

UNIVERSITY OF CAPE COAST

**USAGE OF COMPUTERS AND INTERNET FOR TEACHING AND
LEARNING MATHEMATICS: A CASE STUDY OF SELECTED
SENIOR HIGH SCHOOLS IN THE GREATER ACCRA REGION OF
GHANA**

PAUL MARK ABLORH

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HIGH SCHOOLS IN THE GREATER ACCRA REGION OF GHANA

BY

PAUL MARK ABLORH

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of Education, University of Cape Coast, in partial fulfillment of the
requirements for award of Master of Education Degree in Information
Technology

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DECLARATION

Candidate's Declaration

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

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

Name: Paul Mark Ablorh

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 was conducted to establish the level of ICT usage among teachers and students in the teaching and learning of mathematics in senior high school in the Greater Accra region.

To carry out such a research entails a careful study of what others have done and what also pertains on the ground. To achieve this, a thorough review of literature was carried out and questionnaire was used to solicit information from 300 respondents (250 students and 50 teachers) who were selected from five (5) public senior high schools through random sampling.

The study revealed that most of the respondents have access to internet and computers. However, most of the computer and the internet users do not use them for teaching mathematics (in the case of teachers) or learning mathematics (in the case of students).

It is recommended that mathematics teachers in Senior High Schools should be equipped with the necessary know-how to be able to teach mathematics effectively and efficiently using ICT.

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DEDICATION

To Daniel M. Ablorh, Gifty Noi-Ablorh, Tylord Ablorh, Jislord Ablorh,
Eunice Ablorh-Badu, Rhoda Ablorh and the entire Ablorh and Noi family.

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CHAPTER ONE

INTRODUCTION

Background to the study

The driving force of the information revolution and the information society has to do with development, diffusion and use of information and communication technologies (ICTs) in contemporary societies. The diffusion of ICTs has contributed enormously to the growth of economies in developed nations. Developing nations are earnestly facilitating policy frameworks to ensure an equitable diffusion of these technologies (Beyerbach, 2001).

ICTs refer to the various technologies that enhance the creation, storage, processing, communication and dissemination of information. ICTs also refer to the different infrastructures used in these processes, their applications and the numerous services these infrastructures render (Sutherland-Smith, Snyder & Angus, 2003). The following technologies are the elements of ICTs:

1. Media of Communication (e.g. radio, television),
2. Information machine (e.g. Computers),
3. Telecommunications technologies and equipment (Satellites, fiber optic cables, phones, Facsimile machines).

The development in telecommunications has impacted enormously on the applications of ICTs and their uses. Telecommunications technologies, coupled

with computer technology have enhanced network-based information and communication platforms, such as the internet. Telecommunications infrastructures in particular have become the driving force of ICTs. They have the capability to link various ICT elements together irrespective of locations and to provide a converging platform for these elements. The convergence of the various elements of ICTs has enhanced development in all spheres of human activities. Advanced microelectronics-based information and communication technologies (ICTs) are at the heart of recent social and economic transformations in both the industrialised and many developing nations (Marshall, 1993).

In 1995 and 1997, the United Nations Commission on Science and Technology for Development (UNCSTD) investigated the benefits and risks of ICTs. The result of this investigation showed many instances where the use of ICTs affords widespread educational, social and economic benefits. There were also many instances where ICTs were making no differences in the lives of people in the developing countries. The result also showed that the diffusion of these technologies is extremely uneven throughout the developing world. As a result of this, there is a high risk that technologies and services will deepen the disadvantages of those without the skills and capabilities to make the investments required for building innovative ICT-based societies (Marshall, 1993).

According to the European Commission, the importance of ICTs lies less in the technology itself than in its ability to create greater access to information and communication in underserved populations. Internationally, the United

Nations actively promotes ICTs for Development as a means of bridging the digital divide.

Early electronic computers were the size of a large room, consuming as much power as several hundred modern personal computers. Today, computers can be made small enough to fit into a wrist watch and be powered from a watch battery. Society has come to recognize personal computers and their portable equivalent, the laptop computer, as icons of the information age; they are what most people think of as "a computer". However, the most common form of computers in use today is by far the embedded computer. Embedded computers are small, simple devices that are often used to control other devices—for example; they may be found in machines ranging from fighter aircraft to industrial robots, digital cameras, and even children's toys.

In recent years, there has been a groundswell of interest in how computers and the Internet can best be harnessed to improve the efficiency and effectiveness of education at all levels and in both formal and non-formal settings. But ICTs are more than just these technologies. Older technologies such as the telephone, radio and television, although now given less attention, have a longer and richer history as instructional tools. For instance, radio and television have for over forty years been used for open and distance learning, although print remains the cheapest, most accessible and therefore most dominant delivery mechanism in both developed and developing countries. The use of computers and the Internet is still in its infancy in developing countries, if these are used at all, due to limited infrastructure and the attendant high costs of access.

The Open University of the United Kingdom (UKOU), established in 1969 as the first educational institution in the world wholly dedicated to open and distance learning, still relies heavily on print-based materials supplemented by radio, television and, in recent years, online programming. Similarly, the Indira Gandhi National Open University in India combines the use of print, recorded audio and video, broadcast radio and television, and audio conferencing technologies. A good way to think about ICT is to consider all the uses of digital technology that already exist to help individuals, businesses and organizations use information.

ICT covers any product that will store, retrieve, manipulate, transmit or receive information electronically in a digital form, for example, personal computers, digital television, email, robots. So ICT is concerned with the storage, retrieval, manipulation, transmission or receipt of digital data. Importantly, it is also concerned with the way these different uses can work with each other. In business, ICT is often categorised into two broad types of products. These are:

1. The traditional computer-based technologies (things you can typically do on a personal computer or using computers at home or at work); and
2. The more recent and fast-growing range of digital communication technologies (which allow people and organizations to communicate and share information digitally).

Statement of the Problem

Many countries around the world have established organizations for the promotion of ICTs, because it is feared that unless less technologically advanced

areas have a chance to catch up, the increasing technological advances in developed nations will only serve to exacerbate the already-existing economic gap between technological "have" and "have not" areas. In Ghana, however, it appears the use of computers and the internet in the teaching and learning of mathematics by students and teachers in Senior High Schools is absent despite the enormous benefits that can be derived from the use of such tools in the teaching and learning process. The question therefore is: To what extent do teachers and students in Senior High Schools in the Greater Accra Region of Ghana use computers and the internet in the teaching and learning of mathematics?

Purpose of the Study

The main purpose of this study was to find out the extent to which students and teachers use computers and the internet in the learning and teaching of mathematics. Specifically the objectives of the study are to:

1. Examine the extent of teachers and students use of computers and the internet in the teaching and learning of mathematics.
2. Examine the benefits from the use of computers and the Internet by students and teachers in the teaching and learning of mathematics.
3. Examine the barriers to the use of computers and the Internet by students and teachers in the teaching and learning of mathematics.

On the account of the above objectives, the study aimed at making recommendations for consideration by policymakers to promote computers (ICT) and internet use in teaching and learning of mathematics in Senior High Schools.

Research Questions

In order to find answers to the problem, the following research questions are formulated:

1. What is the level of computer and internet usage by students and teachers in the learning and teaching of mathematics?
2. What benefits do students and teachers derive from the use of computers and the internet in the learning and teaching of mathematics?
3. What are the barriers to the use of computers and the internet by teachers and students in the teaching and learning of mathematics?

Significance of the Study

The outcome of the study would serve as a good basis for determining the impact of ICT on teaching and learning, and whether the findings would benefit the other Senior High Schools in Ghana as a whole. The outcome of the study would also help unearth the competencies, benefits, challenges/barriers that the Mathematics educators required for the technology integration at the S.H.S. level. These required competencies, if lacking, would then be a useful tool in organizing workshops, seminars, in-service training, and conferences for the mathematics educators as and when the need arises.

The study would look at various strategies to remove the barriers that may not promote the effective technology integration at the Senior High School level. Finally, the outcome of the study may serve as a resource material for students and researchers who may undertake similar studies in future.

Delimitation of the Study

The problem of computers and internet usage is a broad one. However, this study is being confined to the usage of the internet and computers for teaching and learning mathematics in selected high schools in the Accra metropolis of the Greater Accra Region. The study specifically sampled the views, perceptions and experiences of teachers and students in the area of computers and internet usage and how these tools affect their teaching and learning of mathematics in particular.

Limitations of the Study

The study on the usage of computers and internet in the teaching and learning of mathematics in senior high schools in the Greater Accra Region of Ghana should have been broadened to cover all the schools in the region. However, financial difficulties made it impossible leading to the use of a small sample size compared to the actual number of teachers and students in the Greater Accra Region. This is likely to have effects on generalization. Also, the use of questionnaires limited respondents in their responses. A number of questionnaires were also not returned to the researcher to know the views of all the respondents sampled.

Definition of Terms

For the purpose of this study, the following concepts require operational definitions:

ICT (information and communications technology - or technologies) is an umbrella term that includes any communication device or application,

encompassing: radio, television, cellular phones, computer and network hardware and software, satellite systems, as well as the various services and applications associated with them, such as videoconferencing and distance learning.

Teleconferencing refers to interactive electronic communication among people located at two or more different places.

Audio conferencing involves the live (real-time) exchange of voice messages over a telephone network.

Videoconferencing allows the exchange not just of voice and graphics but also of moving images.

Organisation of the Rest of the Study

The remaining chapters of the dissertation are organized as follows:

Chapter two is a review of related and relevant literature. Both theoretical and empirical review of literature has been undertaken. Chapter three dealt with the research methodology. It focuses on the research design, population, sample and sampling procedure, research instrument, data collection and data analyses procedures. Chapter four dealt with the results and discussion of the data collected and analysed. Chapter five dealt with summary, conclusion and recommendations.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

Overview

Today, as in earlier times, there is much rhetoric about the revolutionary impact on student learning that will result from bringing a new technology into the classroom. In the past it was the motion picture, the radio, the teaching machine, and instructional television. None of these fulfilled expectations; teachers used them occasionally or, when they were used regularly only occupied a small niche in the school day. Currently, it is the computer that is believed to herald a new era of more effective learning. With respect to the mathematics classroom, too, computers are claimed to have the potential to change pedagogical approaches radically, and to improve student learning outcomes.

Teachers' beliefs about how children learn mathematics effectively and the pedagogical approaches they adopt appear to be related to their beliefs about the effectiveness of computers and their implementation in the mathematics classroom. Confidence and skill levels are also implicated. Bender (1994) reported findings from a trial of an integrated learning system. The integrated learning system was considered inconsistent with contemporary notions of effective teaching and learning of mathematics. Teachers who endorsed the integrated learning system had more limited knowledge about computers and

held more traditional pedagogical beliefs about effective mathematics teaching than teachers who disapproved. Students with less computer experience found the integrated learning system an exciting experience (Beyerbach, 2001). Reported that British primary teachers' and students' personal confidence levels with Information and Communication Technology seemed strongly related to student achievement outcomes and confidence was related to ICT skill levels. Effective teachers who used ICT were confident and comfortable with ICT.

Many resources that were once distributed to individuals in hard copy are now available on the Internet, including newspapers, magazines, and scholarly journals. In this age and time, computer knowledge is a must. The computer networks these days have a powerful impact on the ways by which individuals and private organizations can communicate with each other. ICT currently provides a growing range of tools to manipulate digital data, as well as access to the vast range and variety of content. The following major areas will be reviewed or discussed:

1. Information and Communication Technology (ICT)
2. Tools for information and communication
3. Computer technology
4. Environment for ICT facilities
5. Accessibility of ICT
6. Policy frameworks for ICT implementation
7. Educational resources
8. Determining Effective Goals for Technology Use

9. E-learning

10. Accepting New Roles for Teachers in the Classroom

Application of Information and Communication Technology (ICT) in schools

11. Software usage for learning mathematics

12. Placing Computers for Equitable Access

13. Providing Technical Support

14. Promoting the use of ICT

15. Methods of developing ICT skills

16. Barriers related to the use of Computers

Theoretical Foundation

Use of Information and Communication Technology (ICT)

Information and Communication Technology (ICT) encompasses the effective use of equipment and programs to access, retrieve, convert, store, organize, manipulate and present data and information (Gay, 1992). The increased use of computers and the level of Internet access by businesses and individuals alike is an important measure of technological development. Governments also measure this development in areas such as education and health. This development has been heavily influenced by the introduction of formal and informal ICT training, whether conducted in the workplace, through an institution, or by self training.

Training therefore is of paramount importance as current and future employees are expected to be adequately skilled in ICT. Online learning, using ICT and e-learning, have become the norm across tertiary educational institutions

where students have been identified as stakeholders in the development and implementation of e-online learning (Lim, 2001). To support online learning, administrative and faculty offices at universities utilize substantial proportions of their budgets to provide this technology for their students in the learning process. It can be said that in Ghana, ICT can be used in the educational, health, manufacturing, agriculture, business and industrial sectors

Tools for Information and Communication

Radio

Radio is a tool for information and communication. Radio is a fairly inexpensive and pervasive technology, yet it is often overlooked as a tool for development information and communication (Ismail, 2002). In recent years, small community radio stations, which typically have a limited reception range, have increasingly been involved in broadcasting locally relevant development messages, such as health, nutrition, or civic participation (Obonu FM in Accra, Volta star in Ho). Some countries (such as Tanzania and Kenya) use a methodology called interactive radio instruction to provide educational instruction in remote areas where teachers are under-trained or unavailable. In addition, satellites can now provide radio reception to remote areas that were previously beyond reception range. It can be inferred that rural communities in Ghana can implore radio broadcasting to disseminate information to inhabitants of those communities as a way of educating them on social, political and health issues

Television

Television is another tool for information and communication. Television signals are increasingly being used to broadcast relevant developmental messages and to educate the populace who hitherto will have no access to classroom education. In areas beyond broadcast range, signals are often receivable using satellite dishes. In addition, video has become a fairly inexpensive and common technology. Movies or videos with development messages can be shown in the most remote areas using a portable generator or car battery. Visual images such as video, whether it is used for microteaching for interactive teacher training, or showing videos on effective health and nutrition practices —can be a very effective development tool (Folson, 1995). In Ghana, an example of the use of Television as a tool for education is the Presidential initiative on distance learning .This affords students the opportunity to benefit from learning from classroom teachers who are far out of their reach .This television broadcast can be recorded on video compact discs and showed to rural communities who may not have the benefit of direct television signals

Computer technology

There are several variations of computer technology. A basic level would involve a standard computer, monitor, and perhaps printer, with basic word processing, spreadsheet, and database software.

Depending on the processing speed of the computer, software might also be available on CD-ROM. Spreadsheet and database software alone can improve efficiency in organizational record keeping (Hawkins, 2002). An additional level

of computer technology is e-mail. The demand for e-mail access has expanded exponentially because of its ability to provide expanded communication possibilities — particularly across great distances quickly and at a relatively low cost. Another level of computer technology is Internet connectivity, which allows access to the World. In Ghana, CD-ROMs can be used as teaching and learning tool where instructors or teachers in a specialized field will record their tutorials on the CD-ROMS and make it available to learners to use at their convenient time. Teachers in Ghana can also use e-mail to send tasks, assignments and information to their students without being physically present where the students are. This can take teaching and learning to a notch higher and make teachers and learners to have a more convenient way of teaching and learning. Internet is also a very powerful medium by which teachers and learners in Ghana can use as a valuable source of information.

Environment for ICT facilities

Availability of an appropriate environment for ICT facilities is another issue that will determine accessibility of ICT for schools. Some schools (Presbyterian Boys Senior High School-Legon and Accra High School) have successfully implemented ICT projects because they possess the infrastructure to accommodate ICT equipment donated by benevolent organizations. Inadequate infrastructure is a problem facing many secondary schools. The infrastructure of most schools lacks the appropriate environment and the needed security for storing ICT equipment, even if they become available (Osu Presby Senior High School, and Oreilly Senior High School). Such concerns are also setbacks to ICT

implementation in rural schools (Mfum-Mensah,2003). Computers play a very vital role in education; they are commonly used in school settings, in the home, and in social settings. Children are using computers both at home and in school for educational and recreational purposes (Foster, 1965). Teachers and students in Ghana can be aided to acquire computers at home to supplement those provided in the school environment. The laptop per child program being implemented by the Ghana government currently, if sustained and improved, will go a long way to alleviate the challenge facing teachers and learners in using ICT in teaching and learning due to lack of ICT infrastructure in school and at home.

Accessibility of ICT

Accessibility of ICT in schools also interconnects with other development issues, such as accessibility and connectivity to electricity and telephone grids. The challenges to ICT in rural schools are lack of telecommunication and resources (finance, infrastructure, personnel and their training, software, and textbooks). Since 1998, the government of Ghana has extended electricity to many rural communities in the country. However, many rural communities are yet to be connected to the electricity grid.

Most rural communities that have secondary schools do not currently have access to electricity and telephone services. In such localities, the idea of promoting computers in classrooms will require more financial backing, and a considerable amount of time, considering the pace of development in Ghana. In a recent Ghanaian case study (Ismail, 2002), it became apparent that the high costs for providing electricity (where there is none) and connectivity to telephone services are major setbacks to providing ICT in rural areas in Ghana. The

government can aid such communities by making available mobile vans equipped with the necessary ICT facilities. These fully equipped ICT mobile vans can serve deprived communities in turns and this will help students and teachers in those communities to have the benefits that ICT offers.

Policy frameworks for ICT implementation

It appears that in Ghana there is currently no coordination on national ICT policy. Relevant ministries seem not to be actively involved in policy formulation process. This may be due to lack of human resource capacity to devise and implement an appropriate ICT policy for Ghana (Ismail, 2002).

Many educational ministries around the world have made the commitment to computerize schools but few have developed coherent strategies to integrate its use fully as pedagogical tools in the classrooms (Hawkins, 2002). Despite the above challenges, education policy makers are quite enthusiastic about the introduction of ICT in Ghanaian secondary schools.

The use of ICT in secondary schools is now a policy mandate in the Ghanaian educational system. The government has made the promise to extend computers and Internet services to every secondary school in the nation. The Ministry of Education has developed a curriculum for ICT training. The Ministry has also indicated its plan to include ICT in the Senior High School Certificate Examination. These developments at the policy levels show that ICT will soon become a tool for assessing students' ability and determining their fitness for transition to post-secondary education and employment. This is where the equality of output concept comes into play. (Ismail, 2002)

Nations in the developing world are not the only regions caught in the "digital divide" phenomenon, brought about by ICT implementation. Recently

emergent in-country case studies and other comparative studies point out that even in advanced countries like Australia, Canada, Israel and United States, there is evidence of a persisting digital divide, despite a significant growth in computer ownership and usage overall. In the United States, evidence exists of this disparity between whites on one hand and blacks and Hispanics on the other hand(Sutherland-smith 2003). Similarly, in Canada we find the same problem between rural and urban areas where approximately 53% of rural households have access to the Internet, compared to 68% of urban households (Hawkridge, 1990). There is the need for equitable educational provision in school systems; the emerging revelations pose serious policy implications for governments, educators and the development community. For the Ghanaian society, the disparity in ICT provision in schools can be seen as an example of the digital divide that is likely to be created between the "haves" and "have nots" in the Ghanaian school system. ICT can be incorporated in the training manuals of teacher training colleges in Ghana. This will make trainee of teacher training colleges to be able to use ICT in teaching the various subjects they will be teaching after completing their training. This will make it possible for all teachers after a set time to be able to use ICT fully in teaching.

Educational resources

Since the introduction of formal schooling in Ghana, educational resources (finance, infrastructure, personnel and textbooks) have unequally been distributed in the school system (Foster, 1965). It is critical that policy makers ensure that ICT does not become another tool for perpetuating educational inequalities in Ghana's school system. The use of computers can make business

transactions very accurate, thus keeping a proper record of profit and loss. Computers play a very vital role in education.

The introduction of ICT in school systems in Ghana and other sub-Saharan African nations is a major step to promoting innovation. However, like Ghana, many of these educational systems currently do not have any coherent ICT policy framework in place (Ismail, 2002). ICT when used effectively in the teaching and learning process in Ghana can bridge the gap between those schools that have adequate finance, infrastructure, personnel and textbooks and those that do not have. It is therefore very important for the government in Ghana and stakeholders in educational policy implementation to make it priority to implement ICT integration at all levels of our education.

Determining Effective Goals for Technology Use

Technology is not transformative on its own. Evidence indicates that when used effectively, technology applications can support higher-order thinking by engaging students in authentic, complex tasks within collaborative learning contexts. Instead of focusing on isolated, skills-based uses of technology, schools should promote the use of various technologies for sophisticated problem-solving and information-retrieving purposes (Bitner, 2002).

In other words, new technology can be an appropriate vehicle for promoting meaningful, engaged learning. It allows students to work on authentic, meaningful, and challenging problems, similar to tasks performed by professionals in various disciplines; to interact with data in ways that allow student-directed learning; to build knowledge collaboratively; and to interact with

professionals in the field. Technologies also can be used to promote the development of higher-order thinking skills and allow opportunities for teachers to act as facilitators or guides and often as a co-learner with the students. (Hawkins, 2002)

In the classroom, teachers can develop a myriad of technology-supported engaged learning projects that enable students to solve real-world problems, retrieve information from online resources, and connect with experts. Such projects can be adapted for all grade levels. For example, a teacher can share an author's Web site with young students to help them understand how writers make their stories interesting and fun to read. Students can use e-mail and teleconferencing to connect with experts to solve problems. Students can develop a mock technology company and use the Internet, scanners, and presentation software to plan and deliver speeches to stockholders. (Bitner, 2002)

Before technology can be used effectively for engaged learning, however, the school needs to ensure that the technology supports the educational goals for students. The school's initial task is to develop a clear set of goals, expectations, and criteria for student learning based on national educational standards, a profile of the student population, and community concerns. Then the school can determine the types of technology that will support efforts to meet those goals. In other words, the learning goals should drive the technology use.

Rather than using technology for technology's sake, the school can develop a vision of how technology can improve teaching and learning. For example, word processing and e-mail promote communication skills; modeling software promotes the understanding of science and math concepts; database and

spreadsheet programs promote organizational skills; CD-ROMs and the Internet promote inquiry skills. (Hawkins, 2002).

Various tools help schools determine their proficiency in using technology for engaged learning. The Learning with Technology Profile Tool can be used to compare current instructional practices with a set of indicators for engaged learning and high-performance technology (Hawkins, 2002). From the foregoing it is evident that the Ghanaian educational community can benefit greatly from technology use by analysing the set of technology that we need. The authorities then can determine how the use of those technologies can contribute greatly to the advancement of our educational system and then move swiftly to use them in the Ghanaian educational system for the benefit of all stakeholders.

E-learning

E-learning, which is described as the use of ICT to enhance or support learning and teaching in education, has become increasingly important in tertiary education (Hawkrige, 1990). ICT skills are currently of great interest to governments, businesses and individuals alike. More importantly, it is expected that ICT would be fully integrated into the academic curriculum in order to prepare students for the world of work. ICTs are a potentially powerful tool for extending educational opportunities, both formal and non-formal, to previously underserved constituencies—scattered and rural population groups traditionally excluded from education due to cultural or social reasons such as ethnic minorities, girls and women, persons with disabilities, and the elderly, as well as all others who for reasons of cost or because of time constraints are unable to enroll on campus.

One distinct feature of ICTs is their ability to transcend time and space. ICTs make possible asynchronous learning, or learning characterized by a time lag between the delivery of instruction and its reception by learners. Online course materials, for example, may be accessed 24 hours a day, 7 days a week. ICT-based educational delivery (e.g., educational programming broadcast over radio or television) also dispenses with the need for all learners and the instructor to be in one physical location. Additionally, certain types of ICTs, such as teleconferencing technologies, enable instruction to be received simultaneously by multiple, geographically dispersed learners. That is it enhances synchronous learning (Hakkarainen, 2000).

Teachers and learners no longer have to rely solely on printed books and other materials in physical media housed in libraries (and available in limited quantities) for their educational needs. With the Internet and the World Wide Web, a wealth of learning materials in almost every subject and in a variety of media can now be accessed from anywhere at anytime of the day and by an unlimited number of people. This is particularly significant for many schools in developing countries, and even some in developed countries, that have limited and outdated library resources. ICTs also facilitate access to resource persons - mentors, experts, researchers, professionals, business leaders, and peers-all over the world (Mucherah, 2003).

Networked computers and the Internet are the ICTs that enable interactive and collaborative learning best. Their full potential as educational tools will remain unrealized if they are used merely for presentation or demonstration.

Radio and television have been used widely as educational tools since the 1920s and the 1950s, respectively.

Implementation of e-learning in the Ghanaian educational system can be of tremendous benefit in the following areas:

1. Direct class teaching, where broadcast programming substitutes for teachers on a temporary basis;
2. School broadcasting, where broadcast programming provides complementary teaching and learning resources not otherwise available; and
3. General educational programming over community, national and international stations which provide general and informal educational opportunities.

Accepting New Roles for Teachers in the Classroom

Technology integration brings changes to teachers' instructional roles in the classroom. The teacher's roles in a technology-infused classroom often shift to that of a facilitator or coach rather than a lecturer. Technology use also tends to foster collaboration among students document these and other changes in the dynamics of the classroom (Bramald, 2000).

As students become more self-directed, teachers who are not accustomed to acting as facilitators or coaches may not understand how technology can be used as part of activities that are not teacher-directed. This situation may be an excellent opportunity for the teacher not only to learn from the student but also to model being an information seeker, lifelong learner, and risk taker. Teachers

must become comfortable letting students move into domains of knowledge where they themselves lack expertise, and they must be able to model their own learning process when they encounter phenomena they do not understand or questions they cannot answer (Bramald, 2000).

Learning the new roles and ways of teaching that go hand-in-hand with technology integration requires that teachers have opportunities to participate in an extended process of professional development. Teachers need time to acquire technology skills and develop new teaching strategies for integrating technology into the classroom. Except for occasional in-service programs, teachers often have no time built into the school day for their own professional development (Bramald,2000).

Professional development time is especially important when teachers are learning new technology skills, notes. This time for learning is especially important as schools incorporate information and multimedia technologies into the classroom. When a school proposes to install these technologies, each teacher must become adept at their use, identify appropriate hardware and software for his or her subject matter and students, and sit down to work on the computer. Learning to use new technologies well is accomplished best when teachers have time available to learn in a variety of ways. Teachers need large blocks of time to gain initial familiarity with new hardware or software, learning and practicing for sustained periods. Time to observe an experienced user model an application in his or her classroom, time to design a new hypermedia stack, or time for group reflection on a recently tried application--all recommended approaches to

professional development--should be made available every day (Mucherah, 2003).

When professional development activities are conducted after school, teachers may not have the energy necessary for engaging in learning. It's least effective when it's done at the end of the school day. Some researchers advocate embedding professional development time into the school day and school year to maximize its impact. Strategies for professional development time include freed-up time, restructured or rescheduled time, common time, better-used time, purchased time, and volunteer time (Mucherah, 2003).

I am of the opinion that, the successful implementation of ICT in the Ghanaian educational system hinges firmly on the shoulders of teachers. It is therefore very important that the professional development of teachers in the area of ICT should be paramount. The training of teachers in ICT skills can be done as part of an in-service training where teachers take some time or days off their normal schedule and get involved seriously in the training programme. Teachers can also undertake the training as a weekend course where during the weekends; they are seriously engaged in the training programme. Alternatively, teachers who do not have the requisite ICT skills can be required to go on study-leave to be able to acquire the relevant and needed skills.

Application of Information and Communication Technology (ICT) in schools

The application of Information and Communication Technology (ICT) in schools is perceived as a means for transforming teaching and learning processes,

and has thus been met with significant enthusiasm (Ismail, 2002). Ghana perceives ICT as a tool that will promote socioeconomic, political, and sustainable development. Education policymakers in Ghana have hailed the introduction of Information and Communication Technology (ICT) in Ghanaian schools as a remarkable step that will contribute to knowledge production, communication and information sharing among students and teachers in the school system. This perception stems from assertions in the literature about the benefits that come with ICT literacy in schools (Mucherah, 2003).

Hakkarainen et al (2000) point out that ICT is a transformative tool and its full integration into the school systems is necessary to prepare students for the information society they will inherit. Passey (1993) points out that many secondary schools in Ghana can now boast of computer labs through which students are gaining basic computer literacy. A number of these schools have Internet capabilities, enabling students to deepen their connection to the outside world. Although this is encouraging information, extensive review of documents of NGOs that are spearheading ICT implementation in Ghanaian schools reveals that most secondary schools now benefiting from ICT are either located in urban areas or are classified as premier secondary schools (Hawkins, 2002).

According to Passey (1997) computer literacy education in Ghana has been concentrated in major urban areas. A few better schools in outlying areas have attempted to "catch up" with their urban counterparts by contracting with private companies to provide computer education. The costs for private computer training are prohibitive and it is rarely if ever the case that all students have

access. Other schools have taken part in the Ghana Education Service sponsored scheme where for every hundred textbooks they purchase from a private firm, they receive one computer system.

Farrant (1994) posits that among those who have reached a given level of the school system, children who are rural or those from marginalized groups learn less. Will the school system be able to ensure that students who are at the same level of the secondary system are provided with the same ICT knowledge and skills? The history of Ghana's educational development and recent case studies all point to the fact that the distribution of educational resources especially, material inputs, teaching personnel, and well-equipped facilities, have always been skewed in favor of some section of the society (Folson, 1995; Glewwe and Jacoby, 1994; Graham, 1971; Mfum-Mensah, 2003). These educational resources pointed out above have direct effect on students' acquisition of knowledge and learning, and hinder equal implementation of ICT policies.

Many urban secondary schools in the nation have now implemented ICT as part of their schools curriculum. However, most secondary schools in rural areas do not yet have access to ICT. Students in schools that have ICT facilities are using this tool for projects and are able to connect with schools around the world. Through ICT students and teachers in these schools are contributing to the knowledge production and information sharing with other students and teachers around the world.

Analysis of the NGO documents and other emerging case studies in Ghana reveal some interesting themes, which we need to consider in the light of

equality of output. First, the implementation of ICT has resulted in positive impacts in secondary schools that have ICT programs. Second, the dimension of impact extends to include students and teachers. Third, the provision of technical support for ICT has been a challenge for its effective implementation (Ismail, 2002). The World Bank impact assessments reveal that through ICT, students in Ghanaian schools have gained knowledge and skills.

The literature and other emerging Ghanaian case studies on ICT implementation reveal that technical support is a challenge to ICT implementation (Ismail, 2002; Ministry of Education, 1999). This body of literature points out that the major challenge for schools that have ICT is lack of resources and proper implementation by trained personnel. There is the probability that the distribution of educational resources will skew in favor of those in urban schools (Folson, 1995; Glewwe and Jacoby, 1994; Mfum-Mensah, 2003). It is most likely that a situation will be created where schools that have the technical support will get comparative learning advantages over those without, therefore creating a digital divide in the school system.

In order to promote the study of science in Ghanaian schools, science resource centers were built across the length and breadth of the country. In the same vein, ICT resource centers can be developed across the country where a number of schools are grouped under one well developed ICT resource center. Those schools in the group who are far away from the ICT resource center will be provided with buses to convey them to the ICT resource center at their scheduled days of visiting the center. I firmly believe that when such a

programme is well implemented, the seemingly gap between the well-endowed schools and the less endowed schools will be bridged.

Teleconferencing

Teleconferencing is used in both formal and non-formal learning contexts to facilitate teacher-learner and learner-learner discussions, as well as to access experts and other resource persons remotely. In open and distance learning, teleconferencing is a useful tool for providing direct instruction and learner support, minimizing learner isolation. (Beyerbach, 2001). For instance, an audio graphic teleconferencing network between Tianjin Medical University in China and four outlying Tianjin municipalities was piloted in 1999 as part of a multi-year collaboration between Tianjin Medical University and the University Of Ottawa School Of Nursing funded by the Canadian International Development Agency. The audio graphic teleconferencing network aims to provide continuing education and academic upgrading to nurses in parts of Tianjin municipality where access to nursing education has been extremely limited. Other higher education institutions using teleconferencing in their online learning programs include the Open University of the United Kingdom, Unitar (Universiti Tun Abdul Ruzak) in Malaysia, Open University of Hong Kong, and Indira Gandhi National Open University (Beyerbach, 2001).

The Ghana government through the appropriate agencies such as the ministry of education can use Teleconferencing in both formal and non-formal learning contexts to facilitate teacher-learner and learner-learner discussions, as well as to access experts and other resource persons remotely. This will act as a

useful tool for providing direct instruction and learner support in the teaching and learning process.

Software usage for Learning Mathematics

Wong (1999) found that of 10 discipline-based categories of teachers at the secondary level in the USA, mathematics teachers were the second lowest users of computers in their classrooms after Fine Arts teachers. Among mathematics teachers at the secondary level skill practice games, was the category of software most frequently reported to be used. This was followed by simulations environments, internet browsing, and word-processing. Software considered most valuable for students were Geometer's, ClarisWorks, Excel (spreadsheet), Math Blaster, M.Word (word-processor) and Netscape (Internet browser). While secondary school teachers used a range of generic software such as spreadsheets and desktop publishing as well as specific educational packages, word-processing dominated their use of ICT. Other forms of ICT such as Internet, e-mail, computer conferencing, video conferencing, fax, digital scanner and digital camera were used relatively little (Wong, 1999)

In Ghana, the apparent lack of use of software in the teaching and learning process can be due to the high cost of the needed software, the availability of the software and the suitability and appropriateness of the software for teaching and learning. Teachers in Ghana must be adequately trained such that, they will be able to apply effectively the available software for teaching and learning, and where possible develop their own software for teaching and learning

Placing Computers for Equitable Access

Access to technology is an important issue for teachers and students. Although schools may have computers available, one factor that determines their use is where those computers are located. If computers are connected to the Internet but are not in a convenient location, the availability to students and teachers will be limited. To make the best use of limited connections and equipment, schools can explore various strategies for allocating computers (Ismail, 2002)

The standard computer lab is commonly used in schools. If the use of the computer lab is carefully scheduled, it will provide high equipment utilization; on the other hand, keeping the computers in one place may be a barrier to using them on a continual but intermittent basis as a part of the curriculum.

Some schools prefer to place computers in the regular classroom. These computers often are distributed through incremental roll out. In incremental roll-out, technology is given to a limited number of classrooms at first and then expanded to an additional classroom each year. Sometimes the computers are distributed on a class-by-class basis with lower class first and upper class later receiving the most up-to-date equipment. This approach requires continual, yearly funding(Ismail, 2002).

In Ghana, most of the head of institutions or those in charge with the responsibilities of ensuring the equitable access of ICT lack the requisite knowledge, skills and know-how to be able to carry out their responsibilities effectively and efficiently. This can be addressed by placing the right people

there or ensuring that, those already there acquire the needed skills, knowledge and know-how to be able to discharge their duties as required.

Providing Technical Support

Without continuous technical support, technology integration in the classroom will never be satisfactorily achieved. Most teachers have heard horror stories about equipment failure, software complexity, data loss, embarrassments, and frustration. They don't want to be left hanging with students wondering why nothing is working the way it is supposed to be. When teachers are trying to use technology in their classrooms and they encounter difficulties, they need immediate help and support. Helping technology users while they are actively engaged with technology at their work location is probably the most meaningful, essential and appreciative support that can be provided (Clifford, 1998).

Timing is everything, particularly when it comes to technology. Real learning takes place (or stops) when actually trying the new skills. The best way to win widespread use of new technologies is to provide just-in-time support, assistance, and encouragement when needed. (Clifford, 1998).

Infrastructure repair or upgrades must be responsive and well timed. Frequent occurrences of a server being down, printers jammed, or insufficient computer memory will not only disrupt instructional and administrative activities but also may undermine the entire technology program. When technical problems arise frequently and teachers have to wait hours, days, or weeks to get them resolved, they will abandon their efforts to incorporate technology.

Perhaps the best situation is having a technical specialist in the building whose role is to provide technical support on a full-time basis. Hiring an on-site technology coordinator is the single most effective action a school administration can take when embarking on technology integration, Clifford (1998). Other responsibilities could include designing ongoing staff development, planning hardware and software purchases, and determining when outside technology experts must be called in.

Another practical strategy is to have computers available through mobile computer labs. In this strategy, the computers are placed on small carts or desks with wheels so they can be moved to the area of need. Even though some educators believe that computers should be equally distributed throughout the school so all teachers have equal access, mobile computer labs offer a workable approach. Teachers may find that they do not need access at the same time and would rather pool their resources to give each of them a critical mass of computers at varying times. For elementary teachers, a critical mass to support meaningful technology integration might be six to eight computers; for secondary teachers, a critical mass might be 10 to 15 computers. The mobile computer lab allows teachers to have enough computers for projects when they need them and the classroom space when they do not.

Promoting the use of ICT

The Government, educational policy makers, non-governmental organizations (NGO), bilateral and multilateral donor organizations, and school administrators should make the collective efforts to promote ICT in Ghanaian

schools .The government should show commitment to extend computers to all schools in the country and promote equitable ICT in the school system so that all students will equally benefit from ICT regardless of geographical location. The successful implementation of such a policy would be a great achievement in the educational system (Sutherland-Smith, 2003). However, existing inequality, poor infrastructure and the nation's present economic situation is likely to pose a challenge to implementing equitable ICT in the school system.

The role of the educator was identified as the most important factor to successful integration (Bitner & Bitner, 2002). Within the context of the educator's role a number of factors contributed to the level of successful integration. The individual's willingness to adapt to change, his or her comfort and skill level, as well as the ability to deal with issues of time management were the most common indicators. Within the realm of the physical environment issues of accessibility and organizational constraints arose. Existing literature revealed that support systems were a critical piece of the puzzle as well (Bitner & Bitner, 2002). Within this social realm, educators who had support systems including technicians, administrators and peers who could assist when needed were more likely to successfully integrate technology. An additionally needed support system was effective professional development models and those models that were designed to incorporate an internal support system, also aided in successful integration.

It was the skill and attitude of the educator that determined the effectiveness of technology integration into the curriculum (Bitner & Bitner,

2002). Once educators developed skills, they could begin to find ways to integrate technology into their curriculum and demonstrate its use to others. If learning was the impetus that drove the use of technology in the school, educators and students could be partners in the learning process, altering traditional paradigms of the educator providing wisdom and the student absorbing knowledge. Motivation to endure the frustration and turmoil of the process change needed to be intrinsic. Some examples of successful integration centered on ICT (Information, Communication Technology) ingrained in a constructivist view of education. Constructivist theory is based on the premise that learning is provoked by the learner's desire to minimize a mismatch between what is already known and what needs to be learned or has been provoked by circumstances. The intrinsic need of the learner to make sense of the environment drives the learning, and instruction must be tailored to the developmental needs of participants (Marshall, 1993).

Constructivist educators are facilitators in their classrooms where students are actively engaged in exploration, invention and discovery. Collaborative and cooperative learning are favoured in order to expose the learner to alternative viewpoints. Unfortunately, electronic technologies often were not used in ways consistent with constructivist principles of learning and no reason existed to believe they would be in the near future (Pepi & Scheurman, 1996). Educators were observed using technology as an instrument for classroom management, allowing students to use the computer as a reward or for drill and practice type activities. The time students spent using technology resulted in incidental

learning but the activities were often justified by educators in terms of keeping students on task rather than because of evidence that technology aided in the construction of meaningful knowledge. Computers should be used as facilitators of thinking and knowledge construction (Jonassen, 1995). Until our conceptions of learning are reformed, technologies would continue to be delivery vehicles and not tools to think with or to advance our conceptual understandings.

For a successful integration of ICT into the mathematics curriculum, it is essential to have knowledge of the existing software that is used by mathematics educators. A survey carried out by Forgasz and Prince (2002) found that 61% of the respondents (educators) used spreadsheets, 45% used word processing and 30% used Internet browsers. In the same survey, it was found that 19% used Geometer's sketchpads, 19% used CD-ROMs that accompanied mathematics textbooks, 18% used Graphmatica, 14% used Maths Blaster and 8% used other mathematics-specific software. Knowledge of the use of software on the part of the educators was not the only criterion for integrating ICT into mathematics lessons; a sound pedagogical knowledge on how to integrate it was another critical success factor. There are three different varieties of technology usage:

- i. using technology as a data analysis tool,
- ii. using technology as a problem-solving/ mathematical modeling tool,
and
- iii. using technology to integrate mathematics with a context.

Researchers argued that with the introduction of technology, it is possible to de-emphasize algorithmic skills; the resulting void may be filled by an increased emphasis on the development of mathematical concepts. They have discussed the impact of technological forces on learning and teaching mathematics (Cuban, Kilpatrick & Davis, 2001). Technology saves time and gives students access to powerful new ways to explore concepts at a depth that has not been possible in the past. The power of computers leads to fundamental changes in mathematics instruction. For example, the ability to build and run complex mathematical models, and easy exploration of "what if" questions through parametric variation has opened up new avenues for mathematics. The teaching of calculus has seen a dramatic change now that activities such as exploring data or graphical data analysis have been revolutionized by the computer technology. It is also reported that weaker students often are better able to succeed with the help of technology, and thereby come to recognize that mathematics is not just for their more able classmates (Wimbish, 1992).

Although there has been much written about the potential of technology to change how mathematics is taught, there does not seem to be much written about the how the use of technology changed students perception about mathematical problem solving. We are interested to know whether the use of technology could change students' perceptions of problem solving. However, we are aware that students were not exposed

and didn't have the experience of using technology during most of their school mathematics lessons.

Methods of developing ICT skills

Universities have sought methods of developing ICT skills and knowledge in their graduates in an effort to prepare them for employment. These methods include possession of basic ICT certification as an entry requirement, specific ICT foundation courses, or integrating ICT skills into the curriculum, which is accredited as part of the degree award. Universities and other tertiary education institutions have indicated that e-learning has a generally positive effect on the quality of teaching and learning, although few have been able to offer detailed evidence (Mucherah, 2003).

Computer usage primarily assists student learning. Internet and computer usage can also impact positively on critical thinking, problem solving, prompt feedback and collaborative instruction. Most students had a strong preference for ICT resources to supplement teaching and that they would prefer to use a computer during their studies (Muchera, 2003). However, it is still unclear whether students use these resources enough. It should be determined whether refraining from its use is simply through ignorance or some other underlying concern, and how it can be addressed.

In Ghana, it can be said that, developing ICT skills in both teachers and learners will not only benefit the educational sector but also be of benefit to other sectors such as agriculture and industry. Developing ICT skills in the youth

of Ghana therefore holds the key in helping transform tremendously the economy of Ghana in to a well-developed economy.

Barriers related to the use of Computers

First-order barriers to ICT integration are obstacles that are extrinsic to educators. First-order barriers may include obstacles such as the lack of access to ICT (Ertmer, 1999), insufficient time to plan instruction and for educators to familiarize themselves with ICT , inadequate technical and administrative support, the lack of training provided to educators in integrating ICT, and the pressure for students to do well in end-of-prescribed course examinations (Lim, 2001).

Second-order barriers, on the other hand, are obstacles that impede fundamental change of educators towards ICT integration (Ertmer, 1999). Second-order barriers are usually rooted in educators' underlying beliefs about teaching and learning and may not be immediately apparent to others or even to the educators themselves. These barriers are often thought to cause more difficulties than the first-order ones (Dede, 1998). This may be due to the fact that second-order barriers are less tangible and also because they are more personal and more deeply ingrained. It is said that, it matters little whether or not an innovation has a great degree of advantage over the idea it is replacing-what really matters is whether the individual perceives the relative advantage of the innovation (Rogers,1983). Second-order barriers include educators' lack of belief that ICT enhance the learning process, educators' belief systems about students in their schools, "good teaching" in their school context and the role of ICT in their

student lives, educators' unwillingness to change (Greenberg, Raphael, Keller, & Tobias, 1998).

Identifying and examining the barriers to ICT integration is not an end by itself. They serve no purpose unless there is research done on how these barriers are overcome to support effective integration of ICT. Based on the review of literature, it is clear that either type of barrier alone can halt ICT integration efforts. Since different barriers may appear at different points in the integration process, schools need strategies for dealing with both kinds of barriers to support educators in the integration of ICT.

The ability to make use of software tools for solving problems requires the acquisition of a number of ICT skills. E.g. remembering commands and dialogue boxes, finding details associated with the software, understanding the software functions and their relationships, understanding the overall principle of the software, finding the right sequence, creating associations in their own language, transferring previously acquired skills to the software. Teaching these skills involves two major steps: First the educator gives an overview and demonstrates the functionality of the software. Second, the students do hands on exercise using the software (Herskin, 2004). During the overview; the educator uses a video projector to present the software functions and demonstrates how the following exercise should be solved. Then, the students work on their own trying to remember this

procedure. There are three (3) basic problems that are related to this form of ICT integration.

1. The memory problem: The student must remember a detailed procedure.
2. The understanding problem: The student has to master the principles of how to solve the exercise.
3. The dependence problem: the student is not able to work on his own solving the problem.

Techniques such as teaching small groups, breaking down the lesson into smaller parts providing the students with detailed manuals showing how the exercise should be done step by step, using text books or adopting similar methods do not solve the basic problems of traditional ICT integration. However, as Webb (2002) argued, it is important for educators not to be overwhelmed by trying to master all the details of software but to focus on the main features of types of software and how to find information about the detailed techniques.

Jones (2004) found that seven barriers existed while integrating ICT into lessons. These barriers were:

- i. lack of confidence among educators during integration,
- ii. lack of access to resources,
- iii. lack of time for the integration,

- iv. lack of effective training,
- v. facing technical problems while the software is in use and
- vi. lack of personal access during lesson preparation

Contrary to the promising notion of ICT as a means of knowledge production, numerous scholars have highlighted the need to address the numerous problems that the introduction of ICT will bring. These issues include: a lack of adequate planning for implementation of ICT, inadequate teacher training, inequalities in ICT distribution, lack of information regarding the distribution of ICT, low levels of literacy in general, and lack of relevant content and technology applications to meet the needs of diverse societies. The literature identifies the tendency for ICT to lead to a digital divide between urban and rural schools (Webb, 2002).

A review of the available literature reveals significant inequity in the implementation of ICT in Ghanaian schools. The literature (Adams&Mfum-Mensah, 2005) reveals that ICT provision in schools is skewed in favour of schools categorized as premier schools and schools in urban areas. Unfortunately, this is not a new trend.

Summary of current state of computer and internet usage

1. Inadequate infrastructure is a major problem facing many secondary schools in their quest to implement ICT in the teaching and learning process,

2. Lack of Government policy and will to accelerate the integration of ICT in the educational system. This is making ICT usage in schools currently to be done in a non-coordinated manner.
3. Rural schools are lagging far behind urban schools in terms of ICT usage.
4. The usage of computers and internet in the teaching and learning mathematics in developing countries including Ghana is very low
5. Usage of computers and internet in teaching and learning mathematics has the potential of assisting student learning, enhancing critical thinking, impacting positively on problem solving skills, giving prompt feedback and promoting collaborative instruction

CHAPTER THREE

METHODOLOGY

Overview

This chapter discusses the procedures the researcher used in his study. This includes research design, population, sample and sampling techniques used. It also includes instrumentation used, pilot testing, procedure for data collection and procedure for data analysis.

Research Design

Research is a form of collective self-reflective inquiry undertaken by participants in social situation in order to improve the rationality and justice of their own social or educational practices, as well as their understanding of these practices and the situation in which these practices are carried out (Kemmis and McTaggart,1998).The aim of any research project is to bring about practical improvement, innovation, change or development of social practice, and the practitioners better understanding of their practices (Zuber-Skeritt,1996).

The researcher considered descriptive survey design as appropriate because it involves collecting data in order to test hypotheses or answer questions concerning the current status of the subject of the study. Descriptive surveys interpret, synthesize and integrate data, point to implications and interrelationships (Osuala, 1987). Descriptive study determines and reports the

way things are. Its survey design is directed towards determining the nature of a situation as it exists at the time of the study. It is versatile and practical in that, it identifies present conditions and points to recent needs. It also attempts to determine the incidence, distribution and interrelation among sociological and psychological variables. It focuses on vital facts about people and their beliefs, opinions, attitudes, motivations and behavior and simply describes and provides understanding of a phenomenon (Gay, 1992).

The researcher considered other designs such as case study or action research but realized that if the researcher had used case study for instance, only a specific case would have been used (Nisbet and Watt, 1984). Case study is an in-depth investigation of an individual, group, or institution. In education, it is typically conducted to determine the background, environment of children with problems. It is used in individual counseling, not usually as a solution (Gay, 1992).

In practice, action research begins with a general idea that some kind of improvement or change is desirable. In deciding just where to begin in making improvements, one decides on a field of action where the battle (not the whole war) should be fought. It is a decision on where it is possible to have an impact. The general idea prompts a reconnaissance of the circumstances of the field, and fact-finding about them. Having decided on the field and made a preliminary reconnaissance, the action researcher decides on a general plan of action. Breaking the general plan down into achievable steps, the action researcher settles on the first action step. Before taking this first step, the action researcher becomes more circumspect, and devises a way of monitoring the effects of the

first action step. When it is possible to maintain fact-finding by monitoring the action, the first step is taken. As the step is implemented, new data start coming in and the effect of the action can be described and evaluated. The general plan is then revised in the light of the new information about the field of action and the second action step is planned along with appropriate monitoring procedures. The second action step is then implemented, monitored and evaluated, and the spiral of action, monitoring, evaluation, and preplanning continues (Kemmis & McTaggart, 1991).

Action research combines diagnosis with reflection, focusing on practical issues that have been identified by participants and which are somehow both problematic yet capable of being changed (Elliot, 1998). The aim of any action research project is to bring about practical improvement, innovation, change or development of social practice, and the practitioners better understanding of their practices (Zuber-Skerritt, 1996). Action research is a form of collective self-reflective inquiry undertaken by participants in social situation in order to improve the rationality and justice of their own social or educational practices, as well as their understanding of these practices and the situation in which these practices are carried out (Kemmis & McTaggart, 1998).

Population

The target population of this study was all senior high school students and mathematics teachers in the Greater Accra Region of Ghana. However, the accessible population consisted of students and mathematics teachers in five senior high schools in the Greater Accra Region. The selected schools were five because of the cost involved and proximity of the schools.

Sample and Sampling Procedure

A total sample size of 250 students and 50 mathematics teachers from five senior high schools in the Greater Accra Region were chosen as shown in Table 1.

Table 1: Distribution of students and teachers according to institutions

Name of Institution	Number of Students	Sample	Number of Mathematics Teachers	Sample
Accra High School	1356	55	13	11
O'Reilly SHS	1014	41	11	9
Kinbu SHS	966	39	10	8
Presec- Osu	958	39	9	8
Presec –Legon	1871	76	17	14
Total	6165	250	60	50

Source: Field data, June 2009

The simple random sampling technique was used. In simple random sample, a subset of individuals (a sample) chosen from a larger set (a population). Each individual is chosen randomly and entirely by chance, such that each individual has the same probability of being chosen at any stage during the sampling process, and each subset of individuals has the same probability of being chosen for the sample as any other subset of individuals (Starnes D. S, 2008). Each member of the population has an equal chance of being selected and the probability of a member of the population being selected is unaffected by the selection of other members of the population. That is, each selection is

entirely different from the rest. The sample contains subjects with characteristics similar to the population (Hopkins, 1996). In a simple random sample, one person must take a random sample from a population, and not have any order in which one chooses the specific individual.

In Accra High school for example with 1356 students, the students were divided equally into boys and girls, and then 55 of them were selected for the study. Their names were selected randomly from the class registers of the various classes. This made each student in the school to have an equal chance of being selected. In the case of the mathematics teachers, all the 13 names were put in a box and then 11 names were pulled out. This process was repeated for the other four senior high schools in the greater Accra region to get a sample size of 250 students and 50 mathematics teachers as respondents.

Instrument

The principal method for data collection was the use of questionnaires. The questionnaire is a widely used and useful instrument for data collection, comparatively straightforward to analyze. Some of the questionnaires were closed-ended while others were open-ended. The open-ended questionnaires will enable the respondents to freely express their views on major issues relevant to the study. Despite the fact that questionnaires do not provide an opportunity to collect additional information through probing, it is known that, the use of questionnaires provides a wider coverage and offer greater assurance of anonymity.

There were two sets of questionnaires. One set for the teachers and the other set for the students. The questionnaires were in five sections. Section A has three questions that deal with the background information of the respondents. Section B (Questions 4-9) deals with the use of computers and internet by respondents. Section C (questions 10-13) deals with the benefit derived from the use of computers and internet by respondents. Section D (questions 14-19) deals with the challenges that respondents face in the use of computers and internet. Question number 19 of section B is an open-ended question. Finally, Section E (20-24) deals with the measure to improve the use of computers and internet facilities.

Pre-testing

Prior to the collection of the primary data, the 60 questionnaires were pre-tested with some teachers and students at Accra High School. To ensure that the questionnaires consistently measure what they should measure, the researcher did his best to make the questionnaire items as clear as possible. Moreover, the questionnaires were administered at the most convenient time to the respondents. The afore-mentioned reduced errors of measurements and thus ensured high reliability.

Data Collection Procedure

Questionnaires were the main instrument used in collecting the data. The data was collected within 6 weeks in September and October 2009. Permission was sought from authorities of the schools concerned together with the day, time and number of respondents required for the research. On the day of the administering of the questionnaire, the respondents (students) were briefed about the importance of answering each question independently and truthfully. The

questionnaires were administered to selected respondents in an atmosphere that guarantee their independence in answering the questions truthfully. After the respondents finished answering the questions, the researchers collected the questionnaires, thanked them and assured them that whatever opinion they expressed would be kept confidential. The researcher distributed two hundred and fifty questionnaires for students, out of which two hundred and forty-six were returned (98.4%) and fifty questionnaires for teachers, out of which thirty-nine were returned (78.0%).

Data Analysis

Data collected was represented in descriptive and inferential manner. Descriptive statistics involves the use of frequencies and percentages to compute responses. Analysis of data was done through the use of the Statistical Package for Social Sciences (SPSS) software in consistent with the research instrument.

CHAPTER FOUR

RESULTS AND DISCUSSION

Overview

This chapter presents the survey data and analysis based on the objectives set for the study and the research questions, which were outlined in chapter one. The researcher focuses attention on the analysis of the research data collected from the field. The analysis is in two parts. The first part is on respondents' background information. The second is on the main research questions. In order to simplify the analysis, the responses from mathematics educators are analysed using frequencies and percentages. Additionally, tables and figures are added to enhance understanding.

Analysis of Respondents' Background Information

Distribution by School

The researcher was interested in the school of respondents. The results of Table 2 indicate that the highest number of respondents came from the Presbyterian Boys Senior High School 74 (30.1%) for students and 11 (28.2%) for teachers. This was so because it has the highest population and hence the highest sample.

Table 2: Name of Institution

School	Number of Students	Percent	Number of Teachers	Percent
Accra Senior High	55	22.4	9	23.1
Oreilly High School	40	16.3	7	17.9
Presec Senior High, Osu	38	15.4	6	15.4
Presby Senior High, Legon	74	30.1	11	28.2
Kinbu Senior High School	39	15.9	6	15.4
Total	246	100.0	39	100

Source: Field data, September 2009

Distribution by Age and Years of Service

On age distribution, those in the age bracket of 16-19 years are the highest 223 (90.7%) respondents. These are people who are young, energetic and curious. The distribution is fairly distributed among the number of years of teaching of teachers (see summary on Table 3).

Table 3: Age of Students and Teachers' Years of Teaching

Age (Year)	Number of Students	Percent	Years of Teaching Mathematics	Number of Teachers	Percent
12-15	16	6.5	0-5	11	28.2
16-19	223	90.7	6-10	14	35.9
more than 19	7	2.8	above 10	14	35.9
Total	246	100.0		39	100.0

Source: Field Data, September 2009

Distribution by Gender

The male student respondents were 152 (61.8%) and the female respondents were 94 (38.2%). There were no female respondents for teachers. This does not mean that there were no female teachers in the selected schools. There were few female teachers in the selected schools, but none was available to give her response. The responses are therefore skewed towards male respondents.

Table 4: Distribution by Gender

Gender	Number Of Students	Percent	Number Of Teachers	Percent
Male	152	61.8	39	100.0
Female	94	38.2	-	-
Total	246	100.0	39	100.0

Source: Field Data, September 2009

Distribution by Educational Level

The educational level of the respondents was displayed. Most of the student respondents were from year two (81.7%). This shows that most of the respondents have spent at least a year in senior high school. The results also indicate that all the teacher respondents (100%) have at least a first degree.

Table 5: Level of Education

Level	Number of Students	Percent	Level	Number of Teachers	Percent
SHS 1	20	8.1	First Degree	39	100
SHS 2	201	81.7	Second Degree	-	-
SHS 3	25	10.2	Specialist	-	-
Total	246	100.0	Total	39	100

Source: Field Data, September 2009

Analysis of Data for main Research Questions

This section focuses on steps taken to derive answers for the research questions.

Research Question One: To what extent do students and teachers use computers and the internet in the learning and teaching of mathematics?

The researcher was interested in the accessibility of computers and internet by students and teachers. The frequency of computer and internet usage by respondents and where they normally use the computer and the internet were also considered. The researcher was also interested in finding out whether respondents use computers and the internet for teaching and learning mathematics. The data in Tables 6, 7 and 8 indicate that out of the 246 student

respondents, 230 (93.5%) had access to computers and 173 (70.3%) had access to the internet. It also shows that 39 (100%) of the teacher respondents had access to computers. This shows that majority of respondents had access to computers and internet and could use it in school, at home or a commercial center such as an internet café. Most students had a preference for ICT resources to supplement teaching and that they would prefer to use a computer during their studies. Majority of student respondents however indicated that they used the computer 143 (58.1%) and the internet 78(31.7%) for one hour or less per week but only few used it for teaching (5.1%) and learning 29 (11.8) mathematics.

Table 6: Access to Computer and Internet Usage

Place of Access to Computer Usage	Number of Students	%	Number of Teachers	%
Home	75	30.5	8	20.6
School	106	43.1	10	25.6
Café	49	19.9	21	53.8
None	16	6.5	-	-
Total	246	100.0	39	100

Source: Field Data, September 2009

Table 7: Place of Access to Internet Usage

Place of Access to Computer Usage	Number of Students	%	Number of Teachers	%
Home	59	24.5	7	17.9
School	32	13.1	10	25.6
Café	82	33.3	21	53.8
None	73	29.7	1	2.7
Total	246	100.0	39	100

Source: Field Data, September 2009

Table 8: Frequency of Computer Usage

Access to Computer Usage	Number of Students	%	Number of Teachers	%
Sometimes	127	58.2	6	15.4
Often	50	21.7	26	66.7
Very often	53	23.1	7	17.9
Total	230	100.0	39	100

Source: Field Data, September 2009

Table 9: Frequency of Internet Usage

Access to Internet Usage	Number of Students	%	Number of Teachers	%
Sometimes	78	45.1	10	25.6
Often	55	31.8	18	46.2
Very often	40	23.1	11	28.2
Total	173	100.0	39	100

Source: Field Data, September 2009

Table 10: Place of Access to Computer

Place of Access to Computer Usage	Number of Students	%	Number of Teachers	%
Home	75	30.5	8	20.6
School	106	43.1	10	25.6
Café	49	19.9	21	53.8
None	16	6.5	-	-
Total	246	100.0	39	100

Source: Field Data, September 2009

Table 11: Place of Access to Internet Usage

Place of Access to Computer Usage	Number of Students	%	Number of Teachers	%
Home	59	24.0	7	17.9
School	32	13.0	10	25.6
Café	155	63.0	21	53.8
None	-	-	1	2.7
Total	246	100.0	39	100

Source: Field Data, September 2009

Table 12: Respondents who use Internet for Teaching and Learning

Internet	Number Of Students	Percent	Number Of Teachers	Percent
Yes	29	11.8	2	5.1
No	217	88.2	37	94.9
Total	246	100.0	39	100

Source: field data, September 2009

The evidence shows that few schools have developed coherent strategies to integrate computer use fully as pedagogical tools in the classrooms (Hawkins, 2002). It also supports the assertion that mathematics teachers are among the lowest users of computers in the classrooms (Wong, 1999). It also supports the fact that inadequate teacher training (Webb, 2002) in the use of computers in the teaching of mathematics accounts for the low use of computers in the teaching of mathematics

In summary it can be inferred that, the practical approach to solving research question one is to equip teachers with more professional development in the use of computers and the Internet who will in turn be more likely to assign students various types of work involving computers or the Internet.

Research Question Two: What benefits do students and teachers derive from the use of computers and the internet in the learning and teaching of mathematics?

In the second research question, the researcher was interested in the benefits that students and teachers derive from the use of computers and internet in learning and teaching mathematics. In answering this question, teachers were required to answer questions relating to lesson delivery, students performance and number of mathematics topics covered.

In answering research question two, students were required to answer questions that relate to academic performance, understanding of topics, accessing more information, ability to do assignments and ability to do self-tuition. Table 10 shows that students agreed that their academic performance, understanding of

topics, access to more information, ability to do assignment and ability to do self-tuition have greatly improved through the use of computers and the internet. This supports the assertion made by Goldman (1999) that computer usage has numerous benefits as it primarily assists student learning and also that Internet and computer usage can also impact positively on critical thinking, problem solving, prompt feedback and collaborative instruction in mathematics.

Table 13: Student benefits

Statement	Agree	Disagree
1. Academic performance has greatly improved	183(74.4%)	63(25.6%)
2. I am able to understand the topics taught better	195(79.3%)	51(20.7%)
3. Able to access more information	232(94.3%)	14(5.7%)
4. Able to do my assignment with less difficulty	202(82.1%)	44(17.9%)
5. Able to learn some topics on my own	191(77.7%)	55(22.3%)

Source: field data, September 2009

Table 14: Benefits to teacher

Statement	Agree	Disagree
My lesson delivery has greatly been enhanced	13(33.4%)	26(66.6%)
Performance of students has greatly improved	15(38.5%)	17(61.5%)
I am able to cover more mathematics topics	21(53.8%)	17(46.2%)

Source: field data, September 2009

In summary it can be inferred that, the answer to research question two is that computer and internet can enhance teaching and learning. Furthermore, multimedia presentations can facilitate comprehension, benefit diverse learner by allowing for individualized instruction and have effects on engagement and interest of students.

Research Question Three: What are the barriers to the use of computers and the internet by teachers and students in the teaching and learning of mathematics?

Students were required to answer questions relating to: access to computer and internet, personal know-how and teachers’ know-how. Teachers were also required to answer questions relating to cost of computers and the internet, inadequate supply of computers, reliability of power supply, personal competence, students competence. The responses are presented in Table 12.

Table 15: Barriers to Teachers’ use of Internet and Computer

Statement	Agree	Disagree	Undecided
1. Expensive to acquire	25(64.1%)	11(28.2%)	3(7.7%)
2. Availability of computers	26(66.7%)	13(33.3%)	0(0%)
3. Lack of electric power	28(71.8%)	11(28.2%)	0(0%)
4. Have no know-how	13(33.3%)	18(61.6%)	2(5.1%)
5. My students have no know-how	15(28.4%)	21(53.9%)	3(7.7%)

Source: field data, September 2009

Table 12 shows that teachers agree that, the cost of acquiring computers 14 (35.9%), inadequate supply of computers in the schools 19(48.7%), reliability

of power supply 14 (35.9%), personal competence in using computers and the internet 11(28.2%) and the competence level of students 10 (25.6%) in using computers and the internet are barriers to their usage of computers and the internet in teaching and learning mathematics. It can be said that inadequate supply of computers in school is a major challenge to teachers using computers and the internet in teaching mathematics. The findings are in support of existing findings which indicate a lack of adequate planning for implementation of ICT , inequalities in ICT distribution, lack of information regarding the distribution of ICT; low levels of literacy in general, and lack of relevant content and technology applications to meet the needs of diverse societies (Sunderland, 2003).

The data in Table 13 further shows that students agreed that teachers having no know-how 151(61.6%) are a major challenge to the use of computers and the internet for teaching and learning mathematics. It can therefore be said that students' challenges to the use of computers and the internet in learning mathematics are largely as a result of teachers not using computers and the internet to teach them mathematics.

Table 16: Barriers to Students' use of Internet and Computer Usage

Statement	Agree	Disagree
1. Have no access	111(45.1%)	135(54.9%)
2. Have no know-how	74(30.3%)	172(69.7%)
3. My teachers have no know-how	151(61.6%)	95(38.4%)
4. Lack of electric power	51(20.7%)	195(79.3%)

Source: field data, September 2009

In summary it can be inferred that, the practical approach to solving research question three is to offer more technical support, greater access to hardware, the availability of high quality software, and ongoing professional development to teachers.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Introduction

This chapter presents a summary of findings, conclusions drawn from the study and recommendations for action.

Summary of Research Procedures

The purpose of the study was to investigate the usage of computers and the internet in teaching and learning mathematics in selected Senior High Schools in the Greater Accra Region of Ghana. The instrument used for the study was mainly questionnaires. A total sample of 300 respondents took part in the survey which was made up of 50 mathematics teachers and 250 mathematics students. These samples were picked from 5 selected Public Senior High Schools. However, 39 questionnaires for teachers and 246 questionnaires for students were retrieved. The data was analysed into percentages, frequencies, and cross-tabulations using SPSS software.

The main research questions were:

1. To what extent do students and teachers use computers and the internet in the learning and teaching of mathematics?
2. What benefits do students and teachers derive from the use of computers and the internet in the learning and teaching of mathematics?

3. What are the barriers to the use of computers and the internet by teachers and students in the teaching and learning of mathematics?

Summary of Main Findings

The following were the findings:

1. The results indicate that most teachers and students have access to computers and the internet. They however used computers and the internet for activities other than teaching and learning mathematics.
2. Teachers and students who used computers and the internet in teaching and learning mathematics agreed that their academic performance has improved
3. The major barrier to the use of computers and the internet in teaching and learning mathematics is lack of teacher's know-how. Respondents agreed to an extent that, availability of computers, lack of electric power and student know-how also affect the use of computers and internet in the teaching and learning of mathematics.

Conclusions

From the findings of the study, it can be said that in the big cities such as Accra, it is much easier to have access to internet and computers. Most computer and internet users do not use them for teaching mathematics (in the case of teachers) or learning mathematics (in the case of students).

Availability of ICT, Infrastructure for ICT activities in schools, reliable supply of power for ICT activities, skills and technical know-how for both

teachers and students remain the main challenge to the use of ICT in the teaching and learning of mathematics

Recommendations

On the basis of the findings, the following recommendations are made:

1. The Government must have an ICT policy in place to ensure the rapid integration of ICT in the teaching and learning of mathematics in the senior high schools.
2. Mathematics teachers in Senior High Schools should be equipped with the necessary know-how to be able to teach mathematics using ICT. They must also endeavour to assist students to use ICT in the learning of mathematics.
3. Policy makers should ensure that ICT is integrated into the everyday life of students and teachers by subsidizing the purchase of computers and the usage of internet for educational purposes

Suggestions for Future Study

It is suggested that this study should be replicated in other parts of the country and other areas of study (Physics, Chemistry, Biology, English etc) so that the findings could be generalized as true state for the use of ICT in teaching and learning in Ghana.

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APPENDICES

APPENDIX A: QUESTIONNAIRE FOR TEACHERS

The purpose of this questionnaire is to ascertain the level of ICT usage by students and teachers in selected Senior High Schools in the Greater Accra Region. You are assured that any information given is solely for academic purpose and would be kept confidential. Please, try as much as possible to respond all the questions. Thank you.

SECTION A: BACKGROUND INFORMATION

Instruction: Please, tick [√] to what is applicable to you.

1. Name of your institution?

- Accra High School.
- Oreilly High School
- Presec Senior High, osu
- Presby Boys Senior High School, Legon
- Kinbu Senior High School.

2. What is your gender?

- Male Female

3. How many years have you been teaching mathematics?

- 0-5yrs 6-10yrs above 10yrs

4. Educational level?

- Specialist Diploma 1st Degree 2nd Degree

SECTION B: USE OF COMPUTERS AND INTERNET FACILITIES

5. Do you have access to a computer? Yes No

If *YES*, where do you normally use the computer {Please tick as many as apply }

- 1. At home
- 2. At School
- 3. Internet Café

6. Indicate the frequency of use:

- 1. Sometimes** (1 hour per week or less)
- 2. Often** (2-5 hours per week)
- 3. Very often** (More than 5hours per week)

7. Do you have access to the internet?

- Yes
- No

If *YES*, please indicate the frequency of use:

- 1. Sometimes** (1 hour per week or less)
- 2. Often** (2-5 hours per week)
- 3. Very Often** (Every day)

8. Do you use the internet for teaching Mathematics?

- Yes
- No

9. Where do you normally use the Internet? (Please tick as many as apply)

- At home
- At School

Internet Café

Do not use internet at all

10. Do your mathematics students use computer during lesson delivery?

Yes

No

11. Does the use of internet help you in the teaching of mathematics?

Yes

No

I don't know

SECTION C: BENEFITS IN USING COMPUTERS AND INTERNET FACILITIES

Statement	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
My lesson delivery has greatly been enhanced since I started using the internet for teaching.					
Performance of students has greatly improved since I started using internet and computers for					

teaching mathematics					
I am able to cover more mathematics topics since I started using computers and the internet for teaching.					
My lesson delivery has greatly been enhanced since I started using the computers for teaching.					

SECTION D: CHALLENGES TO USING COMPUTERS AND INTERNET FACILITIES

STATEMENT	Strongly Agree	Agree	Disagree	Strongly Disagree	Undecided
I do not use computers and the internet for teaching mathematics because they are expensive to acquire					
I do not use					

computers and the internet for teaching mathematics because there are not enough computers for the students to use					
I do not use computers and the internet for teaching mathematics because there is no reliable source of power					
I do not use computers and the internet for teaching mathematics because my competence in computing is low					
I do not use computers and the internet for teaching mathematics because my student's competence in computing is low					

12. What are the other difficulties you encounter in the use of computers and internet in teaching mathematics?

.....

.....

.....

SECTION E: MEASURES TO IMPROVE THE USE OF COMPUTERS AND INTERNET FACILITIES

STATEMENT	Strongly agree	Agree	Disagree	Strongly disagree	Undecided
Mathematics teachers should be well trained to use computers and the internet to teach mathematics					
There must be reliable power supply to power the computers					
There must be laboratory readily available for the computers to be used safely					
The computers must be enough for the students to use independently					
Computers and the internet must be readily available in the schools					

What would be your recommendations and suggestion to remedy these difficulties?

.....

.....

.....

APPENDIX B: QUESTIONNAIRE FOR STUDENTS

The purpose of this questionnaire is to ascertain the level of ICT usage by students in selected Senior High Schools in the Greater Accra Region. You are assured that any information given is solely for academic purpose and would be kept confidential. Please, try as much as possible to respond all the questions. Thank you.

SECTION A: BACKGROUND INFORMATION

Instruction: Please, tick [√] to what is applicable to you.

1. Name of your institution?

- Accra High School.
- Oreilly High School
- Presec Senior High, Osu
- Presby Boys Senior High School, Legon
- Kinbu Senior High School.

2. What is your age range?

- 12 -15 years of age
- 15-19 years of age
- More than 19 years

3. What is your level?

- SHS 1
- SHS 2
- SHS 3

4. What is your gender? Male Female

SECTION B: USE OF COMPUTERS AND INTERNET FACILITIES

a. Do you have access to a computer? Yes No

If *YES*, where do you normally use the computer {Please tick as many as apply}

At home

At School

Internet Café

b. Indicate the frequency of use:

Sometimes (1 hour per week or less)

Often (2-5 hours per week)

Very often (More than 5hours per week)

c. Do you have access to the internet?

Yes

No

If *YES*, please indicate the frequency of use:

Sometimes (1 hour per week or less)

Often (2-5 hours per week)

Very Often (5 hours per week)

d. Do you use the internet for learning Mathematics?

Yes

No

e. Where do you normally use the Internet? (Please tick as many as apply)

- At home
- At School
- Internet Café

f. Do your mathematics teacher use computer during lesson delivery?

- Yes
- No

g. Does the use of computers help you in the learning of mathematics?

- Yes
- No

h. Does the use of internet help you in the learning of mathematics?

- Yes
- No

SECTION C: BENEFITS IN USING COMPUTERS AND INTERNET

STATEMENT	Strongly agree	Agree	Disagree	Strongly disagree
My academic performance has greatly improved since I started using the computers and the internet for my academic work.				
I am able to understand the topics taught better through the use of computers and the internet				
I am able to access more information through the use of computers and the internet				
I am able to do my assignments with less difficulty through the use				

of computers and the internet				
I am able to learn some topics on my own through the use of computers and the internet				

FACILITIESSECTION D: CHALLENGES TO USING COMPUTERS AND INTERNET FACILITIES

STATEMENT	Strongly agree	Agree	Disagree	Strongly disagree
I do not use computers and the internet for learning mathematics because I do not have access to a computer and the internet				
I do not use computers and the internet for learning mathematics because I do not know how to use computers				
I do not use computers and the internet for learning mathematics because my teachers do not use computers for teaching mathematics				
I do not use computers and the internet for learning because there is no power where I need to use the computer and the internet				

SECTION E: MEASURES TO IMPROVE THE USE OF COMPUTERS AND INTERNET FACILITIES

STATEMENT	Strongly agree	Agree	Disagree	Strongly disagree	Undecided
Mathematics teachers should be well trained to use computers and the internet to teach mathematics					
There must be reliable power supply to power the computers					

There must be laboratory readily available for the computers to be used safely					
The computers must be enough for the students to use independently					
Computers and the internet must be readily available in the schools					

Thank you very much for the information