from the specification is the use of vacuum cleaner, used to evacuate dust from the laboratory. The specifications in the MOE ICT Report (2006) is what has been used to prepare the pro-forma invoice in Table 2.

19

Table 2: Pro-foma Invoice for Local Area Network (LAN) Hardware

Hardware Equipment for LAN	Cost (in GH¢)
100 pieces @ 20ft of Cat5e 350MHz UTP Ethernet	500.00
150 pieces of RJ 45 connectors	30.00
180 meters PVC Casing/ conduits for cable laying	130.00
1 of 9U fixed wall mount cabinet	400.00
2 of 24 port Cat5e Patch panel (with a Rack, patch cords.)	600.00
Battler boxes/13A Sockets/Plugs	50.00
1 scanner (flat bed)	1265.00
1 Network printer (Black & white – toner fill) which print up to 55ppm and has duplex printing on both sides of paper	1976.77
A3 colour printer at 30 pages per minute	500.00
1 Photocopier machine (IR 4570-print version)	1850.00
1 LCD Projector with screen (2500 ANSI lumen)	1349 .00
Storage Media (500GB external drives/16GB pen drive/DVD)	350.00
1 Server Computer (Intel Pentium Dual core with 3 RAID	900.00
50 Work Station Computers (Pentium IV – refurbished)	15000.00
50 of D-Link DGS 10/100 PCI Network Card	1275.00
2 of 24 ports D-Link DGS 10/100 switches for L A N connections	765.00
1 Wireless Router (4 ports) for Internet connectivity	1188.30
1 D-Link WAP(high speed 2.4GHz – 802.11g with 108Mps)	198.00

Source: (MOE ICT Report, 2006)

Table 2 shows the Pro-foma invoice from TBS-Ghana Limited, for local area network (LAN) installations. The estimates of this computer network company is based on forming a local area network with internet connectivity, using 50 computers with peripherals. TBS Ghana Limited prepared the pro-forma invoice for schools which would like to network their system (Sampana, 2010). The invoice list are all items required to set up a local area network for 50 users in one Senior High School.

Software is an active ingredient for the operation of any vibrant local area network (Stallings, 2005). The software for the local area network according to Table 3 are all necessary.

Table 3   Pro-foma Invoice for Local Area Network Software

Software for LAN	Cost (Gh ¢)
Operating System (Windows NT Server-Enterprise Edition)	169.00
Operating System (Windows NT Workstation with service pack)	152.00
Microsoft Office 2007	272.00
Antivirus software (AVG or Kasperky - for 2years)	68.00
Host Based Firewalls	170.00
Internet Content filtering Software (for 1 year)	1474.00
Software that support Instructions(e.g. Encarta)	330.00
Software that support Remote Lab. Administration	179.00
Software that support Audio and Video (VLC & flash player- updates)	50.00

Source: (MOE Report, 2006)

With regard to operating system for the local area network, windows 2000 or 2003 or 2008 server can all work well for a school network. According to Schnaidt (1990) in recent months, Windows NT Server, Enterprise Edition sells at $98.99 (GH¢169), while Windows NT Workstation version 4, upgraded with service pack sells at $89 (GH¢152) on the international market while AVG and Kasperky antivirus software each cost GH¢68 for 2 years PC protection against virus attack.

Table 4 shows that the specifications of the optional equipment for the Local Area Network (LAN) by TBS Ghana Limited fall in line with the minimum requirement needed by the computer laboratories of the schools according to MOE ICT Report (2006) policy guidelines.

Table 4 Pro-foma Invoice for Local Area Network Optional Equipment

Optional Equipment for LAN	Cost (GH ¢)
5 Webcam(D-Link USB 30 FPS Desktop 64)	174.00
1 Television (43 inches LCD screen)	1500.00
1 Digital Camera (Nikon's coolpix S8200)	425.00
1 Video Camera/Camcorder(JVC Everio GZ HM445)	230.00
1 Fax machine(Laser G3 Fax with 16MB memory)	642.00
Telephone Systems(AT &T TL86109 Cordless phone)	184.00
1 Radio/Wireless (Sony – 6 batteries)	31.00
1 Tape Recorder (Sony – 10 batteries)	65.00
1 Resogragh (RP3100 RECON with PC connectivity)	3300.00

Source: (MOE Report, 2006)

The optional equipment according to Table 4 are necessary for the schools to form their local area network. However, the ICT policy guidelines by Ghana Education Service do not make them mandatory for schools to include them on the local area network.

Operational Costs of Running a Computer Laboratory with

Local Area Network

UNDP ICT Report (2006) presented some cost analysis for owning computer laboratory with local area network and internet connectivity by local schools, in some selected African countries. In Egypt, the expenditures necessary for the use of computers in schools have helped to generate some guidelines and formulas to help policy makers and planners to estimate the cost effectiveness of computers used in education.

In 2006, a school-based estimates in Egypt showed that substantial amount of ICT budget was spent on central management (planning and recurrent). Hardware (annualized investment per school) was 24% ($10,950) of ICT budget in a school. Software (annualized investment per school) was 2% ($749). Facilities and renovation (annualized investment per school) was 7% ($3,100). Connectivity (recurrent) was 6% ($3,000). Maintenance and technical support (recurrent including personnel) was 4%. This is also emphasized by Muller (1996). Professional Development (annualized investment and recurrent) was 29% ($13,275). Total annual cost per school was $45,045. Total annual cost per student was $75. Total annual cost per computer was $2,048. The above data analyzes the costs of computers in classrooms in Egypt which is a developing nation like Ghana according to the UNDP ICT Report (2006).

The Cost of Energy is what we pay for when we use electricity. Cost of energy is paid per kilowatt-hour of use. One kilowatt-hour is equivalent to 1000 watts used continuously for one hour. Average cost per kilowatt-hour is equal to one unit of electrical energy and this costs GH¢0.1707 in Ghana. According to Electricity Company of Ghana (ECG), electricity bill for school with computer laboratories having, 50 computers, 2 of 2 hp air conditioning units, 8 fluorescent lamps, 2 laser printers, 6 fans, 1 vacuum cleaner, 2 network switches, 1 wireless router, 1 wireless access point device, 1 scanner, and 1 copier machine, all together consumed a total energy of 1480.1 units which cost GH¢252.74 per month for running the local area network (LAN).

For maintenance and support, Batanov, Dimmitt and Chookiful (2002) suggested that the number of support staff required depends on the number of computers, the number of software applications, and the ability of users. Many network experts elaborate that annual expenditures for a healthy education computer system can range from 30 to 50 per cent of the initial investment in computer hardware and software. According to Cuban (2001), the cost implications summary for a local area network of 50 computers for a school would include maintenance costs - $4000 per year (excluding salaries of staff) and; cyclical replacement costs after year 1 (assuming 5 year equipment life-cycle) - $1700 per year.

However, UNDP ICT Report (2006), on ICT funding in sub-Sahara Africa had it that maintaining 50 computers in a local area network with internet connectivity cost GH¢2380.00, and cyclical replacement cost GH¢1726.00 per year, while internet connectivity from an internet service provider costs between

GH¢1200.00 to GH¢200.00 per month. This is confirmed by Sulberger (2001). These estimates were for the teaching institutions.

MOE - ICT Acceptable Used Policy Document

MOE ICT Report (2006) came with ICT Acceptable Use Policy for Junior and Senior High Schools in Ghana. The policy document was not meant to impose restrictions that are contrary to openness, trust, integrity and academic freedom of the schools. The policy was committed to protect teaching staff, students and non-teaching staff and the school computer systems from illegal or damaging actions by individuals, either knowingly or unknowingly as far as the discovering of computers are concerned, from the perspective of Shelle (2008).

According to the policy document the internet, extranet or intranet-related systems, including but not limited to computer equipment, software, operating system storage media, network accounts providing electronic mail, world wide web browsing, and FTP are the property of the school. From Baharul (2003), these systems were to be used for educational purposes in serving the interests of the school, including students and teachers in the course of teaching and learning. It is the responsibility of every computer user in the school to know these guidelines and to conduct their activities accordingly, the policy stressed. From the policy guidelines: Ghana Education Service recommends that any sensitive information such as examination questions should not be within the reach of ordinary users. All users of the school systems for administrative and other activities that require a certain level of confidentiality must be given password and user accounts.

User must not tamper with computer CD-ROM, RAM, Hard drives and

25

floppy drives.   Users are not allowed to install, alter, delete, or uninstall any software   whatever on any computer without approval from ICT coordinator or system administrator. From the perspective of Mccain and Ekelund (1996) all removable drives such as pen drives, floppy disc, digital camera, phones, must have been thoroughly scanned before use.

According to Pelgrum (1996), browsing of pornographic sites by students was strictly prohibited. The internet must not be used for any illegal activities such as hacking, port scanning, slander, obscenity, and profanity. These are activities that consume excess bandwidth, hence slowing down the computer systems such as audio streaming (listening to internet radio) and video streaming should not be allowed. Downloading software and programmes must not be done without the permission of the teacher-in-charge. This is to check the integrity of the sites and the programme and E-mail attachment should not be larger that 10 megabytes to save bandwidth. All these policy monitoring need the teacher's intervention as asserted by Zhao and Cziko (2001), as long as media will influence learning (Kozma, 1994).

ICT Sources of Funding and Cost Savings Strategies in Education

According to Pelgrum (2001), there were many obstacles to the integration of ICT in education. An example is the cost implications with respect to local area network set up and operation. Since the government alone can not bear the cost of ICTs deployment in education and other sectors of the economy, foreign and local partners are complementing government effort. There are some evidences that the current and recent ICT initiatives and projects in Ghana, are being financed by

some foreign partners. For instance, the UN ICT Task Force is funding a project to expand the deployment of ICTs in schools in Ghana and to promote the effective use of these ICTs to achieve Ghana's educational and community development objectives. Also, SchoolNet South Africa and International Institute for Communication and Development (IICD) are funding Global Teenage Project where the use of the internet and especially e-mail become catalyst to structure exchanges between schools and teachers according to Government of Ghana ICT Report (2003).

Apart from the foreign partners it appears Ghana can imitate the examples of other sister nations like Egypt where Muslims have been urged to set up a US$1 billion fund to give information communications and technologies (ICTs) a greater role in development; and in Kenya, where at least 8 out of every 10 public secondary schools will have computers within the next five years from the country's multi-million information communication technology trust fund. It appears funds can be generated internally to support ICT development in Ghana schools.

According to UNPD ICT Report (2006), prices for Information and Communication Technology (ICT) devices and services were falling worldwide, and services continue to grow, propelled by mobile cellular use, but broadband internet remains outside the reach of many in poor countries. In spite of the fall in the prices of ICT devices worldwide, many educational institutions engaged in the shipment of oversold and under used computers in the classroom (Cuban, 2001) as opposed by Australia Council for Computers in Education (1999).

With the passage of the Public Procurement Act, 2003 (Act 663), and given the technicalities that lie beneath the practice, there has arisen an apparent need for procurement officers and other functionaries to be trained in order to attain an appreciable level of understanding of the various provisions of the law in order to contribute effectively to the procurement process. By the law provisions, heads of schools are compelled to use school funds to procure ICT equipment through the bidding (procurement) committee so as to save cost and reduce ICT funds spending.

A value Added Tax (VAT) is a form of consumption tax according to, Ahmed and Nicholas (1991). VAT is a tax applied on the value added to goods and services at each stage in the production and distribution chain. It forms part of the final price the consumer pays for goods or services. In Ghana, the tax regime which started in 1998 had a single rate but since September 2007 entered into a multiple rate regime. In 1998, the rate of tax was 10% and amended in 2000 to 12.5% in accordance with the world tax systems (Tait, 1988).

The National Health Insurance Levy (NHIL) is a levy on goods and services supplied in or imported into Ghana. All goods and services are subject to the levy unless they are exempt. The Levy is charged at a rate of two and one half per cent (2½%) on the VAT selling price of the goods supplied or services rendered. The levy is to partly finance the National Health Insurance Scheme (NHIS) which replaced the Cash and Carry System of healthcare financing of the people of Ghana. The levy is collected by the VAT Service through VAT-registered persons in the same way that VAT is collected. With VAT being 12.5% and NHIL being

2.5%, a total of VAT + NHIL being 15% was the expected tax schools and public institutions were to pay on all computer network equipment and services. However, in recent times, schools have been exempted from the payment of VAT and NHIL for ICT equipment (Tait, 1988).

Summary of the Review of Related Literature

It was quite clear that the Education Reforms of 1987 and 2007 which introduced information communication and technology (ICT) into the Ghana educational system did not address the cost implications of how ICTs should be diffused into the schools. The review of the related literature sought to find out what had been published on the topic by accredited scholars and researchers so as to convey to readers: what knowledge and ideas had been established on the topic and what their strengths and weaknesses were.

The literature therefore critically analysed and assessed key information about the topic, "Cost implications of computer networking in Senior High Schools in Kumasi," for their strengths and weaknesses. In the literature, areas about the topic which were reviewed include: the concept of ICT in education, LAN formation in schools, affordable LAN equipment, LAN equipment availability in Senior High Schools, the cost involved in setting up the LAN, the operational cost of the LAN per year, MOE ICT acceptable use policy document for schools; and ICT sources of funding and cost saving strategies for schools.

According to the literature, to make ICT work in schools, was to create local area networks environment. In such situations, each computer on the network may access and use hardware resources on the network, such as sharing files, and

data.

Market prices have revealed that schools could afford most of the local area network equipment. According to MOE survey (2009), most schools already had some ICT equipment they needed for LAN formation. To install or set up the LAN, some amount of money was required to procure hardware, software and other optional equipment. Operating the LAN on annual basis also required an amount of money for internet connectivity, electricity bills, and maintenance. Foreign and local partners were into funding of school ICT projects like LANs. In the literature, MOE ICT Acceptable Use Policy was necessary to regulate the use of the LAN in schools.

CHAPTER THREE

METHODOLOGY

This chapter describes the research methodology employed in the study on the topic, "The Cost Implications of Computer Networking in Senior High Schools in Kumasi". The chapter looks at the nature, scope and content of computer networking also known as Local Area Network (LAN) as it is being adopted by Ghanaian Senior High Schools in Kumasi metropolis and its associated cost benefits implications for implementation and sustainability. It describes the strategies adopted to find answers to the research questions outlined for the study.

The section therefore focuses on the research design, study area and population, sample size, the pilot study, sampling procedure, source of data and data collection instruments, data processing and analysis, and ethical consideration. The methodology envisages and comments the relationship between the research problem, the data collection method and instrument, and the analysis of the research.

Research Design

The methodology for this research is basically a descriptive survey. Creswell (2003) noted that a survey design provides a quantitative or numerical description of trends, attitudes or opinions of a population by studying a sample of

that population. From the sample results, the researcher can generalize or make claims about the population.

The research was mostly approached from the quantitative perspective. According to Glatthorn (1998), quantitative perspective indicates that there is an objective reality that can be expressed numerically and be described. Glatthorn intimates that the purpose of a descriptive research is to describe a phenomenon. Descriptive studies report frequencies, averages and percentages from which conclusions can be drawn from numerical values presented.

The data describes ICT teachers and school heads' knowledge on cost of setting up a local area network, cost of yearly operation, and the amount of money required for funding the local area network in the Senior High Schools in Kumasi metropolis. Data from the study also describes list of affordable and available ICT equipment required to form local area network in the Senior High Schools in the Kumasi metropolis. In the report therefore, attempt has been made to use the mixed method approaches (quantitative and qualitative) of the data collection for the analysis and discussions according to Creswell (2003) where statistics, tables and graphs, have been used to present the results of these methods.

Population

This research was conducted in Kumasi which is the capital city of the Ashanti region. Tradition is held very high in Kumasi and blends very well with modernity. With its current population, Kumasi is the second-largest city in Ghana. It has an area of 254 km². The largest ethnic group is the Ashanti, but other ethnic groups are growing in size. Approximately 80% of the population is Christian and 5% Muslim, with a smaller number of adherents to traditional beliefs. Most of the

Christian and the Muslim communities have established Senior High Schools to complement government's effort in education delivery in Kumasi. From MOE ICT Report (2006), out of the 474 public education institutions at the Senior High School level in Ghana, more than 80 are in the Ashanti region, and more than 25 are in the Kumasi metropolis. There are over 28 registered Private Senior High schools in Kumasi.

The target population of the study was made up of ICT teachers, ICT coordinators (who were also ICT teachers in the schools) and school heads (the head or the deputy) in both the Public and Private Senior High Schools in Kumasi. The respondents were ICT teachers, ICT coordinators and school heads in the Senior High Schools where ICT had gained root. In these schools, computer networking or Local Area Networks (LAN) existed. These schools were chosen due to the adequate ICT infrastructure and personnel who managed or applied the ICT tools in teaching. Schools with computers but with no Local Area Networks (LANs) were not selected for the study because ICT infrastructure and personnel were not available.

Thirty-eight schools were selected for the study. The criterion used for the selection was availability of Local Area Network (LAN) hence, all schools that had no LAN were excluded. The total number of ICT teachers in the thirty-eight schools (including public and private) was 190 and Heads, 38. Thus, the accessible population was two hundred and twenty-eight (228). The public schools in the Kumasi metropolis selected for the study were 20 and private schools, 18 (See Appendices F and G).

Sample and Sampling Procedure

Sampling is that part of statistical practice concerned with the selection of a subset of individual observations within a population of study by which conclusions drawn from the study can be generalized to the entire population (Stuart, 1962). The researcher used sampling in this survey for three reasons. These reasons are in accordance of Mellenbergh (2008): the cost is lower, data collection is faster, and since the data set is smaller it is possible to ensure homogeneity and to improve the accuracy and quality of the data. According to Salant and Dillman (1994), the size of the sample is determined by four factors: (1) how much sampling error can be tolerated; (2) population size; (3) how varied the population is with respect to the characteristics of interest; and (4) the smallest subgroup within the sample for which estimates are needed.

The researcher, however, employed the Krejcie and Morgan's (1970) method to select an appropriate sample size. The corresponding sample size for the study was based on a confidence level of 95% and 5% margin of error (Krejcie & Morgan, 1970).

Since the population was not too large for the researcher to adequately handle, the purposive sampling technique was used in selecting the sample for the study. According to Deming (1990), purposive sampling is considered when the researcher chooses the sample based on who he thinks would be appropriate for the study. This is used primarily when there is a limited number of people that have expertise in the area being researched. Hence, purposive sampling was used to select the 38 school heads because they were the main spenders of ICT funds, and all the 190 ICT teachers because of their familiarity with ICT issues in the schools.

The main reason why the researcher used purposive sampling was to focus on particular characteristics of a population that were of interest, which could best enable him to answer his research questions on Local Area Network (LAN) in the Senior High Schools. During the sampling procedure, the purposive sampling started with a purpose in mind and the sample was thus selected to include people (ICT teachers and school heads) of interest and exclude those who do not suit the purpose. In other words, the researcher rejected all ICT teachers and school heads in those Senior High Schools which had no Local Area Network (LAN) and were in the Kumasi metropolis. The type of purposive sampling used was homogeneous sampling where sample was chosen when the research question that was being address was specific to the characteristics of the ICT teachers and school heads who had similar background and occupation (Deming, 1990).

Instrumentation

The target population was literate. Respondents could read and write (ICT teachers and school heads). This encouraged the researcher to employ questionnaire as the main instrument for the survey. According to Mellenbergh (2008), a questionnaire consists of a number of questions that the respondent has to answer in a set format. In the questionnaire, the researcher included open-ended questions where the respondent was to formulate his own answers, whereas a closed-ended question requested the respondent to pick an answer from a given number of options. The response options for the closed-ended question were exhaustive and mutually exclusive (Mellenbergh, 2008). ICT teachers and school heads responded to the same set of questionnaire.

The items were put into four sections. Section A sought information on the demographic characteristics of the respondents, including gender, age in years, working category, position in the school, rank in GES and years of experience, as well as the student population and the type of ICT model in education for the school. Section B, looked at affordability of infrastructure or equipment required to set up a local area network (LAN) for the school. Section C, looked at the users' knowledge on amount of money capable of setting up the LAN for a high populated school. Section D looked at the users' knowledge on operational cost of the LAN per year. Section E, talked about the source of funds and some cost saving strategies for the school's local area network.

<p align="center">**Pilot-Test**</p>

According to Haralambos and Holborn (2000), a pilot test is the pre-testing or 'trying out' of a particular research instrument in order to receive advance warning about inappropriate or too complicated research instruments. Haralambos and Holborn advised researchers not to take the risk until they pilot test first. The researcher after designing the instrument conducted a pilot test in two public senior high schools to test the reliability of the instruments.

The respondents were ICT teachers and school heads from the Osei Tutu Senior High School and Toase Senior High School, all in the Atwima Nwabiagya district of Ashanti Region. The two schools were chosen because they were close to Kumasi where the major research was to be conducted. Each of the two schools had adequate ICT infrastructure for local area network (LAN) and also had huge student population. The sample size for this study was 8 ICT teachers and 2 school heads. In all, 10 questionnaires were administered. Both ICT teachers and school

heads were made to respond to the same set of questions. Nine of the questionnaire items were retrieved. A respondent took an average time of 25 minutes to a questionnaire.

The questionnaires were collected and analyzed using SPSS data editor and the Cronbach's alpha value was noted. One of the most popular reliability statistics in use today is Cronbach's alpha according to Crobach (1951) and Nunnally (1978). Cronbach's alpha determines the internal consistency or average correlation of items in a survey instrument to gauge its reliability. Before the research, it was very important to know whether the same set of items would elicit the same responses if the same questions were recast and re-administered to the same respondents. Alpha coefficient ranges in value from 0 to 1 and was used to describe the reliability of factors extracted from questions with two possible answers or multi-point formatted questionnaires or scales (i.e., rating scale: 1 = poor, 5 = excellent). The higher the score, the more reliable the generated scale was. Nunnaly (1978) has indicated 0.7 to be an acceptable reliability coefficient. The results from the pilot-test, produced a Cronbach Alpha value of 0.78. This meant that the reliability of the instrument was guaranteed. Even though the pilot exercise was to give the researcher the opportunity to reduce a number of unanticipated problems by way of redesigning parts of the study, there was the difficulty of some teachers not willing to participate in the process.

Data Collection Procedure

According to Weimer (1995) data collection is a term used to describe a process of preparing and collecting data. The purpose of data collection was to obtain information to keep on record, to make decisions about important issues on

local area network (LAN), and to pass information on to others such as school authorities, stake holders and the government. Salant and Dillman (1994) have said that, the most popular data collection techniques or methods include surveys. The major survey instrument used in this study was questionnaires.

The questionnaires were self-administered to ICT teachers and school heads in all the 38 selected Senior High Schools in Kumasi. Necessary guidance and directives were also given on how to complete the questionnaire and the respondents were allowed to ask for clarification. Out of 228 instruments administered, 201 of the instruments were retrieved and fully answered. Seventeen (17) of the questionnaires were not retrieved while ten (10) were not properly answered and were rejected.

The average time for a respondent to answer a questionnaire was estimated at 25 minutes, with the hope that the questionnaires could be completed within some few days. However, the researcher had to wait for more than six weeks to retrieve the questionnaire instruments from the two hundred and one (201) respondents.

Data Processing and Analysis

After collection of the data, inspection was done on the completed questionnaire by sorting, editing, coding and giving serial numbers for easy identification for scoring. When a respondent checked a response it was considered to be correct, but if the response was left unchecked it was considered incorrect. During analysis all items checked were aggregated and the percentage count, frequencies, mode and median calculated.

On Likert scale, value points were assigned to a participant's responses to a series of statements. In items where ICT teachers and school heads were required to rate their point of view on certain notions on local area network (LAN) for the school, a four point Likert scale of strongly agree, agree, disagree, and strongly disagree was used. Never, sometimes, often, and always were also used to scale and rate respondents' view on some issues of the local area network for the school. During the coding, strongly disagree, disagree, agree and strongly agree were assigned the letters 'p', 'l', 'k', and 'j' respectively; not applicable (NA) or unchecked was assigned the letter 'u'. The value of these letters did not predict how knowledgeable or deficient ICT teacher or school head was in local area network (LAN) issues, rather the number of times an item was chosen by a respondent. The possible responses of each item were also assigned a unique code to ease the analysis according to Albert and Settle (1985).

Statistical Package for Social Sciences (SPSS) and Microsoft excel were employed to facilitate the analysis of the data. In analyzing the data, descriptive statistics such as frequencies and cross tabulation were employed to sum up and present the quantitative data in the form of tables, and charts to aid interpretations and analysis. Percentages, mean, median and mode were used to describe the data.

Ethical Consideration

This study was a non-invasive one because it was not meant to cause any physical harm. To deal with ethical issues, permission was sought from the school administration. At each questionnaire administration point, respondents were given the opportunity to decide whether to partake in the study. The respondents were assured of the confidentiality of their involvement in the study.

CHAPTER FOUR

RESULTS AND DISCUSSION

Overview

This chapter discusses the presentation, analysis and interpretation of data obtained from the survey conducted in the thirty-eight Senior High Schools in Kumasi about the cost implications of Local Area Network (LAN) also called, Computer Networking. Data was obtained from both ICT teachers and school heads through questionnaire. The results are analysed, and the findings discussed.

The scope of the results and discussions in this chapter include respondents' characteristics and the background information to Local Area Network (LAN) formation; affordable equipment and services required to set up a LAN with internet connectivity; ICT infrastructure already available to the school for LAN formation. The scope also looks at users' knowledge on cost involved in setting up a LAN with internet connectivity and its cost of operation per year. Data Sources of funding for the LAN and the perceived amount of money received for the funding in the Senior High Schools have been presented and discussed in this chapter.

Analysis of Background Data

The findings here relate to the demographic characteristics of the respondents. This includes sex, position in the school, rank in the education service, working age and years of experience. It also includes student population, number per class and the concept of ICT used in education by the schools.

In Table 5, a cross tabulation results of sex of respondents and working

category shows a count of 23 females representing 11.4% from Public Senior High schools as against a count of 19 females representing 9.4% from Private Senior High schools.

Table 5: Working Category Cross Tabulation Results for Sex of Respondents

| | Working Category | | | |
Sex	Pensioner on contract	Private Employee	Govern. employee	**Total**
Male	12	58	87	157
Female	2	19	23	44
Total	**14**	**77**	**110**	**201**

Source: (Fieldwork, December, 2011)

Table 5 further shows a count of 12 male respondents and 2 female respondents representing 6% and 1% respectively who were pensioners on contract. Out of 201 respondents there were 44 females and 157 males representing 21.9% and 78.1% respectively. Male respondents were more than their female respondents.

Table 6 shows the crosstabulation results of respondents' position in the school and their rank in the education service. Table 6 established that no ICT teacher or coordinator had the rank of deputy director. Also, no school head had a lower rank of principal superintendent. This gives the indication that school heads who were the spenders of ICT funds had higher ranks.

Table 6: Cross Tabulation Results of Respondents' Position in the School

| Position in the school | Rank in the education service | | | |
	Principal Supt.	Assistant Director	Deputy Director	**Total**
I C T teacher	120	10	0	130
I C T coordinator	15	22	0	37
School head	0	19	15	34
Total	**135**	**51**	**15**	**201**

Source: (Fieldwork, December, 2011)

In Table 6, there were however a count of 130 ICT teachers representing 64.7%, a count of 37 ICT coordinators representing 18.4%, and a count of 34 school heads representing 16.9%. This makes up the total sample of the population who responded to questionnaire items.

Table 7 presents the age group of respondents. From the Table few individuals with old age responded to the questionnaires.

Table 7: Age Group of Respondents

Age Group	Frequency	Percent
25 – 29	72	35.8
30 – 44	78	38.8
45 – 59	36	17.9
60 and above	15	7.5
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

From Table 7, 35.8% and 38.8% of respondents belonged to the age group 25-29 years and 30-44 years respectively with only 7.5% in the 60 and above year

group bracket. This reviews the fact that information technology in Ghanaian schools is relatively a new system and that it is targeting the youth as envisaged in the National Youth Policy of Ghana (2010).

Table 8 displays the number of years respondents have been with the schools. Some teachers and school heads had spent more years while others few years.

Table 8: Years of Experience of Respondents

Years of experience	Frequency	Percent
1-10	126	62.7
11-20	34	16.9
21-30	25	12.4
31 and Above	16	8.0
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

According to Table 8, respondents with 31 and above years of experience only constituted 8% while 62.7% of respondents had up to 10 years working experience in the education service. Also, 16.9% had experience between 11-12 years and the remaining 12.4% had 21-30 years working experience.

Figure 1 shows the percentage distribution of student population in the schools. From the distribution, more schools had huge students' enrollment.

43
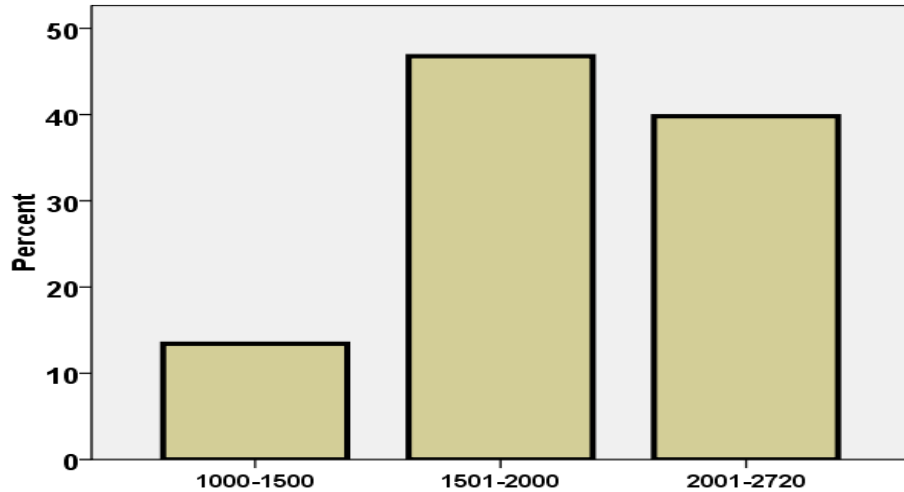
Figure 1: Student population in the schools

In Figure 1, more than 13% of the schools had a student population ranging between 1000 to 1500. More than 46% of the schools had a student population ranging between 1501 to 2000, and 39.8% of the schools also had a student population between 2001 to 2720. The distribution shows that the Senior High Schools in Kumasi are heavily populated.

Table 9 shows the percentage distribution of student number per class in the schools. From Table 9, many schools had an average of 53 students per class.

Table 9: Number of Student per Class in the Schools

Number per class	Frequency	Percent
45-50	78	38.8
51-55	86	42.8
56-60	37	18.4
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

More than 38% of the schools had student number per class ranging between forty-five to fifty. More than 42% of the schools had student number per

44

class ranging between 51 to 55, and 18.4% of the schools had student number per class between 56 to 60. Discrete statistics results in Appendix A shows that there was a mean or average student population of 1916 with an average number of 52 students per class for a senior high school in the Kumasi metropolis. The modal student population for the schools stood at 2500.

What this means is that, at the time of the fieldwork many Senior High Schools in Kumasi had their student population at 2500 with the modal number of students per class set at 50. The distribution shows that the Senior High Schools in Kumasi are heavily populated.

Table 10 displays the percentage distribution of ICT concept in education. The two major concepts included centralized computer laboratory model and diffused classroom model.

Table 10: ICT Concept Used in Education

ICT concept in education	Frequency	Percent
Centralized computer lab. Model	201	100.0
Diffused classroom model	0	0
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

In Table 10, all (100%) Senior High Schools in Kumasi chosen for the study had adopted centralized computer laboratory model of ICT concept in education. This clearly shows that all the schools chosen for the study have a cluster of computers accommodated elsewhere (usually at the laboratory) for ICT education and practice.

<center>**Analysis of Main Research Questions**</center>

The analysis in this section seek answers to the five research questions on the topic, "Cost implications of computer networking in Senior High School in Kumasi metropolis". The aim is to draw conclusion on the amount of money involved in setting up and operating local area network for academic and management purposes in the schools.

Research Question One: Categories of Affordable Equipment and Services required to set up a Local Area Network (LAN) with Internet Connectivity.

In an attempt to answer this question, the various categories of equipment or facilities necessary to form computer networks or local area network (LAN) included in item 10 of the questionnaire were designed. How much affordable the items were to the schools were observed and analyzed in Table 11.

Table 11 shows the degree of affordability of the equipment required to form Local Area Network (LAN). According to the Table11, the percentage for *Always Affordable* and *Often Affordable* for computers, scanners, LCD projectors, printers, internet, storage devices, software and other optional equipment was more than 50% for most of the items. Also, other facilities such as vacuum cleaners, electric orbit fans and air conditioners were affordable to schools. However, vacuum cleaner and air conditioning unit were *Least Affordable* to schools.

<center>46</center>

Table 11: LAN Equipment Affordability

Tendency To Afford	Computer	Scanners	Projectors	Network Hardware	Printers	Internet	Storage Devices	Software & Others	Optional Equip.	Cleaners	Electric Fan	Air Con.
Never	0.0	0.0	0.0	8.5	0.0	8.5	0.0	0.0	0.0	23.6	0.0	2.0
Sometimes	0.5	6.5	6.0	41.3	0.0	42.3	0.5	0.0	46.8	52.7	4.0	46.3
Often	22.9	29.9	78.1	40.8	17.4	45.8	16.9	17.4	43.8	20.4	7.0	49.3
Always	76.6	63.7	15.9	9.5	82.6	3.5	82.6	82.6	8.5	3.5	89.1	2.5
TOTAL	**100%**	**100%**	100%	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: (Fieldwork, December, 2011)

The results from Table 11 clearly indicates that most LAN equipment are affordable to the Senior High Schools. This basically means that schools in the Kumasi metropolis can afford to buy LAN equipment as has been ordered the Ministry of Education minimum requirement for Senior High Schools' computer laboratories (MOE ICT Report, 2006). The MOE ICT Report specifies minimum requirement of ICT equipment by a Senior High Schools.

Research Question Two: Equipment or Infrastructure already Available to the Schools for Local Area Network (LAN) Formation.

In order to assess the availability of ICT equipment necessary for local area network formation in the schools items 11 to 15 on the questionnaires were designed. This was to ascertain what percentage of the equipment that could be afforded was already available to the schools. It was also to find out the most and the least available ICT equipment in the schools; the type of software used for the computers; and to investigate, if schools used unlicensed software as captured in MOE Survey (2009). Table 12, 13 and 14 show the analysis of the responses.

Table 12: LAN Equipment Available in Senior High Schools

Equipment Availability	Frequency	Percent
60-65	20	9.0
66-70	47	23.0
71-75	6	2.0
76-80	64	30.0
81-85	73	36.0
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

From Table 12, exactly 23% of the respondents said between 66-70 percent of local area network (LAN) equipment which were affordable were also available to their schools. Thirty percent of the respondents said between 76-80 percent of the affordable equipment were also available to their schools. There were 36% of the respondents who said between 81-85 percent of the affordable equipment were also available to their schools.

The Discrete statistics results show that, on the average, the schools had 76.9% of the affordable LAN equipment available (see Appendix B). Most schools, however had 85% of LAN equipment available since that was the mode.

Table 13, shows more than 75 % of the respondents accepted that Work stations (low capacity computers) were the most available ICT equipment for the local area network in their schools. This was followed by optional equipment which received a score of 24.9%. Also, internet connectivity devices were the least available LAN equipment as this received 85.5% responses, followed by LAN connectivity devices which received 14.5% responses.

Table 13: Most and Least Available ICT Equipment

ICT Equipment to schools	Most Available		Least Available	
	Frequency	Percent	Frequency	Percent
Optional equipment	50	24.9	0	0.0
LAN connectivity devices	0	0.0	29	14.5
Internet devices	0	0.0	172	85.5
Work station computers	151	75.1	0	0.0
Server computers	0	0.0	0	0.0
Total	**201**	**100.0**	**201**	**100.0**

Source: (Fieldwork, December, 2011)

MOE Survey (2009) information reveals ICT situation in senior high schools in Ghana. According to the survey, only 46.1% of schools nationwide had computers that meet minimum standards. The survey further revealed that only 17.7% of schools had internet and these were mostly in urban or metropolitan areas. The information in Table 13 reveals that there has been a significant improvement in ICT equipment availability in the schools (Barron & Orwig, 1995).

Table 14 displays the cross tabulation results of the respondents' knowledge of software used in the schools. The Table highlights the kind of software which were used the most in the schools.

The crosstabulation results in Table 14 shows that 156 respondents representing 77.6% used opened office for Windows operating system; 10 respondents representing 5% used opened office for Linux operating system; 15 respondents representing 7.5% used licensed office for Windows operating system. 20 respondents representing 10% used opened and licensed office for Windows

operating system. This information further confirms the MOE Survey (2009) which states that 93.4% of the schools nationwide use unlicensed software.

Table 14: Cross Tabulation Results of Respondents' Knowledge of Software

| Operating System Used | Office software used for computers | | | |
	Licensed office	Opened Office	Licensed opened	**Total**
Novel NT	0	0	0	0
Linux	0	10	0	10
Windows	15	156	20	191
Total	**15**	**166**	**20**	**201**

Source: (Fieldwork, December, 2011)

No school used licensed office for Linux operating system. This confirms the fact that Linux operating system is an opened source or free software. Users of Linux operating system face no software piracy for no user fee payments (Stallings, 2005). Also, no school ever used Novel NT operating system to run office software as it has not been specified in the Ministry of Education (MOE ICR Report, 2006) which specifies Linux or Windows operating system for computer laboratory installations in senior high schools.

Research Question Three: Users' Knowledge with respect to the Cost Involved in setting up a Local Area Network with Internet Connectivity for a High Populated School

In an attempt to answer this question, items 16 to 21 on the questionnaire were designed to solicit information from respondents about how much they know with respect to the cost involved in setting up the local area network. This included information on how much money was require to procure hardware, software,

facilities, optional equipment and amount of money required to pay a technician for the local area network installations. Also, respondents' knowledge on ICT equipment and their procurement from the market was ascertained. Tables 15,16,17,18,19, and 20 present the results.

Table 15: Users' Knowledge on the Amount for Hardware Procurement

Amount for Hardware (GH¢.00)	Frequency	Percent
25054 – 27236	46	22.9
27237 – 29419	110	54.7
29420 – 31600	45	22.4
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

According to Table 15, more than 54% of the respondents had the knowledge that it would take an amount of money ranging between GH¢27237 to GH¢29419 to procure hardware equipment for the local area network formation for their schools while 22.9% of the respondents said it would take between GH¢25054 to GH¢27236 to procure hardware. The remaining 22.4% respondents settled on GH¢29420 to GH¢31600 as the amount of money required to procure hardware for their schools.

Table 16: Users' Knowledge on the Amount for Software Procurement

Amount for Software (GH¢.00)	Frequency	Percent
2728 – 2819	79	39.3
2820 – 2910	50	24.9
2911 – 3000	72	35.8
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

From Table 16, more than 39% of the respondents had the knowledge that it would take an amount of money ranging between GH¢2728 to GH¢2819 to purchase software for the local area network formation for their schools while 35.8% of the respondents said it would take between GH¢2911 to GH¢3000 to purchase software. The remaining 24.9% respondents settled on GH¢2820 to GH¢2910 as the amount of money needed to procure software for their schools.

Table 17: Users' Knowledge on the Amount for Facilities and Renovation Procurement

Amount for Facilities (GH¢.00)	Frequency	Percent
9600 – 9950	50	24.9
9951- 10300	84	41.8
10301 – 10650	67	33.3
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

Table 17, shows that more than 41% of the respondents had the knowledge that it would take an amount of money ranging between GH¢9951 to GH¢10300 to acquire facilities such as furniture to aid the local area network formation for their schools while 33.3% of the respondents said it would take between GH¢10301 to GH¢10650 to acquire facilities. The remaining 24.9% respondents settled on GH¢9600 to GH¢9950 as the amount of money schools would need to acquire facilities.

Table 18 reveals that more than 37% of the respondents had the knowledge concerning the amount of money, ranging between GH¢6501 to GH¢6600 to secure optional equipment. This include webcam and resograph to aid the local area network formation for their schools.

52

Table 18: Users' Knowledge on the Amount for Optional Equipment Procurement

Amount for Optional Equipment (GH¢.00)	Frequency	Percent
6400 – 6500	74	36.8
6501 – 6600	76	37.8
6601 – 6700	51	25.4
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

Also, 36.8% of the respondents said it would take between GH¢6400 to GH¢6500 to secure optional equipment. The remaining 25.4% respondents settled on GH¢6601 to GH¢6700 as the amount of money schools would need to secure optional equipment.

Table 19: Users' Knowledge on the Amount for Local Area Network (LAN) Installations Paid to a Technician

Amount for LAN Installations(GH¢.00)	Frequency	Percent
1580 – 1653	74	36.8
1654 – 1727	56	27.9
1728 – 1800	71	35.3
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

Table 19 shows that, more than 36% of the respondents had the knowledge on amount of money, ranging between GH¢1580 to GH¢1653 to be paid to technicians for the local area network installations for their schools while 35.3% of the respondents said it would take between GH¢1728 to GH¢1800 paid to a technician for the installations. The remaining 27.9% respondents settled on GH¢1654 to GH¢1727 as the amount of money required to be paid to technicians for installations and wiring for their schools.

The statistics in Appendix C further reveals respondents' knowledge about the cost involved in setting up the local area network (L A N). In the table, statistics such as the mean, median, mode, minimum and maximum values about the components that constitute the cost for setting up the LAN have been outlined.

From the Appendix C, the amount required for hardware procurement yielded a mean of GH¢28306.04 with a maximum value quoted at GH¢31600.00 and minimum value also pegged at GH¢25054.00. The central value quoted (i.e. the median) with respect to the distribution was GH¢28327.00. The modal amount was however GH¢28850.00 of which 18.9% of the study population considered.

Also from the Appendix C, the amount required for software purchasing gave a mean of GH¢2861.24 with a maximum value quoted at GH¢3000.00 and minimum value also pegged at GH¢2728.00. The amount required for facilities and renovation yielded a mean of GH¢10157.46 with a maximum value set at GH¢10650.00 and minimum value also put at GH¢9600.00. The amount required for Optional equipment according to MOE ICT Report (2006) produced a mean of GH¢6554.57 with a maximum value quoted at GH¢6700.00 and minimum value of GH¢6400.00.

According to Appendix C, the amount required to be paid to a technician in order to install the local area network (LAN) produced a maximum value quoted at GH¢1800.00 to a minimum value of GH¢1580.00. The mean amount was however GH¢1701.39 for installing or networking 50 or more computers and peripherals to form the local area network with internet connectivity.

These price quotations from the study is about a third for same cost quoted in United Kingdom according to Comer and Stevens (1993), and also fall in line

54

with the price list quoted according to MOE ICT Report (2006) for school local area network set up.

In order to set up the local area network in the school, respondents expressed their degree of awareness about ICT equipment. This information can be seen in Table 20.

Table 20 (a): Respondents' Extent of Awareness of ICT Equipment and Information Outside the School

DEGREE OF AWARENESS	Prices of equipment	Falling Price	Procurement Rules	New Equipment	Warranty Cover	Reduction Offer
Never	0.0	0	85.0	32.8	72.6	0
Sometimes	12.9	12.9	10.0	67.2	27.4	12.9
Often	78.1	75.1	5.0	0	0	54.7
Always	9.0	11.9	0.0	0	0	32.3
TOTAL	100%	100%	100%	100%	100%	100%

Source: (Fieldwork, December, 2011)

Table 20 (a) declares that 78.1% of respondents were *Often* aware of prices of ICT equipment on the market. Furthermore, 75.1% of the respondents were *Often* aware of the falling prices of ICT equipment worldwide as was reported by the UNDP- ICT Report (2006).

Also, 85% of the respondents were *Never* aware of Ghana Education Service (GES) Procurement rules on ICT equipment and services in accordance with Public Procurement Act, 2003 (Act 663); 67.2% of the respondents *Sometimes* purchased brand new ICT equipment and 72.6% *Never* demanded warranty cover for the items they bought. Moreover, 32.3% of the respondents *Always* requested

for reduction offer on equipment and services.

Table 20 (b): Respondents' Extent of Awareness of ICT Equipment and Information Outside the School

DEGRE OF AWARENESS	VAT/NHI Receipts	Expert's Advice	Purchase any Brand	Place of Purchase
Never	0.0	57.7	0.0	64.7
Sometimes	27.4	32.3	15.5	35.3
Often	10.0	10.0	24.9	0.0
Always	72.6	0.0	59.7	0.0
TOTAL	**100%**	**100%**	**100%**	**100%**

Source: (Fieldwork, December, 2011)

According to Table 20 (b), 72.6% of the respondents *Always* requested for VAT/NHIL receipts on equipment and services they pay for. This could be attributed to the fact that respondents were not well informed that ICT equipment and services for educational institutions do not attract VAT/NHIL under the new tax law.

Also, 57.7% of the respondents *Never* consulted expert's advice when it came to purchases of ICT equipment, with 59.7% *Always* purchasing any brand of equipment. Above all, 64.7% *Never* purchased equipment from reliable source or place. All these could inflate the set up cost and seriously affect the efficiency of the local area network.

Research Question Four: Users' Knowledge with respect to the Cost Involved in Operating and Maintaining the Local Area Network per Year.

In order to answer this question, items 22 to 29 on the questionnaire were designed to solicit information from respondents' with respect to their knowledge on the cost involved in operating and maintaining the local area network for a period of one year. This covered information which ascertained the amount of money needed for central management and planning to operate and maintain the local area network for one year, the amount of money needed for internet connectivity, component replacement and repairs, the amount of money paid to technicians for maintenance and technical support, money needed for professional development and money needed to pay electricity bill in order to operate and maintain the local area network for one year. Also, level of staffs' ICT skills, the school's internet service provider, internet bandwidth per month and frequency of component replacement were ascertained. Tables 21 to 28 present the results.

Table 21: Users' Knowledge on the Amount for Central Management and planning Per Year

Amount for Planning (GH¢.00)	Frequency	Percent
300 – 700	50	24.9
701 – 1100	91	45.3
1101 – 1500	60	29.9
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

According to Table 21, more than 45% of the respondents had the knowledge that it would take an amount of money ranging between GH¢701 to GH¢1100 for central management and planning to run the local area network

57

within a period of one year while 29.9% of the respondents said it would take between GH¢1101 to GH¢1500 for the one year operation. The remaining 24.9% the respondents claimed that GH¢29420 to GH¢31600 amount of money was enough for the planning.

Table 22: Users' Knowledge on the Amount for Professional Development and Training Per Year

Amount for Training (GH¢.00)	Frequency	Percent
750 – 950	12	6.0
951 – 1151	58	28.9
1152 – 1350	131	65.2
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

From Table 22, more than 65% of the respondents had the knowledge that it would take an amount of money ranging between GH¢1152 to GH¢1350 for professional development and training of ICT teachers and personnel to run the local area network within a period of one year while 28.9% of the respondents said it would take between GH¢951 to GH¢1151 amount for training annually.

Table 23: Users' Knowledge on the Amount for Internet Connectivity Per Year

Amount for Connectivity (GH¢.00)	Frequency	Percent
875 – 1143	53	26.4
1144 – 1411	138	68.7
1412 – 1680	10	5.0
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

In Table 23, more than 68% of the respondents had the knowledge that it would take an amount of money ranging between GH¢1144 to GH¢1411 for

58

internet connectivity to run the local area network within a period of one year while 226.4% of the respondents said it would take between GH¢875 to GH¢1143 amount for internet connectivity annually.

Table 24: Users' Knowledge on the Amount for Electricity Bill Per Year

Amount for Electricity bill (GH¢.00)	Frequency	Percent
3000 – 3022	65	32.3
3023 – 3045	86	42.8
3046 – 3066	50	24.9
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

According to Table 24, more than 42% of the respondents had the knowledge that it would take an amount of money ranging between GH¢3023 to GH¢3045 to pay for electricity bill to run the local area network within a period of one year while 32.3% of the respondents said it would take between GH¢3000 to GH¢3022 for the one year electricity bill for operation. The remaining 24.9% respondents claimed that GH¢3046 to GH¢3066 amount of money was enough for the electricity bill.

Table 25: Users' Knowledge on the Amount for Maintenance and Technical Support Per Year

Amount for Maintenance (GH¢.00)	Frequency	Percent
2310 – 2356	32	15.9
2357 – 2403	144	71.6
2404 – 2450	25	12.4
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

In Table 25, more than 71% of the respondents had the knowledge that it would take an amount of money ranging between GH¢2357 to GH¢2403 for maintenance and technical support to run the local area network within a period of one year while 15.9% of the respondents said it would take between GH¢2310 to GH¢2356 for the one year operation. The remaining 12.4% respondents claimed that GH¢2404 to GH¢2450 amount of money was enough for maintenance.

Table 26: Users' Knowledge on the Amount for Component Replacement Per Year

Amount for Replacement (GH¢.00)	Frequency	Percent
1452 – 1634	69	34.3
1635 – 1817	82	40.8
1818 – 2000	50	24.9
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

From to Table 26, more than 40% of the respondents had the knowledge that it would take an amount of money ranging between GH¢1635 to GH¢1817 for component replacement to run the local area network within a period of one year while 34.3% of the respondents said it would take between GH¢1452 to GH¢1634 for the one year operation. The remaining 24.9% respondents claimed that GH¢1818 to GH¢2000 amount of money was enough for component replacement.

According to Appendix D, the amount required for Central Management Planning yielded a mean of GH¢922.64 with a maximum value quoted at GH¢1500.00 and minimum value also pegged at GH¢300.00. The central value quoted (i.e. the median) with respect to the distribution was GH¢900.00. The modal amount was also GH¢900.00 of which 20.9% of the study population considered.

60

Also from the Appendix D, is the amount required for Internet connectivity which gave a mean of GH¢1203.34 with a maximum value quoted at GH¢1680.00 and minimum value also pegged at GH¢875.00. The amount required for Components replacement yielded a mean of GH¢1713.11 with a maximum value set at GH¢2000.00 and minimum value also put at GH¢1452.00. The amount required for Labour in order to maintain the LAN produced a mean of GH¢2378.36 with a maximum value quoted at GH¢2450.00 and minimum value of GH¢2310.00.

Moreover, Appendix D further reveals the amount required for Professional Development of ICT teachers which gave a mean of GH¢1192.84 with a minimum value of GH¢750.00 and maximum value of GH¢1350.00. The mean amount for Electricity bill yielded GH¢3031.17 with the minimum and maximum amount yielding GH¢3000.00 and GH¢3066.00 respectively. These amounts quotations per year for maintaining the LAN in schools within the Kumasi metropolis are far below the cost of maintaining a local area network in Egypt according to Clemm (2006).
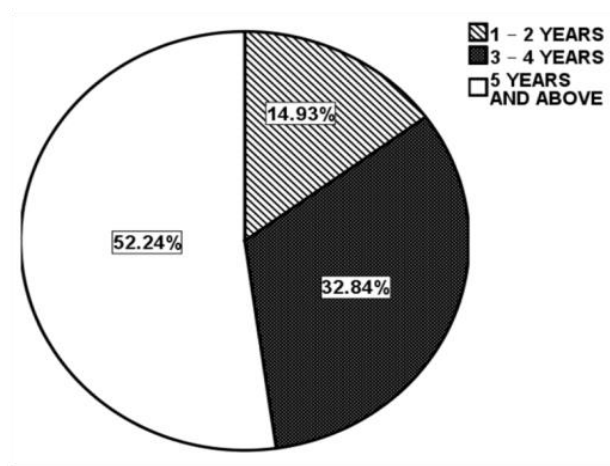
Figure 2: Rate of component replacement

From the pie-chart in figure 2, it could be seen that 52.245% of respondents said that their schools replaced old and weak LAN components every 5 years while 32.84% said their schools replaced components every 3-4 years, and 14.93% replaced components every 1-2 years. This observation confirms what Cuban (2001) published that a $100,000.00 network technology breaks down $20,000.00 per year.

Table 27: Competency among ICT Teachers in the Schools

ICT Competency	Frequency	Percent
Advance ICT Skills	55	27.4
Basic ICT Skills	91	45.3
Content Development skills	9	4.5
ICT Integrated Skills	14	7.0
Networking Skills	15	7.5
Trouble Shooting Skills	17	8.5
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

From Table 27, more than 27% of the teachers and school heads had Advance ICT skills while 45.3% had Basic ICT skills. Very few had Content development skills, ICT Integrated skills, Networking skills or Trouble shooting skills. Comparing this data to the MOE survey (2009) on ICT competency skills in schools, more teachers are gradually gaining advance ICT skills but the number of teachers gaining Basic ICT skills remains almost the same.

Research Question Five: Sources of Funding and Cost Savings Strategies for the Local Area Network in the Schools.

The research question five was designed to verify if sources of funding and cost savings strategies for the local area network in the schools exist. In an attempt to answer this question, items 30 through 36 of the questionnaire were created to solicit information such as the amount of money parents pay per student, amount of money the school contributes, and the amount of money received as donations, all towards the ICT development in the school.

Also, information such as the main source of ICT funds, and the body which pays for repairs and internet connectivity for the LAN in the schools, as well as the opinions of respondents with regard to cost saving strategies for the LAN were included in the questionnaire. Tables 24 to 28 were used to present the results for analysis and discussions.

Table 28: Amount Parents Pay Per Student for ICT Development in the School Per Year

Amount Parents Pay (GH¢.00)	Frequency	Percent
9	155	77.1
12	31	15.4
15	15	7.5
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

Table 28 shows that more than 77% of the respondents had the knowledge that parents pay an amount of money equal to GH¢9.00 per student per annum towards ICT development. in the schools. Also, 15.4% of the respondents said parents pay GH¢12.00 per student for one year of operating the local area network.

The remaining 7.5% respondents were aware that GH¢15.00 per student was paid annually by parents towards ICT or local area network funding. This confirms a computer levy of GH¢9.00 allowed to be collected annually in most Senior High Schools by the MOE ICT Report (2006).

Table 29: Amount School Contributes towards ICT Development Per Year

Amount School contributes (Gh¢.00)	Frequency	Percent
300 – 700	61	30.3
701 – 1101	28	13.9
1102 – 1500	112	55.7
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

From Table 29, more than 55% of the respondents had the knowledge that their schools contributed an amount of money ranging between GH¢1102 to GH¢1500 towards local area network formation and support within a period of one year while 30.3% of the respondents were aware that their schools contributed between GH¢300 to GH¢700 for the one year LAN operations. The remaining 13.9% the respondents knew that GH¢701 to GH¢1101 amount of money was paid to ICT fund annually.

Table 30: Amount Received as Donations towards ICT Development in the School Per Year

Amount Paid by Donations (GH¢.00)	Frequency	Percent
350 – 733	121	60.2
734 -1116	61	30.3
1117 – 1500	19	9.5
Total	**201**	**100.0**

Source: (Fieldwork, December, 2011)

In Table 30, more than 60% of the respondents had the knowledge that their schools received an amount of money ranging between GH¢350 to GH¢733 as donations towards local area network formation and support within a period of one year. Also, 30.3% of the respondents were aware that their schools received between GH¢734 to GH¢1116 for the one year LAN operations. The remaining 9.5% of the respondents knew that GH¢1117 to GH¢1500 amount of money was received as donations to ICT fund annually.

Table 31: ICT Development Funding Sources in the Schools

Funding Source	LAN Infrastructure		Repairs and Replacement		Internet Connectivity	
	Freq.	percent	Freq.	Percent	Freq.	percent
P T A	138	73.1	163	81.1	135	67.2
The School	38	21.9	28	13.9	28	18.4
Old Student	15	3.0	10	5.0	23	11.4
N G O's	10	2.0	0	0.0	15	3.0
Government	0	0.0	0	0.0	0	0.0
Total	**201**	**100%**	**201**	**100%**	**201**	**100%**

Source: (Fieldwork, December, 2011)

According to Table 31, more than 73% of the respondents were of the view that the local area network (LAN) infrastructure was funded by the Parent Teacher Association (PTA) while 21.9% of the respondents said LAN infrastructure was funded by the school. Also, 81.1% of the respondents were of the view that repairs and replacement for the local area network was funded by the Parent Teacher Association (PTA) while 13.9% of the respondents said repairs and replacement was funded by the school.

With regard to internet connectivity, 67.2% of the respondents were of the view that internet connectivity was funded by the Parent Teacher Association (PTA) while 218.4% of the respondents said internet connectivity was funded by the school. The remaining 11.4% respondents said, Old Student Association paid for internet connectivity.

For NGO's contributions, only 2% of the responses went for LAN infrastructure while 3% of the responses went for internet connectivity. There was however, zero response for Government's contribution. Government's contribution towards ICT deployment in the schools was nil.

In the respondents' view according to Appendix E, the local area network was funded from money parents paid to the school as ICT levy, money from school's own contribution and money received as donations including those from the old students association. According to Appendix E, the mean amount of money received from donations was GH¢508.85 per annum. School's mean contribution per annum was GH¢949.33. Money from PTA levy yielded a mean of GH¢9.90 and a maximum amount of GH¢15.00 per student per annum. The amount paid by parents per student looks scanty, but when the amount is multiplied by the student population it is obvious it could be large enough.

Table 32 suggests a number of ways schools could adopt to maximize revenue generation towards an effective local area network. From Table 32, more than 71% of the respondents agreed that cost benefit software should be installed on the LAN, 69.7% of the respondents believed that PTA Levy for ICT should be increased while 68.7% said, more of the school funds should be allocated to LAN development in the school.

Table 32: Suggestions for more Funds for the Local Area Network (LAN)

Degree of Response	Cost benefit software installations	Increase PTA Levy for ICT	More school funds for LAN	Fund raising for LAN.	ICT Policy for funding	Separate account for ICT funds
Strongly Disagree	0.0	5.0	0.0	0.0	0.0	0.0
Disagree	0.0	12.4	0.0	0.0	6.5	6.0
Undecided	0.0	5.0	0.0	0.0	0.0	0.0
Agree	71.6	69.7	68.7	80.1	74.6	28.9
Strongly Agree	28.4	8.0	31.3	19.9	18.9	65.2
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: (Fieldwork, December, 2011)

More than 80% were of the view that fund raising activities should target LAN implementation, 74.6% believed that there should be proper ICT policy to secure adequate funding while 65.2% of respondents strongly agreed that there should be separate account for ICT funds, as has been suggested in the MOE ICT Report (2006) for education.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Overview of the Study

At the Senior High School level, Ghana Education Service policy mandates schools to establish ICT centers with local area networks (LAN's) connected to the internet in the acceptable standard (MOE ICT Report, 2006). This research work tried to assess the detailed and up to date information school heads and ICT teachers have about local area network (LAN) formation and operation at the Senior High Schools, taking into consideration feasibility and cost implications.

The purpose of the study was to accomplish three goals; first, it was to report the findings on affordable and available infrastructure (equipment and facilities) that Senior High Schools can depend on effective local area network (LAN) formation. Second, it was to come up with a precise cost or amount a particular Senior High School should afford when it comes to setting up and operating the local area network (LAN) for ICT skills development. Third, the research study was also to ascertain the funding sources and cost saving strategies for the local area network.

The descriptive survey design was used for the study. Thirty-eight Senior High Schools and 228 research participants were purposively selected from the Kumasi metropolis. The questionnaire was the main instrument and was composed of 36 items. Other sources of data were through the internet, daily news print and

journals at libraries. The, questionnaires were administered to school heads, ICT coordinators and ICT teachers since they were directly involved in the setting up and use of the local area network in the schools. The return rate was 88% or 201 of the 228. The questionnaire was analyzed using the SPSS software for percentage distributions, mean and median values. The percentage distributions and mean values on costs and funding were summed up individually for observation and conclusion.

Even though many people shared the view that local area network usage in education could favour teaching, learning and management purposes, it appeared we had not considered how much it would cost in providing the facilities to promote the use of local area network especially in our educational institutions. As a third world country with low Gross Domestic Product (GDP) the question the study sought to answer was: "How feasible and affordable is it to implement policy on computer networks or local area networks (LAN) formations and operations in senior high schools in Ghana?"

<div align="center">

Key Findings

</div>

Summary of Findings for Research Question One

Research Question one explored the various categories of equipment or facilities required to form computer networks or local area network (LAN) with internet connectivity at the Senior High Schools in the Kumasi metropolis. From the study, host of hardware equipment for LAN formation were affordable to the schools. However, equipment such as photocopier machine and vacuum cleaner could only be afforded by few schools while printers by many schools.

Router for internet connectivity and optional equipment such as, webcam

were also affordable to the schools. Majority of the schools used windows and Microsoft office as software and application programmes respectively.

Summary of Findings for Research Question Two

Research Question two ascertained which equipment or infrastructure were already available to the schools for local area network (LAN) formation in the Kumasi metropolis. On the average, schools had 76.9% of the LAN equipment they could afford. Few schools had LAN equipment below this percentage average. Work stations (low capacity computers) were the most available ICT equipment for the local area network in the schools with internet connectivity devices being the least.

Over 77% of schools used opened office for Windows operating system which were not licensed. This, confirmed the MOE survey (2009), which stated that more than 93% of schools nationwide use unlicensed software.

Summary of Findings for Research question three

Research Question three was to find out how knowledgeable were users with respect to the cost involved in setting up a local area network with internet connectivity for a high populated school. According to the study, an amount of money required for hardware procurement yielded an average of GH¢28306.04 while the amount required for software purchasing revealed GH¢2861.24.

Also, the amount required for facilities and renovation yielded an average of GH¢10157.46 while that for optional equipment targeted GH¢6554.57. Moreover, the amount required to be paid to a technician in order to install the local area network (LAN) produced GH¢1701.39. This amount was for installing or networking 50 or more computers and peripherals to form the local area network

with internet connectivity (see appendix C).

Furthermore, respondents' awareness about ICT equipment and information outside the school in the Kumasi metropolis revealed that Senior High Schools were aware of the falling prices of ICT equipment on the market. However, most of the schools were not aware of Ghana Education Service procurement rules, and many of the schools neither demand warranty cover for the items they bought nor consulted expert's advice when it came to the purchasing of ICT equipment. Most of the schools always requested for VAT/NHIL receipts on ICT equipment and services they paid for.

Summary of Findings for Research Question Four

Research Question four assessed how knowledgeable were users with respect to the cost involved in operating and maintaining the local area network for a period of one year. It was found out from the study that an amount of GH¢922.64 was required for central management and planning. Also, an amount of GH¢1203.34 was required for internet connectivity per annum while the amount for components replacement was GH¢1713.11. The amount required for labour in order to maintain the LAN was GH¢2378.36. The amount required for professional development of ICT teachers targeted GH¢1192.84 while the amount for electricity bill yielded GH¢3031.17 (see Appendix D).

Moreover, more than 50 per cent of schools replaced old and weak LAN components every 5 years and less than 50 per cent of ICT teachers and school heads had advance ICT skills, basic ICT skills, content development skills, ICT integrated skills, networking skills or trouble shooting skills. Also more than 60 per cent of schools used fixed broadband and they were allowed unlimited bandwidth

for internet connectivity.

Summary of Findings for Research Question Five

Research Question five made the attempt to find out what sources of funding and cost savings strategies were there for the local area network in the Senior High Schools in Kumasi metropolis. The local area network was funded from money parents pay to the school as ICT levy. Money from school's own contribution and money received as donations including those from the old students association also added to the sources of funding ICT in the Senior High Schools.

On the average, the amount of money received from donations per annum was GH¢508.85. A Senior High School's average contribution per annum was GH¢949.33. Money from parent teacher association (PTA) levy gave an average of GH¢9.90 per student per annum and the total average money paid by parents per year was GH¢18975.12 (see Appendix A & E).

With regard to cost saving and funds generation strategies, many Senior High Schools in the Kumasi metropolis agreed that cost benefit software should be installed on the LAN; PTA Levy for ICT should be increased; more of the school funds should be allocated to LAN development in the school; and, fund raising activities should target LAN implementation. The views also supported that there should be proper ICT policy to secure adequate funding, and there should be separate account for ICT funds, as has been suggested in the MOE ICT Report (2006) ICT for education.

Conclusions

The study noted that ICT or local area network equipment and infrastructure were available to the Senior High Schools in the Kumasi metropolis. However, the equipment were not enough to serve the huge student population in some of the schools. For instance, about 40% of the Senior High Schools within the Kumasi metropolis had restricted internet access to their students. This was because those schools did not used fixed broadband which allowed unlimited bandwidth for internet connectivity. Also, many of the schools used opened office for Windows operating system which were not licensed. This practice by the schools contradicts copyright laws and this had serious legal implications, should Microsoft corporation take actions.

The findings of the study revealed that most local area network equipment were affordable to the Senior High Schools in the Kumasi metropolis. However, lack of parent teacher association's levy upward adjustment and the introduction of new policies for ICT revenue generation prevented schools from raising sufficient funds for procurement, installations, and maintenance of a vibrant local area network.

Moreover, teachers and school heads in the Senior High Schools in the Kumasi metropolis had adequate knowledge about the cost of set up and operation of the local area network. In their view, total cost involved in the set up yielded GH¢49580.70, and the operational cost for running the local area network over a period of one year, totaled GH¢10441.48. However, this amounts were far below the cost of implementing local area network for 50 users in Egyptian school. Therefore, the local area networks in many Senior High Schools in Kumasi

metropolis lack the acceptable standards as prescribed by the MOE ICT Report (2006).

Furthermore, the study revealed that there were sources of funding for the local area network (LAN) in the Senior High Schools in the Kumasi metropolis. For instance, an amount of GH¢20433.30 was noted as the average amount per annum, raised by the parent teacher association (PTA), the school and donations. These were the main funding sources of ICT and LAN development in the schools (see Appendixes A and E). However, the funds raised through these sources were inadequate. This is because, implementing the local area network for 50 users in a Senior High School within the Kumasi metropolis required GH¢60022.18. It is therefore obvious that the local area networks in Senior High Schools still needed more funds for their establishments and functionalities. Funding the local area network was the most serious issue, in Senior High Schools in the Kumasi metropolis.

In setting up and operating the local area network, the study further noted that the Senior High Schools in the Kumasi metropolis failed to adopt some cost saving strategies. As a result, the cost of set up and operation for the local area network could be inflated. For example, very few schools and for that matter, few heads and ICT teachers asked for reduction offer, warranty cover, or expert's advice when it came to purchase of ICT equipment. Also, very few schools followed procurement rules on ICT equipment and services. Many schools, however, purchased ICT equipment, through VAT/NHIL receipts which was against the new tax law in Ghana. Moreover, more than 50 percent of schools did not repair old and weak local area network components on annual basis. Less than

50 percent of ICT teachers and school heads had ICT skills. This implied that most personnel who handle ICT in the Senior High Schools in Kumasi metropolis were not knowledgeable or professionals.

Recommendations

In view of the findings and conclusions based on the study, making recommendations for policy and practice is necessary. The following recommendations are made to task authorities at the Senior High Schools in the Kumasi metropolis and beyond, as well as stakeholders and organizations for implementation where possible:

1. Restricted internet access hampers teaching and learning activities in schools where there are local area networks. Authorities at the Senior High Schools in the Kumasi metropolis may used fixed broadband which allowed unlimited bandwidth for internet connectivity. Also, Senior High Schools in the Kumasi metropolis should avoid the use of opened office for Windows operating system. The schools are being urged to use licensed software for the local area networks in order not to fall victim to copyright laws.

2. Ghana Education Service policy empowered schools to levy the parent teacher association (PTA) an amount of GH¢9.00 per student per annum. This should receive an upward review. The new policy could task parents and donors to do more either in cash or in kind for an effective local area network implementation in the Senior High Schools in the Kumasi metropolis. Also, schools should be mandated to have internal ICT policy where a good percentage of the internally generated fund (money from PTA and donations) could be allocated for the local area network development. Moreover, there could be a separate account for ICT

75

funds. The school head and the ICT coordinator could be the signatories to the account and the account should be subjected to audit cheeks every term in the academic year.

3. The cost of owning a local area network (LAN) at the Senior High School in Kumasi metropolis includes cost of set up and cost of operation. From the study an amount of over GH¢60,000.00 was what could implement the local area network for 50 users at a time. This is huge, compared to the amount of GH¢20433 that could be raised annually to fund the local area network in the schools. Government should restructure the national budget such that it includes funds specifically set aside to supplement ICT infrastructure development in schools. For instance, a portion of the Ghana Education Trust Fund (GET Fund) could go into ICT funding in schools as being done in other countries like Kenya and South Africa.

4. There should be frequent in-service training to equip and update the ICT skills of ICT teachers and school heads in the Senior High Schools within the Kumasi metropolis. Schools could extend their staff training in ICT skills to cover Linux operating systems and office. This is an opened source or free software and users do not face copyright piracy. Also Linux software originally protects the LAN from computer virus. The staff training could also target repairing old and weak local area network components.

5. In procuring ICT equipment and services, Senior High Schools in the Kumasi metropolis should take notice of the following as cost saving strategies:

i   Procurement rules should be followed according to Public Procurement Act
        of Ghana (2003, Act 663).

ii.   Ask for reduction offer for any bulk purchase of ICT equipment and services

iii. Demand for warranty cover for ICT equipment bought.

iv.   Seek for expert's advice for all LAN installations and maintenance.

v.   Do not ask for VAT/NHIL receipts. ICT equipment and services for education do not attract VAT/NHIL under the new task law in Ghana.

Suggestions for Further Research

The research work concentrated so much on the cost of setting up the local area network and the cost involved in its operation on annually basis. Every local area network for a high populated school needs to be upgraded and expanded from time to time so as to withstand modern trends in information communication and technology.

However, the study could not cover the cost involved in upgrading and expanding the local area network for Senior High Schools in the Kumasi metropolis. An area for further research should therefore target the cost involved in upgrading and expanding the local area network. This may include the cost of new computer laboratory, setup, training, software support, hardware support, electricity, internet connectivity, as well as damage and theft.

REFERENCES

Ahmed, E., & Nicholas, S. (1991). *Theory and practice of tax reform in developing countries*. Cambridge: Cambridge University Press.

Albert, R. L, & Settle, R. B. (1985). *Survey research handbook*. New York: Irwin

Allotey, F. K. A. (2003, September). *Do Developing Countries have Access to scientific knowledge?* Paper presented at the 3rd Biannual Conference of the Abdus Salam ICTP, Triesty, Italy. p.3.

Australian Council for Computers in Education. (1999). *Teacher learning techniques and competencies*. Commonwealth of Australia: Author.

Baharul, I. (2003). National ICT policies and plans towards poverty reduction in. Ethiopia. *Ethiopian Herald*, *3*(2), 23-35.

Barron, A. E., & Orwig, G. W. (1995). *Multimedia technologies for training*. Englewood: Wadsworth Press.

Batanov, D. N., Dimmitt, N. J., & Chookiful, W. (2002). Assisted learning, training and development. *Research and Teaching in Developmental Education, 18* (3), 17-28.

Castells, M. (1996). *Rise of the network society.* Cambridge, MA: Blackwell Publishers.

Clemm, A. (2006). *Network management fundamentals.* Retrieved November 4, 2011, from http//www.ciscopress.com/bookstore/

Comer, D. E., & Stevens, D. L. (1993). *Client-server programming and applications*. Purdue University, West Lafayette: Prentice Hall.

Creswell, J. W. (2003). *Research design: Qualitative, quantitative, and mixed method approaches.* Thousand Oaks, CA: Sage Publications.

Crobach, L. J. (1951). Coefficient alpha and internal structure of tests. *Psychometrika, 16,* 297-334.

Cuban, L. (2001). *Oversold and underused computers in the classroom* .Cambridge, Massachusetts: Harvard University Press.

Darkey, E. (2004, Aug.10). ICT and Development. *Daily Graphic (*No. 167742), p.9.

Deming, E. W. (1990). *Sample design in business research*. New York, NY: John Wiley and Sons.

Ely, D. P. (1993). Computers in schools and universities in the United States of America. *Educational Technology*, *33*(9), 53 – 57.

Ghana Poverty Reduction Strategy (2009). *Education Strategic Plan* (2009). Retrieved November 5, 201, from http//www.imf.org/external/pubs/ft/scr/2009/cr09237.pdf

Glatthorn, A. A. (1998). *Writing the wining dissertation step by step*. California: Saga Publications.

Gooden, A. R. (1996). *Computers in the classroom*. New York: Apple Inc.

Gokhale, R. (2001). Perspective of ICT and sustainable development. *African Journal of AYF/BGP Organization,* *5*(23), 12-21.

Government of Ghana ICT Report (2003): *Ghana ICT for Accelerated Development Policy* (2003). Retrieved February 6, 2012, from http://www.moc.gov.gh/moc/PDF's/Ghana ICT4AD policy.pdf.

79

Government of Ghana ICT Report (2005): *Ministerial ICT Policy Statements* (2005). Retrieved March 23, 2012, from http//www.irmt.org/documents/building.../IRMT_Case_Study_Ghana.pdf

Hag, S., & Keen P. (1996). *Information technology tomorrow's advantage today*. Irwin: McGraw-Hill Book Company.

Haralambos, M., & Holborn, M. (2000). *Sociology: Themes and Perspectives*. London: Harpercollins Publishers.

Hutchingson, S. E., & Sawyer, S. C. (1999). *Computers, communication and information* (2nd ed.). Irwin: McGraw-Hill Book Company.

Kee, E. (2010). *Networking illustrated.* Indianapolis: Que Corporation.

Kozma, R. B. (1994). Will media influence learning? Reframing the debate. *Educational Technology Research and Development, 42* (2), 7 – 19.

Krampa, P. (Executive Producer). (2012, November 13). *Basic school computerization project in Ghana* [Television Broadcast]. Accra, Ghana: Joy TV Broadcast Service.

Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement, 30*, 607-610.

Kufuor, J. A. (2007). *The New Education Reform programme in Ghana*. Retrieved January 24, 2012, from http://www.ghanaweb.com/GhanaHomePage/education/artikel.php

Lowe, D. (1994). *Networking for dummies*. San Mateo, CA: IDG Books Worlwide, Inc.

Mangesi, K. (2007). *Ministry of Education, Youth and Sports ICT in education policy framework*. Retrieved February 22, 2012, from http://www.infodev.org/en/Document.406.pdf

Mccain, T., & Ekelund, M. (1996). *Computer networking for educators*. Eugene: ISTE Publications.

Mellenbergh, G. J. (2008). *Surveys on research methods*. Huizen, The Netherlands: Johannes van Kessel Publishing.

Mooij, T., & Smeets, E. (2001). Modeling and supporting ICT implementation in secondary schools. *Computers and Education, 36*, 265 – 281.

MOE ICT Report (2006). *Review of ICT policy on education*. Retrieved December 22, 2011, from http://www.vibeghana.com/moe/review-ict-policy

MOE Survey (2009). *ICT Situation in schools*. Retrieved November 3, 2011 from http//www.census.gov/econ/ict/forms/2009/icts.pdf

Muller, S. (1996). *Upgrading and repairing PC* (6th ed.). New York, USA: Que Corporation.

National Youth Policy of Ghana (2010). *Towards an empowered youth, impacting positively on national development*. Retrieved January, 2012, from http://www.ghana.gov.gh/documents/nypolicy.pdf/

Noe, R. A. (1999). *Employee training and development*. New York: McGraw Hill Book Company.

Nunnally, J. C. (1978). *Psychometric theory* (2nd ed.*)*. New York: McGraw-Hill, O'Reilly and Associate Inc.

Nyarko, E. (2007). *Developing ICT enabled education-the future for Ghana*. Retrieved January 22, 2012, from http://www.iconnectonline/

Oppenheimer, P. (2004). *Top-down network design*. Indianapolis: Cisco Press.

Pelgrum, W. J. (1996). *Information technology and children from a global perspective.* Mahwah, NJ: Erlbaum Press.

Pinnington, A., & Edwards, T. (2000). *Introduction to human Resource*. New York: MacMillan Publishers.

Procurement Act (2003, Act 663). Public Procurement Board for schools (2003). Retrieved February 20, 2012, from http//*www.ppbghana.org/documents/FINALMANUAL_PPB.pdf*

Salant, P., & Dillman, D. A. (1994). *How to conduct your own survey*. New York, NY: John Wiley & Sons.

Sales of computers and LAN equipment. (2010, July 27). *Daily Graphic (*No. 169544), p.20.

Sampana, J. (2010). *Pro-forma invoice for LAN in schools*. Retrieved March 20, 2012, from http//www.tbsghanaltd.com/ *tbs_document.pdf*

Sasser, S., & McLaughlin, R. (1994). *Fix your own LAN.* New York, NY: McGraw Hill Book Company.

Schnaidt, P. (1990). *LAN tutorial.* San Francisco, CA: Miller Freeman Publications.

Sharma, C. K. (2005). Implementing VAT in India: Implications for Federal Polity. *Indian Journal of Political Science, LXVI* (4), 14-16.

Sheldon, T. (1994). *LAN TIMES: Encyclopedia of networking.* Berkeley, CA: McGraw-Hill Book Company.

Shelle, G. B. (2008). *Discovering computers (2008).* Boston, MA: Allyn & Bacon Publishing.

Stallings, W. (2005). *Operating systems, internals and design principles*. Pearson: Prentice Hall.

Stuart, A. (1962). *Basic ideas of scientific sampling*. New York: Heffner Publishing Company.

Sulberger (2001). Internet service provider and communications solutions in Ghana. *International Finance Corporation, World Bank, 2*(3), 1-5.

Tait, A. (1988). *Value Added Tax: International Practice and Problems*. Washington: International Monetary Fund.

Tomei, L. A. (2005). *Taxonomy for the technology domain*. New York, USA: Information Science Publishing.

UNDP ICT Report (2006). *Financing* ICTs *for development efforts*. Retrieved January 30, 2012, from

http://www.hdr.undp.org/en/nhdr/support/thematic/ict4d/

Weimer, J. (1995). *Research techniques in human engineering*. Englewood Cliffs, NJ: Prentice Hall.

Zhao, Y., & Cziko, G. A (2001). Teacher adoption of technology: Perceptual control theory perspective. *Journal of Technology and Teacher Education, 9,* 5 – 30.

Descriptive Statistics Results for Student Population and Number Per Class

Statistics	Student population	Number of students per class
Mean	1917	52
Median	1957	51
Mode	2500	50
Minimum	1000	45
Maximum	2720	60

Source: (Fieldwork, December, 2011)

APPENDIX B

Descriptive Statistics Results for Percentage (%) Equipment Availability

Statistics	Percentage(%) Equipment Availability
Mean	76.9
Mode	85.0
Minimum	60.0
Maximum	85.0

Source: (Fieldwork, December, 2011)

APPENDIX C

Descriptive Statistics Results for Users' Knowledge on Cost Involved in Setting Up the Local Area Network

Statistics	Hardware (GH¢)	Software (GH¢)	Facilities and Renovation (GH¢)	Optional equipment (GH¢)	LAN installation (GH¢)
Mean	28306.04	2861.24	10157.46	6554.57	1701.39
Median	28327.00	2864.00	10125.00	6560.00	1700.00
Mode	28850.00	2788.00	10125.00	6560.00	1800.00
Minimum	25054.00	2728.00	9600.00	6400.00	1580.00
Maximum	31600.00	3000.00	10650.00	6700.00	1800.00
Mode %	18.9%	18.9%	26.9%	20.90	35.3%

Source: (Fieldwork, December, 2011)

APPENDIX D

Descriptive Statistics Results for Users' Knowledge on Operational Cost of LAN Per Year

Statistics	Management (GH¢)	Connectivity (GH¢)	Component Replacement (GH¢)	Maintenance (GH¢)	Professional Development (GH¢)	Electricity bill (GH¢)
Mean	922.63	1203.35	1713.11	2378.35	1192.83	3031.17
Median	900.00	1200.00	1726.00	2380.00	1260.00	3033.00
Mode	900.00	1200.00	1726.00	2380.00	1300.00	3033.00
Minimum	300.00	875.00	1452.00	2310.00	750.00	3000.00
Maximum	1500.00	1680.00	2000.00	2450.00	1350.00	3066.00
Mode %	20.9%	50.2%	23.9%	42.8%	33.8%	42.8%

Source: (Fieldwork, December, 2011)

APPENDIX E

**Descriptive Statistics Results for Users' Knowledge on Money Paid towards
ICT development in the School**

STATISTICS	Money Parents Pay (GH¢)	Money School Contributes (GH¢)	Money Received as Donations (GH¢)
Mean	9.90	949.32	508.85
Median	9.00	1200.00	500.00
Mode	9.00	1400.00	0.00
Minimum	9.00	0.00	0.00
Maximum	15.00	1500.00	1500.00
Mode %	77.1%	22.4%	41.3% (none)

Source: (Fieldwork, December, 2011)

APPENDIX F

Public Senior High Schools Selected for the Study

Serial number	Name of public School	Number of school heads	Number of ICT teachers
1	Adventist Senior High School	1	8
2	Ghana Armed Forces Senior High School	1	6
3	Anglican Senior High School	1	7
4	Asanteman Senior High School	1	6
5	Kumasi Academy Senior High School	1	6
6	Kumasi Girls Senior High School	1	5
7	Kumasi High School	1	7
8	Kumasi Senior High Technical School	1	5
9	Wesley Girls High School	1	4
10	Opoku Ware Senior High School	1	9
11	St. Louis Senior High School	1	6
12	Osei Kyeretwie Senior High School	1	5
13	Prempeh College	1	9
14	T.I. Ahmadiyya Senior High School	1	9
15	KNUST Senior High School	1	5
16	Yaa Asantewaa Girls Senior High School	1	5
17	Serwaa Nyarko Senior High School	1	5
18	Kumasi Technical Institute	1	8
19	Presbyterian Girls Senior High School	1	5
20	University of Ghana Senior High	1	6
	Total	**20**	**126**

Source: (Fieldwork, December, 2011)

Private Senior High Schools Selected for the Study

Serial number	Name of public schools	Number of school heads	Number of ICT teachers
1	Pentecost Senior High School	1	3
2	Angel Educational Complex Senior High	1	5
3	Ideal college	1	4
4	Manceils Vocational Institute	1	3
5	Adebi Commercial Institute	1	3
6	Garden City College	1	4
7	Nigrition College	1	1
8	Catholic Technical Institute	1	5
9	Assemblies of God Senior High School	1	5
10	Faith AG Senior High School	1	4
11	Opoku Ware Vocational Institute	1	2
12	Kings' College	1	6
13	Saint Peters Senior High School (Kumasi)	1	4
14	Central International. Senior High School	1	3
15	Prince of Peace Senior High School	1	2
16	Joy Professional Academy	1	2
17	Action Progressive Institute	1	3
18	Akwasi Pong Senior High School	1	5
	Total	**18**	**64**

Source: (Fieldwork, December, 2011)

<u>**QUESTIONNAIRES**</u> *(APPENDIX H)*

SECTION A:

Demographic Characteristics of Respondents and school background

1. Are you a male or female?   Male [   ]   Female [   ]

2. How old are you? _____(*age in years*)

3. Which working category do you belong?

    Government Employee [   ]   Private Employee [   ] Pensioner on contract [   ]

4. What is your position in the school?

    ICT teacher [   ]   ICT coordinator [   ]   School head [   ]

5. What is your rank in the education service?

    Principal Supt. [   ]   Assistant Director [   ]   Deputy Director [   ] Others [   ]

6.   How long have you been in teaching ? _____(*age in years*)

7. What is the student population of this school? _____

8. What is the average number of students per class?_____

9. Which concept of computers in education is employed in your school?

Centralized Computer Laboratory Model [   ]   Diffused classroom model [   ]

SECTION B:

Categories of affordable equipment and services required to set up a local area network (LAN) with internet connectivity?

10.   In the list provided below, indicate by ticking [√] those that are affordable to your school.

Degree of Affordability	Affordable Equipment and Services to schools								
	Com-puters	Scan-ners	Prin-Ters	Copiers	LAN Hardware	Internet	Vacuum Cleaner	Air Con	Others
Never									
Often									
Sometimes									
Always									

SECTION C:

Equipment or infrastructure already available to the schools for local area network (LAN) formation.

11.   On the average, what percent of the affordable L A N equipment are already available to the school? _____%

12.   Which LAN equipment is most available to the school? _____   and, which is least available? _____

13.   Which major operating system is used for the LAN?

    Novel NT [   ]   Linux [   ]   Windows [   ]

14.   Which office software is used for the LAN?

    Licensed office [   ]   Opened office[   ]   Both licensed and Opened [   ]

15.   What computer model is available in the school?

    Pentium III & below[   ]   Pentium III & IV[   ]   Pentium IV & above[   ]

SECTION D:

The cost involved in setting up a local area network (LAN) with internet connectivity for a high populated school

16.   What amount of ICT budget is spent on Hardware(annualized investment per school) per year?   GH¢ _____

17.   What amount of ICT budget is spent on Software(annualized investment per school)? GH¢ _____

18.   What amount of ICT budget is spent on Facilities and Renovation (annualized investment per school)? GH¢ _____

19.   What amount of ICT budget is spent on optional equipment(fax, resograph, telephone systems, webcam, camcorder, tv, radio, etc.)? GH¢ _____

20.   What amount of ICT budget is paid to a technician for LAN installation or wiring? GH¢ _____

21.   In the list provided below, indicate by ticking [√] those that are applied to your school.

Questions	Never	Some times	Often	Always
21a. How often is the school aware of price of some ICT or LAN equipment on the market?				
21b. How often is the school aware that prices of ICT or LAN equipment are falling worldwide?				
21c. How often is the school able to follow procurement rules when purchasing LAN equipment and services?				
21d. How often does the school demand warranty cover for the LAN equipment and services purchased?				
21e. How often does the school request for reduction offer for LAN equipment and services purchased?				
21f. How often does the school demand VAT/NHIL receipts for LAN equipment and services purchased?				
21g. How often does the school consult expert's advice prior to the purchase of LAN equipment and services?				

SECTION E:

Operational Cost of running the LAN per year

22. What amount of ICT budget is spent on Central Management (planning and recurrent) per year? GH¢ _____

23. What amount of ICT budget is spent on Connectivity per year? GH¢_____

24. What amount of ICT budget is spent on Component Replacement and Repairs per year? GH¢ _____

25. What amount of ICT budget is paid to a technician for Maintenance and Technical Support per year? GH¢ _____

26. What amount of ICT budget is spent on Professional Development(annualized investment and recurrent)?   GH¢ _____

27. What amount of ICT budget is spent on electricity bill for the LAN per year?

GH¢

28.   How often do you replace LAN components and accessories?

1-2 years [   ]   3-5 years[   ]   5 year and above [   ]

29. Which ICT competency are you most familiar with?

i._____ ii. _____ iii._____iv._____

SECTION F:

 Funding sources and Cost saving strategies

30.   How much money per student does a parent pay towards ICT development in the school? GH¢ _____

31.   How much is contributed by the school per year into ICT fund? GH¢

_____

32.   How much money is received per year as donations outside the school to the ICT fund?   GH¢ _____

33.   What is the school's main source of LAN or ICT funds?

PTA [   ]   The School [   ]   Government [   ]   Others [   ]

34.   Who pays for replacement and repairs of the LAN?

PTA [   ]   The School [   ]   Government [   ]   Others [   ]

35. Who pays for the internet connectivity in the school?

PTA [   ]   The School [   ]   Government [   ]   Others [   ]

.   Please tick [√] only one option for each statement. The legend used are SA,

A, U, D, SD means Strongly Agreed, Agreed, Undecided, Disagreed, and Strongly

Agreed respectively:

Statements	SD	D	U	A	SA
36a. PTA levy for school ICT development should be increased.					
36b. More school funds should be allocated for LAN or ICT.					
36c. ICT policy of the school and the Ghana Education Service should guide the use and development of LAN.					
36d. School fund raising activities should target LAN development.					
36e. Separate account should be opened for ICT funds in schools.					
36f. Signatories to the ICT account should involve the school head the ICT coordinator.					
36g. The account should be subjected to annual audit checks.					