UNIVERSITY OF CAPE COAST

FACTORS THAT INFLUENCE THE USE OF INFORMATION AND COMMUNICATION TECHNOLOGY AMONG GHANAIAN SHS SCIENCE TEACHERS AND STUDENTS: THE CASE OF ATWIMA KWAWOMA DISTRICT

RAPHAEL OKOREEH

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BY

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Dissertation Submitted to the Department of Science, Mathematics and ICT College of Distance Education, University of Cape Coast, in Partial Fulfilment of the Requirement for the award of Master of Education Degree in Information Technology

OCTOBER, 2020

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……

Candidate Name:.....

Supervisor's Declaration

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

Supervisor's Signature…… Date…….

Supervisor's Name: .....

ABSTRACT

The prime purpose of this study was to find out factors that influence the use ICT among Ghanaian science teachers and SHS students with principal focus on SHS in Atwima Kwawoma district. Stratified sampling technique was used to select 40 Science teachers and 200 students from Afia kobi Ampem Girls SHS, Trede SHS, Twedie Vocational and Technical SHS in the Atwima Kwawoma District of Ashanti region in Ghana. A questionnaire instrument was used to elicit information from 240 respondents

The highest response was for 17 teachers indicating that 21 – 30 of computers on the average were in good use in their schools.

The next highest response was that of 10 for the range of 20-29 computers being connected to the internet. This response accounted for 25% of the total responses obtained from the 40 teachers.

Inadequate time to prepare teaching and learning activities with the computer and inadequate ICT infrastructure in schools were the major perceived barriers mostly reported by respondents

It is recommended that Heads of the various SHS should organize in-service training in professional development courses related to the integration of ICT in teaching and learning Science for their teachers.

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I wish to express my profound gratitude to all who in diverse ways assisted in the preparation of this paper, most especially, Dr. Asamoah Gyimah, my supervisor and Dr Arthur Nyarko whose useful suggestions, critiques and recommendation guided me throughout the writing of this dissertation.

I also wish to acknowledge the love and support from wife, Abigail Boakye-Afriyie and children, Kyle, Raphaella, Jaden and Abena throughout the writing of this dissertation. To Clara Appiah and Arthur Peter, I love you and without you, this paper will not be completed, I say God richly bless you.

DEDICATION

To my family

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CHAPTER ONE

INTRODUCTION

Background of the study

Technology has been defined in so many ways from different perspectives. To some authorities, longman English Dictionary (2009) it is seen as machines, equipment and computers whilst others view it as advancement in scientific knowledge. For instance, Macmillan English Dictionary (2002) defines technology as an advanced scientific knowledge used for practical purposes. The Longman Dictionary for Contemporary English (2007) also defines it as new machines, equipment, and ways of doing things that are based on modern knowledge about science and computers. Information and communications technology (ICT) is therefore a generic term that comprises any communication piece of equipment, such as radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and its associated applications.

The need for integration of technology into teaching and learning has become increasingly essential in the 21st century classroom. Various researchers and authorities of education have added their voices to point out the reasons why integration of ICT into classroom instructional delivery cannot be overemphasized.

Yelland (2001) in a presentation at Australia argued strongly that those schools with no ICT integration cannot seriously claim to prepare their students for life in the 21st century. Yelland's assessment of schools without ICT integration is probably too critical but to a large extent he is right. Technology has come to stay with mankind. This is echoed by Dubow (2005) in his book. He argued that

the previous methods have given way to new in various facades of human life. Dubow mentions that activities such as education, sports and recreation, commerce, agriculture, entertainment, politics, medicine, architecture, art and music, communication, transportation and religion have all felt the overwhelming sway of technological advancement.

Hakkarainen, Ilomaki, Lipponen, Muukkonen, and Rahikainen (2000-2009) are among the pro ICT educationists who side with Dubow (2005-2008) and Yelland (2001). They posit that ICT is a transformative tool and its full incorporation into the school systems is essential to prepare students for the information society they will inherit. These authorities in education have made it categorically clear that child education without technology is meaningless and futile since such children have no place to fit in the modern world.

The concern to integrate ICT into teaching and learning in Ghana started in the early 1990s. Since the beginning of the millennium, education authorities in Ghana have embarked on a number of projects to bring in Information and Communication Technologies into Ghanaian education set up at the basic and secondary school levels. For example, in the middle of the 1990s, educational providers realized that Ghanaian professionals could not compete on the global market for jobs, because they were limited in skill, especially in the area of Information Technology (Nyarko, 2007). This assertion is in harmony with the argument made by Yelland (2001) concerning the fact that students who attended schools without ICT integration into teaching and learning had no future in the business world.

In 1997, the World Link for Development (WorLD) to use ICT to open a world of learning for teachers and students. According to Kwei (2001) the aim

of the programme was to assist teachers and students to integrate ICT into their curricula, to facilitate collaborative projects and distance learning among teachers and students, to assist students in using computers and the internet as communication and research tools, and to develop local educational content on the internet.

In implementing policies to achieving national development in Ghana, the ICT for Accelerated Development policy (ICT4AD) emphasized the need to transform Ghana into a knowledge based and technology-driven high income economy and society. The strategy of the ICT4AD was to realize this mission by transforming educational system to provide requisite educational and training services and environment capable of producing the right types of skills and human resources required for developing and driving Ghana's information and knowledge- based economy and society.

In 2002, the Ministry of Education Youth and Sports (MOEYS) together with the Ghana Education Service (GES) presented a policy framework on ICT. The policy stipulated that integrating technology in classroom instruction ensures greater motivation, increases self-esteem and confidence, enhances good questioning skills, promotes initiative and independent learning, improves presentation of information/outputs, develops problem solving capabilities, promotes better information handling skills, increasing focus time on task, and improves social and communication skills. Hence they proposed that the use of ICT in schools must:

i. Ensure that students have ICT literacy skills before coming out of each level of education;

ii. Provide guidelines for integrating ICT tools at all levels of education;

iii. Provide means of standardizing ICT resources in all schools;

iv. Facilitate training of teachers and students in ICT

v. Determine type and level of ICT needed by schools for teaching and administration purposes;

vi. Promote ICT as a learning tool in the school curriculum at all levels.

(GES) levels in pre-university education in Ghana. This compulsory subject has attracted significant attention of educational researchers. Several studies have showed that, like any other subject, technology plays important role in teaching and learning of Integrated Science. One of the aims of the Senior High School Integrated Science syllabus is to help the student search for solutions to problems of life recognizing the interaction of science and technology. The syllabus has also suggested the use of video clips, digitized contents or CD ROM on processes and systems. This is because technology enhances Science learning by furnishing visual images of scientific ideas.

Various researchers have tried to study ICT integration from the perspective of teachers. Baylor and Ritchie (2002) put forth that the integration of ICT in teaching and learning process largely depends on teachers' perception. This study therefore intends to assess technology such as projectors, internet, computer, smart board etc use among Ghanaian SHS Integrated Science teachers and students and factors that influence it with major focus on SHS science teachers at Atwima Kwawoma District in Ashanti Region.

Statement of the Problem

The government of Ghana in collaboration with the Ministry of Education Science and Sports has made provisions to ensure that Senior High School (SHS) students get access to quality education which takes into accounts the integration of ICT in instruction.

In view of this, education stakeholders and policymakers in Ghana have made a remarkable step towards the introduction of ICT in Ghanaian secondary schools that will contribute to knowledge production, communication and information sharing among students and teachers in the school system. For instance, there has been an ICT for Accelerated Development (ICT4AD) policy which seeks to provide a framework in which information and communication technologies will be used to transform the educational sector, allowing all Ghanaians to pursue quality life-long learning opportunities regardless of their geographical location (Republic of Ghana, 2003).

Besides, the new educational reforms in Ghana have also placed high emphasis on the integration of ICT in all subject areas (MOESS, 2010). Thus, the SHS Science syllabus promotes the use of technology to support students' learning and develop their understanding of mathematical concepts.

Also, there has been a sudden increase of computer laboratories at all levels of the school system and this testify to the potency of the use of computer technology in education delivery (Yidana&Asiedu-Addo 2001). Furthermore, ICT has currently become a compulsory (core) subject for every SHS student in Ghana.

To date, however, there has been only limited research to investigate Ghanaian teachers and students' use of technology in teaching and learning and

the factors that support or inhibit their effective integration into classroom practice. Mereku, Yidana,Hodzi, Tete-Mensah, and Williams (2009) asserted that for Ghana, and Africa as a whole, to be able to fully integrate ICT into teaching and learning there is the need for frequent collection and analysis of data on ICT usage.

There are specific objectives in the SHS Science syllabus which encourage the use of technology in teaching and learning and even though these specific objectives emphasize the use of technology in teaching some topics, it is not being used in our public Senior High Schools. It is against this backdrop that the need to conduct an empirical study to investigate the level of technology usage and the factors that influence the use of technology among Ghanaian SHS Science teachers and students in teaching and learning in public SHS schools in the Ashanti Region was born.

Purpose of the Study

The study sought to investigate factors that influence the use of information and communication technology among Ghanaian science teachers and students The study also investigated the SHS Science teachers and students' technology use and suggested effective ways of integrating technology in science instruction at the Senior High School level in Ghana.

Research Questions

The study sought to answer the following research questions:

1. To what extent do SHS Science teachers use technology in teaching?
2. Which factors influence the use of technology among teachers in teaching Science?

3. How do teachers perceive the role of technology in the teaching and learning of Science?
4. To what extent do SHS students use technology in learning Science?
5. Which factors influence the use of technology among students in learning Science?
6. What impact does the use of technology have on the teaching and learning of Science?

Hypothesis

To what extent do SHS students use technology in the learning science? What impact does the use of technology have on the teaching and learning of science?

Significance of the Study

The study is significant because it could provide insight into teachers and students technology use at the SHS level that could be sustainable and transferable to other educational institutions. The study provided empirical evidence on the factors influencing technology use in the teaching and learning of Science at the SHS level in Ghana.

This could provide guidance for policy makers and stakeholders in education when structuring and introducing ICT integration policies in Senior High Schools. The study could also add to knowledge by providing new evidence about the existing factors that influence technology use in science classrooms in Ghana. This could serve as the basics for future studies on how to address some of the challenges to ICT integration which might lead to improving current practice in ICT integration with regards to science instruction.

Delimitation of the Study

The study was delimited to only the three (3) SHS in Ashanti region specifically in the Atwima Kwawoma District and the outcome might be different if private SHS were included. Moreover, the participants who took part in this study were teaching in public SHS in the Ashanti region of Ghana and the outcome might be different from participants in public SHS from a different region.

Furthermore, the study was delimited to only Year (Form) 2 to Year (Form) 3 students because of the fact that the Year 1 students had just reported and were yet to fit in before they begin normal studies at the time of administering the questionnaire, and the outcome might be different if Form 1 students were included.

Limitation of the Study

The findings of this study should not be generalized to all SHS Science teachers in Ghana, as the respondents involved were Science teachers and students of the Atwima Kwawoma District in the Ashanti region of Ghana. This population was selected because of ease of accessibility due to time constraint and limited financial resources. Thus, this places a limitation on the generalization that could be made on the findings of this study.

Organization of the Rest of the study

The rest of the study is organized into five chapters. Chapter one, constituted the study background and problem definition as well as its purpose and research questions. Relevant literature related to the study have been reviewed in Chapter two. The research areas reviewed include methodology employed for the study are described in Chapter three. Chapter four presented

the results and discussion of data. The summary of findings, conclusion, and recommendations based on the finding of the study and suggestions for further studies into the problem are also presented in Chapter five.

CHAPTER TWO

LITERATURE REVIEW

Introduction

This chapter reviewed and discussed the factors from the literature that are related to technology use in science and factors that influence it. The literature review was discussed under the following themes: theoretical framework, extent of technology usage by Senior High School Science teachers, factors influencing technology use among teachers, teachers' perception on the role of technology in teaching Science, extent of technology use by senior high school students, factors influencing the use of technology amongst students in learning Science, impact of technology in teaching and learning Science, challenges of teachers in utilizing technology to teach Science and a summary.

Theoretical Framework

In this study, Valsiner's (1997) zone theory was adopted as the theoretical framework to investigate Science teachers and students' technology use and factors influencing their use at the SHS level. Valsiner's (1997) zone theory was originally designed as an explanatory structure in the field of child development to apply to interactions between teachers, students, technology, and the teaching and learning environment. Valsiner's (1997) zone theory extends Vygotsky's (1978) concept of the Zone of Proximal Development (ZPD) which is often defined as the gap between a learner's present capabilities and the higher level of performance that could be achieved with appropriate assistance to incorporate the social setting and the goals and actions of participants. Valsiner (1997) added two zones: the Zone of Free Movement

(ZFM) and Zone of Promoted Action (ZPA) to Vygotsky's Zone of Proximal Development.

The ZFM structures an individual's access to different areas of the environment, the availability of different objects within an accessible area, and the ways the individual is permitted or enabled to act with accessible objects in accessible areas. The ZPA represents the efforts of a more experienced or knowledgeable person to promote the development of new skills. The ZPA describes the set of activities, objects, or areas in the environment, in which the person's actions are promoted.

Goos and Bennison (2008) argued that the ZFM can be interpreted as constraints within the school environment, such as participants' characteristics, access to resources and teaching materials, and curriculum and assessment requirements, while the ZPA represents opportunities to learn from pre-service teacher education, colleagues in the school setting, and professional development.

Zone theory provides a framework for analyzing the relationship between science teachers and students' technology use and the factors influencing it at the SHS level. Zone theory was adapted as a framework for this study because it enabled the analysis of the relationships between individual respondents' settings, actions, and beliefs, and how these changed across school contexts. Drawing on the zone theoretical framework, possible relationships between SHS Science teachers and students' use of technology and factors known to affect this use were investigated:

1. Zone of Proximal Development – self-perceived efficacy in technology use;

2. Zone of Free Movement – availability of technology resources, age, gender, school location;
3. Zone of Promoted Action – teaching experience, number of years in school.

Extent of Technology Usage by Senior High School Science Teachers

The use of technology in teaching within Senior High Schools has been on the increase amongst teachers. Studies have shown teachers to view technology as a means of aiding pupils develop transferrable skills and even become more inquisitive with regards to subjects being taught. Several studies have highlighted Science teachers' use of technology in the Science classroom. For instance, Loong (2010) conducted a study to investigate Science teachers' use of the internet for teaching in Australia. Out of the 63 secondary Science teachers surveyed, the findings indicated that the teachers use the Internet for finding information such as articles about research or professional issues, or as a source of data for students to analyze in Science lessons. No statistically significant relationships were found between use and competency, professional development, or years of teaching experience.

Similarly, a study conducted by Mereku*et al* (2012) indicated that technology is used in typing examination questions in all institutions and in some cases, educators use technology in processing students' examination results. Their findings further indicated that very few teachers in Ghanaian SHS use technology in their teaching. However, no differences were observed at the pre-tertiary level in the amount of time male and female learners use technology for academic purposes.

Forgasz (2002) surveyed Year 7 to 10 teachers in Victoria to find out how computers were being used in science classrooms and to identify factors that acted as facilitators or hindrances to use. Most teachers felt confident or at least willing to "have a go" at using computers for teaching Science and had used computers with their science classes, but only infrequently. A large proportion of these teachers had participated in professional development in computer education, but most of them wanted more training.

Besides, Goos & Bennison (2008) also conducted a survey to find out teachers' use of technology in secondary Science. Out of 485 Science teachers sampled, 26% indicated they had participated in professional development courses related to computers, the internet and graphics calculators while 16.7% stated they had undertaken no professional course in any of the three types of technology.

However, Boakye and Banini (2008) also conducted a study to find out teachers' readiness for the use of technology in Ghanaian schools. Their findings indicated that out of 221 teachers surveyed, only 24% have received some form of training in the use of computers, with quite minimal training in the pedagogical integration of technology. This indicates that although Science teachers have realized the impact of technology in science, they still need professional training on how to integrate it in their teaching.

Although, technology use in science improves Science teaching and learning, the level of technology use in science fall below average. A report by the National Center for Education Statistics (2005) indicated that 44% of the American teachers used technology for classroom instruction, 42% for computer applications, 12% for practice drills, 41% required research using the

Internet, 27% had students conduct research using CD-ROMs, 27% assigned multi-media projects, 23% assigned graphical presentations of materials, 21% assigned demonstrations, 20% required students to use technology to solve problems and analyze data, and 7% assigned students to correspond with others using the Internet.

Bukaliya and Mubika (2011) surveyed 320 secondary school teachers to find out their competence in ICT. Their findings indicated that only 7.5% of the teachers were knowledgeable and skilled in computer aided instruction. Their findings also revealed that 43% of the teachers used spreadsheet, 37.5% used internet and 46% used email.

Thomas, Bosley, Santos, Gray, Hong, and Loh (2006) also conducted a study to investigate technology use and the teaching of science in the secondary classroom. Their findings revealed that only 36% of science departments have a technology policy, and while 68.4% of teachers had used computers in their lessons, 31.6% had not. However, 75% of teachers would like to use the computer more often, with availability of computers the primary obstacle, and lack of teacher training and confidence also important. This indicates that the level of technology use among secondary school Science teachers is still low.

Keong, Horani and Daniel (2005) conducted a survey to investigate the use of technology and the barriers of integrating technology into the teaching of science. Their findings indicated that the level of technology used by science teachers in their instruction was low. Majority of the Science teachers use technology for word processing (71.1%), spreadsheets (51.2%), internet activity (44.1%), search engines (44.1%), presentation software (36.9%) and databases (21.6%). Out of the 111 Science teachers surveyed, 39.6% of the

respondents stated that they had not used technology at all and 32.1% of them stated that they use technology infrequently. On the other hand, 22.6% of them responded that they had integrated technology into specific areas of instructional units and 5.7% stated that they had fully integrated technology into their instructional programs.

Another similar study conducted by Boakye and Banini (2008) to investigate teachers' readiness for the use of technology in Ghanaian schools indicated that, 71% of the teachers did not use technology in classrooms, 49% of teachers use technology to prepare lesson notes, 55% of teachers have some knowledge of web browsing, 71% use email, and 78% tried to make an effort to learn how to use the computer. These low figures imply that effective integration of technology into Ghanaian classroom instruction has yet to be realized and utilized. Waite (2004) opined that even though teachers show great interest and motivation to learn about the potential of technology, in practice, the use of technology is relatively low and it is focused on a narrow range of applications, with word processing being the predominant use.

Thomas, *et al* (2006) surveyed 32 Science teachers to investigate technology use and the teaching of science in the secondary classroom. Their findings revealed that while 68.4% of teachers had used computers in their lessons, 31.6% had not and 75% of teachers would like to use the computer more often. The findings further revealed that over 90% of the teachers had used calculators in their lessons and the majority of teachers (56.7%) would like to use graphic calculator (GC) more often in their teaching.

Lau and Sim (2008) also gave a self-administered questionnaire consists of six sections to 250 secondary school Science and science teachers in

Malaysia to explore the extent of technology adoption among them. Their findings indicated that teachers less frequently use technology for communication with peers (26%), and for personal development (12%), but frequently use internet for browsing (53%). Their findings further revealed that teachers' computer competency is possibly related to their frequent use of word processing (71%), presentation tools (50%) and courseware (63%) in preparing teaching materials and presenting lessons.

However, a study conducted by Becker (2001) to find out how teachers use computers in instruction revealed that teachers generally used computer technology to support their existing practices (providing practice drills, demonstration) and communication (such as the use of email) rather than to engage students in learning that involves higher order thinking.

Slaouti and Barton (2007) conducted a study to find out the opportunity for newly qualified teachers to use technology in teaching in the secondary school. Their findings revealed that technology most commonly used by teachers was word-processing, spreadsheets and to a limited extent, the Internet.

Similarly, Koo (2008) conducted a study to investigate the factors affecting teachers' perceived readiness for online collaborative learning. Out of the 86 Science teachers surveyed, the findings revealed that, very few of them (24%) indicated they frequently use the Internet, 47% of them indicated they hardly (never or seldom) use it and the rest (29%) indicated they occasionally use it.

Besides, Chigona and Chigona (2010) interviewed 14 educators to find out the factors affecting technology use for teaching. Their findings revealed that the integration of technology in the curriculum delivery was generally low.

Technology use in teaching and learning Science really has the potential to improve the way Science should be taught and enhance students understanding of basic concepts (Ittigson and Zewe, 2003).

Thomas, Tyrrell and Bullock (1996) suggested that the introduction of technology requires a new mind-set on the part of teachers, a shift of Mathematical focus, to a broader perspective of the implications of the technology for the learning of science. This means that Science teachers need to develop knowledge that is pedagogical technological content knowledge that will enable them to use technology in teaching Science.

Factors Influencing the Use of Technology amongst Teachers

A number of factors are responsible for integration of technology by teachers in the educational sector.

Availability of technological tools is a major factor. Studies carried out have shown a limitation in teachers having access to technology that could aid in teaching and other aspects of the educational sector. (Unicef)

Thomas, Bosley, Santos, Gray, Hong, and Loh (2006) in a study drew light on a percentage of teachers not getting access to using computers. Their study further went to outline how the lack of computers was proving a major difficulty for teachers interacting and utilizing technology in teaching. Norris et.al (2003) surveyed rural and urban respondents in California, Florida, Nebraska, and New York to investigate the extent of technology use in K-12 in U.S. Out of the 3,665 teachers surveyed; the analysis revealed that appropriate

access to technology infrastructure is a key factor in the effective technology integration process.

The study revealed substantive correlation between technology access and use. Similarly, Varden (2002) used Ely's conditions as a framework to identify conditions that influence the adoption and integration of laptop computers by teachers in United States high schools. His results indicated that the conditions of "dissatisfaction with status quo," "presence of knowledge and skills," "participation," "commitment" and "leadership," were more prevalent among teachers who were early adopters than late adopters. In addition, the study found that teachers who had a higher degree of technology integration reported greater adherence to all of Ely's conditions than those with a lower degree of technology integration.

Goos and Bennison (2008) surveyed 485 Science teachers in Australia to investigate the factors influencing technology use in science teaching. Their findings revealed that pedagogical knowledge and beliefs, access to hardware and software and participation in professional development course were factors influencing technology use in teaching and learning Science.

Similarly, Mereku, *et al* (2009) conducted a study to investigate pedagogical integration of ICT. Their findings revealed that availability of ICT syllabuses/manual, computers and computer laboratories that can be accessed periodically were factors that influence technology use at the SHS level in Ghana. In order for the school to be proactive regarding technology in the classroom, Williams (1998) argued that the school should have a technology plan, reviewing the curriculum to fit the technology needs in instruction and

ensuring that the staff has skills. He argued for tapping school and community resources to ensure sustainable funding mechanisms.

In a similar study, Valdez (2012) pointed out that if the tremendous potential of technology is to be optimized, educators and community members need to develop a comprehensive learning and technology plan long before technology equipment starts arriving. He further observed that most research studies on technology implementation show that much of the frustration with technology can be attributed to inadequate or non-existent planning. Adequate planning may be especially lacking in how technology is used to improve learning and determining how teachers receive professional development to help enhance student learning.

Also, Bosley and Moon (2010) mentioned case study research in the UK that identified a number of factors that enable teachers to successfully engage in innovative practice. These included the previous involvement in innovations (technology and non-technology based), support at senior management level for implementing new practices and addressing financial implications where appropriate, involvement of several members of staff, a prevailing culture within schools of collaboration and mutual support and willingness to take risks, accepting that some ventures will succeed while others may not.

A study conducted by Martin and Lundstrom (2002) to examine the role of teachers experience as a factor for the integration of computers in schools revealed that almost 60% of the teachers in their study who had under 10 years of teaching experience believed computers in the classroom were essential and

hence they use it extensively, while only 25% of teachers with over 20 years of teaching experience didn't share this belief.

Zidon and Miller (2010) conducted a study to investigate affiliations of attitudes and experience with need for learning computer skills. Their finding indicated that weak relationship existed between years of teaching and technology usage. Conversely, Rosen and Maguire (1990) who reviewed a literature on understanding teachers' perception towards computers and computerized instruction concluded that teachers teaching experience does not eliminate computer phobias and many experienced teachers display some wariness, discomfort and or mild anxiety in relation to computers.

Sia (2010) conducted a study to investigate computer anxiety and computer literacy among urban secondary school teachers in Miri, Sarawak. His findings revealed that the younger, less experienced teachers use computers in a broader, more transformational fashion since these teachers are probably more likely to be computer proficient, will have had more digitally focused teacher education courses, and will be less constrained by prior habits or attitudes than their older, more experienced colleagues.

The findings further revealed that computer literacy levels among secondary school teachers were low, and there were significant differences in computer literacy levels between teachers of different age groups, and teachers with different years of computer experience with different software. (Sio,2000)

However, Gattiker and Nelligen (1998) conducted a study to investigate computer attitude and learning performance for management education and training. Their findings revealed that age does affect teachers' perception of information technology and its usage. Several studies have shown that

participants self-efficacy in technology use significantly influence technology usage.

Samah, Shaffril, Hassan, and D'Silva (2011) conducted a study to investigate what affect perceived ease of ICT usage. Multiple Linear Regression (stepwise method) was used to determine most significant variables that contributed towards perceived ease of ICT usage. Out of the 240 respondents sampled, the findings indicated that self-efficacy was a significant contributor towards perceived ease of ICT usage.

Also, Anderson and Maninger (2007) conducted a study to investigate pre-service teachers' abilities, beliefs, and intentions regarding technology integration. Their findings revealed that students' self-efficacy beliefs significantly influence their intentions to use software in their future classrooms. They further revealed that Students' self-efficacy and intentions were moderately correlated with each other. They however argued that the best predictors of intentions were self-efficacy beliefs, gender, and value beliefs.

Teacher training in the use of tools and technology is another factor that influences the use of technology in teaching. Teachers who are confident and versed in experiencing the use of computers and other related tools will find it easier to implement the use of such technology during classes with students. (Anderson and Maninger,2007).

Research conducted by Crisan (2012) categorized a variety of factors that influence technology use in science into contextual factors and the personal factors. He argued that contextual factors encompass the school context, the availability of and access to technology facilities and resources, teachers' technology skills, teachers' technology professional development,

departmental ethos and key persons in promoting the use of technology and the departmental policy with regard to integrating technology into the Science scheme of work.

Goos and Bennison (2010) surveyed 485 Science teachers in Australia to investigate the factors influencing technology use in science teaching. Their findings revealed that pedagogical knowledge and beliefs, access to hardware and software and participation in professional development course were factors influencing technology use in teaching and learning Science.

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learning and determining how teachers receive professional development to help enhance student learning.

Teachers' Perception on the Role of Technology in Teaching Science

Enjoying a subject like science in high schools is key to making progress, and in so many ways understanding and mastering it. The use of technology in the high schools is definitely of importance in aiding students' progress in their understanding of mathematical concepts. The abacus represents an early stage in the learning curve, in that it is applied in pre high school years, however in advancing past the pre-teen years, a more effective means of imparting knowledge and making students understand mathematical concepts is required.

Advanced tools over the abacus or the geo-board (example – stretching a rubber band over a grid of nails) have been found to be necessary in institutions of learning such as high schools as they aid the grasp of science in a way tools such as an abacus, geo-board, and so forth cannot do (Kaput 2007).

Technology use in teaching Science (education in general) has positively impacted on schools and students most importantly. Research has shown that by the use of technology teachers are of the perception that they are able to build upon students' prior knowledge and skills, emphasize the connections among mathematical concepts, connect abstractions to real-world settings, address common misunderstandings, introduce more advanced ideas.

The above is achieved by the students finding it easier to imagine numbers and the ways they relate to the principles and concepts being presented mathematically. (Bransford, Brown, & Cocking, 1999; Roschelle et al, 2001; djSessa, 2001).

Extent of Technology Use by Senior High School Students

In the rapidly changing and technologically dependent society, students are now faced with the need for a solid understanding of mathematical skills and concepts. One of the key synergisms of science is technology, and as technology advances it inevitably influences what happens in the Science classroom. Research indicates that technology plays essential role in the teaching and learning of science as it influences the Science that is taught and enhances students' learning (NCTM, 2000). Technology influences the skills taught and enhances students' learning. Technology should, therefore, be used to support the learning of science.

In the developed world Students today are apt at using technology, and tools such as laptops, smart phones, and tablets are already second nature to them. (NCTM 2000). However, the same cannot be said of third world countries where accessibility to such technological tools is limited for most students.

Faekah and Ariffin (2013) conducted a survey study on 554 Form Four students to find out gender differences in their computer attitude and skills. Their findings revealed that students were not skilful in computing. Only 17.9% of the students send messages via email, 16.4% search for information on the web and 20.6% print documents or images.

Similarly, Kaino and Salani (2014) surveyed 40 students to investigate gender attitudes towards the use of calculators in science instruction in Botswana. Their findings indicated that majority of students used and enjoyed working with calculators. However, Boakye and Banini (2008) conducted a study to investigate the level of technology use by Ghanaian students. Out of the 5048 students surveyed, the findings indicated that 62% use the computer

for general knowledge while 13% use it for academic purposes. Their findings further revealed that 13% of the students use it for communication whereas 10% use it for research. These findings indicate that technology use is gradually gaining grounds among Ghanaian students.

Factors Influencing the Use of Technology amongst Students in Learning Maths

In a similar situation to the relations between teachers and factors affecting their use of technology in teaching, the use of technology by students will be most likely be influenced foremost by accessibility. Not having access to tools like computers, calculators would definitely affect adversely the use of such technological tools by students.

Another factor that can be considered as playing a part where use of technology by students is concerned is pre-disposal to technology. Being familiar with computers, calculators, smart phones, tablets and more is an advantage where the use of technology in learning in senior high schools comes into play. Students who already are familiar with such technology will find it much easier making the transition from the outside world of using such objects for socialising in their day to day activities to activities involving learning in the classroom. Being conversant with the use of such tools will make their use and adaptation in learning Science and other subjects a much smoother/easier process.

Impact of Technology in Teaching and Learning Science

The important role that Science plays in the overall personal and intellectual development of the individual cannot be underestimated. Science is perceived as an interrelated structure of ideas, principles and processes and

in teaching; its connections among basic concepts should be established to make learning easy for students (Reys, Suydam, & Smith, 1998). Science teaching and learning is crucial to the future of Ghana's knowledge economy and deserves a special focus in education.

Effective Science teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well (NCTM, 2000). Besides, students must learn Science with understanding, actively building new knowledge from experience and prior knowledge. Therefore, teachers must endeavor to make Science easy for students to understand the various concepts taught with ease.

In the rapidly changing and technologically dependent society, students are now faced with the need for a solid understanding of mathematical skills and concepts. One of the key synergisms of science is technology, and as technology advances it inevitably influences what happens in the Science classroom.

Research indicates that technology plays essential role in the teaching and learning of science as it influences the Science that is taught and enhances students' learning (NCTM, 2000). Technology influences the skills taught and enhances students' learning. Technology should, therefore, be used to support the learning of science. In so doing, NCTM (2000) recommends that technology must be embedded in the Science program, rather than provided as a supplementary element.

Using technology in science classroom provides ample learning opportunities for the students. According to Wahyudi (2008), technology enables students to learn from feedback. The computer (technology) often

provides fast and reliable feedback to students. It enables students to produce many examples when exploring mathematical problems. Technology helps students to see patterns and connections. The computer enables formulae, tables of numbers and graphs to be linked readily. The use of technology allows students to work with dynamic images that cannot be done within traditional teaching. Students can use computers to draw graphs and manipulate diagrams dynamically. Technology enables students to work with real data which can be represented in a variety of ways. This supports interpretation and analysis that lead students to higher order mathematical thinking skills.

A study conducted by Roschelle, Pea, Hoadley, Gordin, and Means (2000) supported the use of technology in teaching and learning Science. Their finding indicated that computer technology can help support learning, and that it is especially useful in developing the higher-order skills of critical thinking, analysis, and scientific inquiry. The study explores the various ways computer technology can be used to improve how and what children learn in the classroom by helping students understand core concepts in Science. According to them computer-based Science builds confidences and is a great tool for remediating slower learners.

Collinson (1999) observed that with the use of technology in the Science classroom, students are saved from becoming bogged down in the difficult computations. This allows them to turn their focus to understanding the concepts and how to apply them. Technology also allows open-ended assignments in which the students can learn concepts by "discovery" and are more likely to retain the concepts. The students can also experiment and view different results and methods of solutions to different problems. Without the

use of technology, students spend majority of their time and energy attempting to memorize rules and procedures while using sample exercises as models for their homework problems.

The power of technology leads to fundamental changes in science instruction. Dreyfus (1991) opined that 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 science.

Munirah (2015) also observed that the teaching of calculus has seen a dramatic change now that activities such as exploring data or graphical data analysis have been transformed by the computer technology. In view of this, weaker students often are better able to succeed with the help of technology, and thereby come to recognize that Science is not just for their more able classmates (Wimbish, 1992).

Furthermore, Tall and Ramos (2004) opined that Technology use in science instruction assist the learner in visualizing the process and concept role of symbols, which reaches great heights in calculus. Technology allows real-world applications to be more readily used in the classroom (NCTM, 2008). Besides, Kaino (2008) argued that Technology enhances Science learning by furnishing visual images of mathematical ideas, facilitating the organization and analysis of data, as well as computing efficiently and accurately.

Moreover, there are several reasons for incorporating technology into science instruction. According to Ittigson and Zewe (2003) technology is essential in teaching and learning Science. Technology improves the way Science should be taught and enhances students understanding of basic

concepts. It deemphasizes algorithmic skills resulting in an increased emphasis on the development of mathematical concepts.

Becta (2013) however summarized the key benefits of technology in science instruction as follows: firstly, technology promotes greater collaboration among students and encourages communication and the sharing of knowledge. Secondly, technology gives rapid and accurate feedback to students and this contributes towards positive motivation. Finally, the use of technology in science also allows students to focus on strategies and interpretations of answers rather than spend time on tedious computational calculations.

Technology also supports constructivist pedagogy, wherein students use technology to explore and reach an understanding of mathematical concepts. This approach promotes higher order thinking and better problem solving strategies.

Challenges of Teachers in Utilizing Technology to Teach Science

It is true that the promotion of such teaching strategies will definitely have positive impacts wherever they are brought to bear. However, before such levels of teaching experience and ability can be achieved a number of problems have to be overcome in ensuring such teaching procedures can be effectively implemented across most schools

A problem most likely to be encountered in the educational sector making strides in tutoring students using technological tools for better progress in grasping Science will have to do with current teaching ability. A great number of teachers will have to learn new skills, not only with regards to how to use these tools, but also in the general methods they employ in teaching.

Many teachers graduated from schools which tackled the teaching of science using quite different concepts to what is required in the educational sectors as of now. A related study conducted in the United States, by the National Council of Teachers of Science (NCTM) realized similar problems in the educational sector in the teaching of science. To date such problems continue to persist.

Training of said teachers requires the creation of workshops and forums by the educational sector and government as a whole. Such forums or workshops ideally would have to look at exploring new ways to use technology to see about the teaching of science in schools by present, and upcoming graduate teachers.

Not all schools will find it easy implementing changes in their teaching personnel and the skills they relate to students with. Government budgets for various schools possibly varies, or if not the case inadequate funds available to schools' administrative authorities can hamper the procuring of technological tools to facilitate better teaching of science amongst students.

Another problem has to do with student exposure and this to an extent can be related to the above problem in that in certain regions and districts the students are not familiar with basic technology and tools that could and would be utilized in teaching to help them grasp mathematical concepts more readily. It would require time, and effort which in the long run translates into funds being spent, introducing them to such tools and making it easier for them to relate to subsequent teaching methods which utilize technology in teaching Science.

There is also the likelihood of some teachers considering the introduction of technology into learning as a negative in that they would

perceive the use of smart phones (which all carry multiple applications for accessing internet websites and more), and other devices as distractions to the students during tutelage. Teachers might decide that the use of technology could pose problems of monitoring students and making sure they are truly using such devices in relation to what is being thought and not indulging themselves in non-beneficial activities such as accessing social networks.

Research has shown that it plausible that implementation of measures teaching Science with the use of technology may not necessarily yield results as in improved learning and understanding of science by the students. A case study featured in the New York Times United States on a school in the Kyrene district (Matt Ritchel, New York times, September 3, 2011) showed that despite considerable investments by the institute's administration academic records show low standardized test scores. The implementation of technology in teaching Science did not yield the desired results over a period of time.

There definitely are advantages, and major ones with the implementation of technology in teaching, particularly where the subject of science is concerned. Ghana being a third world country no doubt will have difficulties implementing such procedures in the senior high school curriculum across the entire country. However, if the country is to keep pace at some levels with the rest of the developing world, and even other third world countries there must be a greater implementation of such knowhow.

Technology and Science are key to development and progress in any society. Engineering, architecture, communication and so much more are all supported by understanding Science at a fundamental level and more thus the

need for implementing adequate measures such as using modern technological tools in the educational sector cannot be overemphasized.

CHAPTER THREE

RESEARCH METHODS

This chapter presents the methodology that was employed in the study. It is made up of the research design, the population, sample and the sampling technique(s) that was employed. The chapter also describes the instruments for data collection and the data collection method that was employed. The chapter also looks at the data analysis method that was used.

Research Design

According to Katundu (1998) the purpose of a study and its objectives determine the type of study employed for a study. Considering the nature of the problem and purpose of this study which seeks to the ICT use among Ghanaian SHS science teachers, the most appropriate study's methodology that was used is the descriptive survey design.

Generally speaking descriptive study according to Busha and Harter (1980) is capable of collecting background information and hard – to – find data and the researcher would not have the opportunity to motivate or influence respondents' responses. Sproull (1995) as cited in Iddrisu (2009) recommends the survey technique for studies where attitudes, ideas, comments and public opinion on a problem or issue are studied.

Survey research design, however, have limitations in that they do not involve a treatment being given to participants. Because survey researchers do not experimentally manipulate the conditions, they cannot explain cause and effect; instead, they describe trends in the data rather than offer rigorous explanations. Survey researchers often correlate variables, but their focus is

directed more toward learning about a population and less on relating variables or predicting outcomes (Creswell, 2012).

Bell (2004) opined that surveys can provide answers to the questions what, where, when, and how? But it is not so easy to find out why?

The study also used mixed-method approach. Mixed-method approach combines both qualitative and quantitative methods of research. Tashakkori and Teddlie (2003) argued that multiple methods are useful if they provide better opportunities for a researcher to answer research questions and where the methods allow a researcher to better evaluate the extent to which the research findings can be trusted and inferences to be made from them. Not only is it perfectly possible to combine quantitative and qualitative within the same piece of research, but in our experience it is often advantageous to do so (Saunders, Lewis &Thornhill, 2007).

Quantitative methods ensured high levels of reliability of data gathered. Qualitative research, on the other hand, made it possible to obtain more in-depth information about the extent of technology use among SHS Science teachers and students in Ghana. The purpose of gathering different types of data was to understand more fully, to generate deeper and broader insight, to develop important knowledge claims about the extent of technology use among Ghanaian SHS Science teachers and students and the factors that influence their use. Besides, Quantitative methods enabled me to gather numerical data on SHS Science teachers' and students' use of technology in teaching and learning and also investigated the factors that influence their use.

Qualitative methods on the other hand enabled me to collect non-numerical data on science teachers' beliefs about technology use in SHS

science. Each approach has its particular strengths and, when used together, could provide a thorough picture of the study (Onley& Barnes, 2008).

Population

DeVos (1998) defined population "as a set of entities for which all the measurements of interest to the practitioner are represented". Population is therefore, all the individual or items of interest under consideration.

The population of the study comprised of all public Senior High School (SHS) Science Teachers and students in the Atwima Kwawoma District in Ashanti region of Ghana. Ashanti region was chosen for this study because I have been teaching Science in the region for the past four years and familiar with the academic environment in the region. Science teachers were used in the study because the Science curriculum in particular emphasizes the use of technology in the teaching and learning process and that is an area of specialization from which a lot of pre-existing knowledge and experience was available.

Sample and Sampling Procedure

Stratified sampling technique was used to select 40 Science teachers and 200 students from public SHS in the Atwima Kwawoma District of Ashanti region in Ghana. Stratification is the process of dividing members of the population into homogeneous subgroups before sampling. The strata should be mutually exclusive: every element in the population must be assigned to only one stratum. The strata should also be mutually exclusive: no population element can be excluded. Then simple random sampling is applied within each stratum. This often improves the representativeness of the sample by reducing the sample error.

According to Mason, Lind and Marchal (1999) a stratified random sampling is when the population is first divided into subgroups, called strata. A sample is then selected from these subgroups and then the sample for the study is thus selected from the stratum. The steps in stratified sampling are as follows:

1. Divide the population into strata (e.g. Subgroups)
2. Select groups of strata to be used
3. Select individual elements or participants from the selected strata.

Stratified sampling technique was used in this study because most of the Senior High Schools in Ashanti region are resided in both rural and urban districts. Therefore, to be able to get equal representatives of Senior High Schools from both rural and urban settings, stratified sampling technique was employed.

A simple random sampling technique was employed to select four (4) SHS from urban area and four (4) SHS from the rural area of the district. Five Science teachers were then selected from each school in both rural and urban areas making a total of 40 teachers. Twenty five (25) students were also selected from each school in both rural and urban towns making a total of two hundred (200) students. This sampling technique was used because it affords all the members under consideration the equal chance of being selected and this would also help cater for gender.

The frequency distribution of the sample procedure shows that equal number of teachers and students were selected from both rural and urban SHS.

Instrument for Data Collection

The main instrument used in this study is questionnaire. Both closed ended and opened ended questions were used. The opened ended questions were

used to allow the respondents to express themselves without any given limit. The questionnaire, which was used, was adapted and modified from Rodden (2008). The items in the instrument were based on the objectives of the study. The items were put into six sections. Section one, sought information on the demographic characteristics of the respondents (personal data), including age, gender, educational background, experience in computer use. Section two, looked at the level of requisite training and qualification of ICT teachers including computer usage, Hardware, personal interest, and. Section three, looked at the level of ICT integration in the school for ICT facilitators including years of experience, their access to computers, factors affecting the use of computers in the school. Section four, looked at the barriers of ICT in teaching. Section five looked at attitude and perception of students and teachers towards the use of ICT.

Pilot Testing of the Instrument

It is easy to overlook mistakes and ambiguities in question layout and construction when designing a questionnaire (Wilkinson & Birmingham, 2013). Besides, Awanta and Asiedu-Addo (2008) also cautioned that it is possible to design a questionnaire that is reliable because the responses are consistent, but may be invalid because it fails to measure the concept it intend to measure.

In view of this, the survey instrument was pilot tested. A pilot test of a survey questionnaire is a procedure in which a researcher makes changes in an instrument based on feedback from a small number of individuals who complete and evaluate the instrument (Creswell, 2012).

Science teachers and students from the same context where the study was to be conducted were chosen because they represented the targeted

respondents of the study. Twenty (20) SHS Science teachers and twenty one (21) students from Afia kobi Girls SHS, Trede SHS and Twedie in the Atwima Kwawoma District of the Ashanti Region were used in the pilot study.

The feedback of the respondents helped to improve the quality of the survey in terms of content coverage, content validity and reliability. The teachers' questionnaire yielded a reliability coefficient of 0.682 and the students' questionnaire had a reliability coefficient of 0.701. The reliability coefficients of both questionnaire were comfortably above 0.5.

Data Collection Procedure

An introductory letter was collected from the Department of Information Technology at the University of Cape Coast's College of Distance Education. The Introductory letter was then given to the headmasters of the participating SHS. With consent from the Headmasters, the Heads of the Science department of the participating schools were informed about the study. The questionnaire was then administered personally to the Science teachers and the students to help improve the collection and response rate of the questionnaire.

Methods of Data Analysis

The data collected was checked for consistency. Microsoft Excel and Statistical Package for the Social Sciences (SPSS) version 24.0 was the software used for the analysis. Frequency Tables were used in presenting the data.

The Interface for data analysis was designed from the variable view of SPSS data editor where, each of the items in the instrument was given a unique name. The possible responses of each item were also assigned a unique code. For instance items that had four possible responses (A), (B), (C), (D) and (E)

were assign I, 2, 3,4 and 5 respectively. This was to allow easy data inputting and analysis. Items in the Instrument that required multiple responses were coded using yes or no for each of the responses. When a respondent checks a response it is considered to be yes, but if the response is left unchecked it is considered to be no. During analysis all items checked were aggregated and the percentage count.

Where more detailed comparisons were required cross tabulations of the various variables were carried out. For instance number of males and females who responded to the instruments in each school could only be achieved by a cross tabulation of the variables: Names of school and Gender.

Summary

The study was conducted to investigate the factors that influence the use of ICT among SHS Science teachers and students in Atwima Kwawoma District of the Ashanti region of Ghana. The data collected from both teachers and students were analyzed by using descriptive and quantitative procedures.

CHAPTER FOUR

RESULTS AND DISCUSSION

This chapter presents the results and discussion of this study on the use of technology in senior high schools in the Ashanti region of Ghana. The demographic characteristics of teachers in senior high schools in the Atwima Kwawoma district, their knowledge and use of computers as well as their perceptions on the role of technology in teaching.

Data was also gathered on students of the selected high schools. It investigated their demographic characteristics such as age, sex, and school educational level. Also investigated in this part were the student's use of computers at school and at home as well as factors they felt were influencing their use of technology in learning during classes.

The results and data gathered on teachers and students were summarized and presented in the form of frequency distribution tables. Descriptive analysis was used to summarize the data and discussed in order to interpret the results obtained.

Background of Respondents

These characteristics include age, sex, and educational background of the 40 teachers involved in the study. These were thought to have significant bearing on the study particularly with regards to age and educational background of the teachers. Studies have shown that younger teachers in general encompass the use of technology to a greater extent than their much older counterparts (Sia, 2000).

A total of 40 teachers from a number of selected high schools in the Atwima Kwawoma District were involved in the study.

Table 1 shows the gender distribution of teachers from the senior high schools in the Atwima Kwawoma District.

Table 1: Gender distribution of the teachers from the Senior High Schools

Gender	Response	Percentage
Female	15	37.5
Male	25	62.5
Total	**40**	**100**

Field source: Afia kobi Ampem Girls SHS

Out of the 40 teachers selected, 15(37.5) were females and 25(62.5) were males.

Table 2 shows the age distribution of teachers in the selected schools.

Table 2: Age distribution of Teachers

Age	Response	Response Percentage
25 – 29	7	17.5
30 – 34	13	32.5
35 – 39	11	27.5
40 – 44	8	20.0
45 – 49	1	2.5
Total	**40**	**100**

Table 2 reveals that the majority of ages of the teachers fell below the 35-39 year mark. As can be seen from table 2 only one teacher was categorized in the range of 45 – 49. From the data presented in table 2 it was determined that most of the teachers involved in the study were relatively young, and ideally, they would be more exposed to the use of technologies such as computers and other gadgets as compared to older generations of teachers (those

falling in the ranges of 40 – 44 and over) and by this would be predisposed to utilizing technology in teaching in class.

This finding is significant because in a study by Zidon and Miller (2002), they outlined that there is a weak relation between years of teaching and computer usage.

Furthermore, Sia (2000) found that younger, less experienced teachers are more likely to be computer proficient and would have had more experience in the use of computers and technology in teaching as compared to their much older counterparts. With the majority of teachers involved in the study being young, and with less experience, most of them could be expected to have considerable exposure to computers.

Table 3 shows the teaching experience of science teachers sampled for the study in the Atwima Kwawoma District.

Table 3: Teaching Experience of teachers

Items	Response	Response Percentage
1 – 4	13	32.5
5 – 9	14	35.5
10 – 14	11	27.5
15 – 19	2	5.0
Total	**40**	**100**

As can be determined from table 3, teachers with 5 – 9 years of teaching experience constituted the highest percentage (35.5. Those with 1 – 4 years' experience made up the next highest percentage at 32.5 with 13 teachers. The

smallest percentage was 5.0 recorded for teachers falling into the 15 – 19 year group with two teachers.

Martin and Lundstrom (2002), determined that teachers with 10 years of teaching experience used computers and technology in class work more as compared to teachers with over 20 years' experience who were perceived to employ the use of computers and other technology on a much lesser scale in class. Table 3 reveals that the greater percentage of teachers involved in the study of selected schools from the Atwima Kwawoma District in the Ashanti region had less than 9 years of teaching experience.

Comparing this to findings by Martin and Lundstrom (2002), it can be stated that this characteristic of the sample population with regards to teaching experience will facilitate the greater number of teachers either employing the use of technology in class or being of the perception that technology use in teaching is beneficial and thus they would be willing to embrace it as well.

The gender of the students used in the study is reflected in Table 4.

Table 4: Gender of Senior high school students involved in the study

Gender	Response	%
Female	94	47
Male	106	53
Total	**200**	**100**

Field source: Rapheal Data

Of the 200 students involved in this study from selected schools in the Atwima Kwawoma District of the Ashanti region, 106 (53%) were males, and the remaining 47% females.

Their age distribution was represented in three age ranges as depicted in table 5.

Table 5: Age of Senior high school students

Age	Response	%
15 – 19	163	81.5
20 – 24	36	18.0
25 – 30	1	0.5
Total	**200**	**100**

Source: Field Data, Okoreeh (2020)

The greater number of students fell in the age range of 15 – 19 years with a percentage figure of 81.5. The next highest figure at 18% constituted the age range of 20 – 24 year olds, whilst 25 – 30 year olds had only a single individual at 0.5%. The students selected were taken from various academic levels in the senior high schools involved in the study.

The classification of respondents is presented in table 6.

Table 6: Educational level of Senior high school students

Form	Response	%
Form 1	0	0
Form 2	66	33.2
Form 3	134	66.8
Total	**200**	**100**

Field source: Rapheal Data.

Form 1 academic level had no students involved in the study. Form 2 had a percentage figure of 33.2 of students involved in the study. Form 3 had the highest percentage of participating students at 66.8%.

Ideally, these students would have at least a year of educational experience at their various institutions. They would be able to supply appropriate information pertaining to the study in relation to the use of computers, computer availability and other related queries related to ICT integration in teaching.

Analysis of Main Data

Research Question 1: **To what extent do SHS Science teachers use technology in teaching?**

The first research question sought to identify the extent to which teachers of Science in the Atwima Kwawoma District use technology in teaching. The responses to these questions are shown in Table 7.

Table 7: Availability of ICT Resources in Schools

Item	Yes		No	
	N	%	N	%
1. Presence of a Computer lab in the school	38	(95)	2	(5.0)
2. Teachers who own a Computer	35	(87.5)	5	(12.5)
3. Presence of projectors in the Lab	22	(55)	18	(45.0)
4. Presence of specialized software	1	(2.5)	39	(97.5)
5. Participation in Professional Development Courses	6	(15.4)	33	(84.6)

Field source: Rapheal Data

Table 7 is a summary of the responses of the teachers with regards to resources being present in their school computer laboratories. It was realized from item 1 that 95% of the teachers confirmed the presence of computers in the computer laboratory of the school they teach. This is certainly to be seen in a positive light. However, item 1 above illustrate that despite the high percentage of responses stating that computers were present, the number of computers available to teachers was however considerably low.

The analysis further show that teachers in possession of a computer. Here, most of the teachers possess computers (87.5%). However, possession of a computer does not necessarily imply such teachers will be implementing the use of technology during class hours at schools. It can be however stated that teachers in possession of personal computers would probably show a higher level of familiarity with computer use, more confidence and capable and also favor the use of technology in the class room as compared to their colleagues who do not possess computers.

The use of projectors in teaching is another aspect of technology implementation that can be encouraged or strengthened in schools. Projectors aid in the depicting of diagrams and illustrations for students to be able to better view and understand these diagrams when they are being explained by the teachers during class. Responses of the teachers from item 3 revealed that 55% of the ICT labs from the schools they worked in had projectors, whilst 45% did not.

Requisite software for teaching Science facilitates the implementation of technology in teaching. It also enables students to grasp mathematical concepts easily, facilitates a better understanding of science as a whole, and

makes the teaching process easier and more enjoyable for both teachers and students.

The data in table 7illustrate the dismal state of software's on computers in the school ICT laboratories in relation to this study. The mere presence of computers does not ensure that teachers will be equipped with the necessary tools and skills in order to utilize such technologies in the teaching process.

Up to 97.5% of the teachers responded that computers in their ICT labs do not have software specialized for teaching Science. This state of affairs will adversely affect implementation of technology in teaching Science in these schools.

Another cause for concern is the lack of training in courses related to the integration of ICT in teaching Science as shown in item 5 of table 7. Use of software, computers and other equipment in teaching Science and other subjects in class requires the right training and acquisition of certain skills.

The analysis in table 7 further illustratesthat 33 (84.6%) of the teachers did not have any training in ICT courses that would enable them implement the use of software and other technology in teaching. Only 6 (15.4%) respondents claimed to have had some training by their taking part in ICT courses.

The above results seem to conform to similar findings in studies conducted by Boakye and Banini (2008) who found that out of 221 teachers involved in a survey in Ghana, only 24% had received some form of training in the use of computers and pedagogical integration of technology. Clearly there is the need for more to be done to train teachers and adequately equip them in the use of ICT in teaching.

The respondents were asked about the use of computers in the school laboratory. The result is presented in Table 8.

Table 8: Use of Computers in Schools

	Response		
Range	Computers in School Lab	Computers in good use	Computers connected to Internet
None	0 (0)	0 (0)	11 (27.5)
1 – 10	0 (0)	0 (0)	2 (5.0)
11 – 20	7 (17.5)	8 (21.1)	11 (27.5)
21 – 30	10 (25.0)	17 (44.7)	10 (25)
31 – 40	15 (37.7)	6 (15.8)	1 (2.5)
41 – 50	5 (12.5)	5 (13.2)	2 (5)
51 – 60	2 (5.0)	2 (5.2)	1 (2.5)
61 and over	1 (2.5)	0 (0)	2 (5)

Field source: Rapheal Data

The highest response was for 30 – 39 (15 computers) being available in the school laboratories. This accounted for 37.5% of the feedback from teachers on computer availability in their school laboratories. The next highest response was 10 teachers indicating that 20 – 29 computers were available in their school computer laboratory.

Mereku *et al* (2009) in their study revealed that computers and computer laboratories that could be accessed periodically to be a significant factor influencing the use of technology use at senior high school level in Ghana. The respondents were also to provide information on the number of computers in good use in their school laboratory.

Clearly, there is the need for improvement in the numbers of computers in good use for use by teachers involved in the study. The highest response was

for 17 teachers indicating that 21 – 30 of computers on the average were in good use in their schools.

On computers connected to the internet the highest responses of 11 was obtained for no computers being connected to the internet as well as for 10 – 19 computers being connected to the internet. The next highest response was that of 10 for the range of 20-29 computers being connected to the internet. This response accounted for 25% of the total responses obtained from the 40 teachers.

Table 9 shows the various activities that teachers of science can use the computer to undertake and the results are presented below.

Table 9: Teachers Use of Computers

	I use computers to (Activity)	Yes	%	No	%
1.	To find information on the internet for teaching	37	(92.5)	3	(7.5)
2.	To communicate with colleagues and students	36	(90.0)	4	(10)
3.	To prepare teaching notes/materials using MS Word	32	(80.0)	8	(20.0)
4.	To create spreadsheets (MS Excel)	15	(37.5)	25	(62.5)
5.	To create databases (MS Access)	4	(10.0)	36	(90.0)
6.	To make presentations (PowerPoint)	27	(67.5)	13	(32.5)
7.	To send E-mail	36	(94.7)	2	(5.3)
8.	To attach files to an email message	25	(62.5)	15	(37.5)
9.	To investigate the nature of graphs of functions	1	(2.5)	39	(97.5)
I use calculators					
10.	To express recurring decimals as common fractions	38	(95.0)	2	(5.0)
11.	To calculate the mean, median, and standard deviation	39	(97.5)	1	(2.5)

Field source: Rapheal Data

Use of computers for finding information on the internet had a response of 92.5% for yes as illustrated by table 9. Only 7.5% of teachers responded they did not use the internet for finding information on the internet. This can be looked at as an ideal situation in that teachers are actively using the internet to obtain information to complement their teaching skills and knowledge. Up to 90% of teachers responded they used the internet to communicate with colleagues. This was probably through the use of social media such as Facebook, Google groups and other related websites. Again, this is positive since such social websites are major communication highways that enable individuals to share ideas easily and quickly over great distances.

About 80% of the teachers responded yes to using computers by employing Microsoft word to prepare their teaching notes, however only 37.5% made use of Microsoft excel and its spreadsheets. The figure was even lower for responses of yes (10%) on the use of Microsoft access to create databases. These results could be possibly due to teachers not having the required knowledge as to how to use these software tools, and also not knowing of the capabilities of such software and how they can be applied in the teaching process.

Power point presentations had a better response of 67.5%. This is favorable in that the greater majority of teachers are utilizing power point as a means of conferring concepts and ideas to their students. This use of power point could also be linked to the use of projectors since the power point software package tends to be used with projectors or other large screen presentation hardware.

The analysis shows further that 94.7% of the teachers responded yes to using computers to send e mails, whilst 62.5% of teachers used computers available to them at schools to attach files to their e mail messages during correspondence. Responses of teachers on their use of computers to investigate the nature of graphs of functions yielded 97.5% answering no.

Again, this could be due to the teacher's lack of knowledge or skill sets as to how to use the computers with regards to this activity. Analyzing of graphs using computers (excel spread sheets) is important in the teaching of science, statistics in class. Teacher with adequate knowledge on the use of computers in relation to graphs and functions can better explain the relevance of graphs and their use in interpretation of data for the benefit of students.

The use of calculators was investigated in relation to questions 10 and 11; 95% of teachers used calculators in representing recurring decimals as common fractions. The greater majority of teachers responded yes to using calculators to determine mean, median, and standard deviation. These results for activity 10 and 11 illustrate that the teachers as a greater majority have an adequate knowledge of the use of calculators and are implementing these technological tools in the teaching of science in their classes or in related educational activities.

The findings revealed that the Science teachers often use technology for general computer applications such as finding information on the internet for teaching, communicating with colleagues and students, sending emails, attaching files to email messages and preparing notes for teaching.

However, the extent to which these teachers use technology in teaching Science was very low. This finding is consistent with the findings of Boakye

and Banini (2008) who concluded that majority of the teachers in SHS level in Ghana do not use technology in classrooms but often use technology to prepare lesson notes, browse the web and send emails.

Moreover, Becker (2001) concluded that teachers generally use computer technology to support their existing practices (providing practice drills, demonstration) and communication (such as the use of email) rather than to engage students in learning that involves higher order thinking. This indicates that the use of technology in science instruction is yet to be realized and utilized.

It is quite surprising that the extent to which the SHS Science teachers use technology in teaching is very low even though majority of the teachers believe that technology plays important role in teaching and learning Science. The Science teachers' low technology use was found to be partly due to the fact that the Science teachers had little opportunity to participate in professional development courses related to technology integration.

Research Question 2: Which factors influence the use of technology among teachers in teaching Science?

The second research question sought to find out which factors influence the use of technology among teachers who teach Science in the Atwima Kwawoma District.

Factors that would make Science teachers use computers to teach are shown below in Table 10.

Table 10: Factors that would be more likely to make teachers use computers in the classroom to teach Science

	I would use computers in the classroom (Factor)	Yes	%	No	%
1.	If every student would use computer during the class	36	(90.0)	4	(10.0)
2.	If teacher use technology(computer) in their lesson delivery	38	(95.0)	2	(5.0)
3.	If every student provided their own computer	30	(75.0)	10	(25.0)
4.	If I could receive more training on how to use them in teaching Science	35	(62.5)	5	(37.5)

Table 10 investigated factors which could influence teacher use of computers in the classroom. Yes accounted for 90% of the responses from teachers that they would use computers if every student in their class had access to one during tutoring hours. The next finding had 95% of teachers responding they would use computers if it was made compulsory by heads of their institutions. Whilst 75% of teachers responded yes they would use computers in class if students provided their own computers. The final factor of if I could receive more training on how to use them in teaching Science resulted in 65% of teachers responding yes as to them using computers in class.

The data presented in table 10reveal that teachers involved in the study are willing to employ technology use in teaching in class, provided there is adequate provision of related tools such as computers and other accessories (projectors etc.) which will facilitate their implementation of ICT.

Further, responses of the teachers as demonstrated in table 10outlines the teachers recognizing the need for their being adequately trained in the use of ICT in order to implement it in teaching. These findings are also reflected in similar studies by Forgasz (2002), Goos&Bennison (2008) and Boakye and Banini (2008), in which it was realized that teachers involved in these studies all required professional training on integration of technology in teaching. Clearly this is a problem facing not only schools in the Ashanti region on which this study is based, but it also an international problem facing education in other regions and countries.

It is now clear that if students have access to computers and it is made compulsory for teaching in the classroom coupled with the requisite training that teachers need, Science teaching would be made easier.

Research Question 3**: How do teachers perceive the role of technology in the teaching and learning of science?**

The third research question sought to find out teachers perception on the role and effects of using technology in the teaching and learning of Science. Data gathered on this is presented from table 11 to 13.

Table 11: Effects of introducing technology into the classroom on teaching

Item	Response	Percentage
Easier	39	97.5
More complicated	1	2.5
Total	**40**	**100**

Field source: Rapheal Data

The results presented in table 11 were further consolidated by the opinions of these teachers in relation to the effect of technology use in teaching

on student learning ability. A majority of 97.5% were of the opinion that students learn better when technology is employed in teaching.

Data was also gathered in respect of whether there would be any effects on students learning abilities if Science lessons are delivered with technology. Information on that is presented in Table 12.

Table 12: Effect on student learning ability if lessons are delivered with computers, calculators and other technological aids.

Item	Response	Percentage
True	39	97.5
False	1	2.5
Total	**40**	**100%**

Table 12 revealed that 97.5% of teachers taking part in this study were of the view that Science as a subject can be suitably thought using technological aids or accessories.

Table 13 shows if Science as a subject is suited to the use of technological aids.

Table 13: Science as a subject being suited to the use of technological aids in its teaching.

Item	Response	Percentage
True	39	97.5
False	1	2.5
Total	**40**	**100%**

Clearly the majority of teachers are of the opinion that technology use has many advantages in the teaching process. It aids teachers in conveying the

required information to their students, and also enables students to learn and better under what the teachers are presenting to them in class.

Research Question 4: **To what extent do SHS students use technology in learning Science?**

This research question sought to assess the extent to which students in the Atwima KwawomaDistrict use technology in learning Science. Tables 14 – 21 summarized data on the students' technology usage in school and at home.

Student's response on the presence of computer laboratories in their schools is presented in table 14 below.

Table 14: Students' response on presence of computer laboratories in their schools.

Presence of a computer laboratory in school	Response	Percentage
Yes	181	91.4
No	17	8.6
Total	**198**	**100%**

A total of 198 students responded to the query on the presence of a computer laboratory at their school. Of this number 91.4% responded yes to having a computer laboratory in school. Only 8.6% responded no, that there was no computer laboratory present in school. This is an ideal situation in that the vast majority of students as depicted in table 14 involved in the study claimed their school had a computer laboratory.

Mereku et al (2009), investigations revealed that availability of computers and computer laboratories are factors that influence the use of

technology at senior high school levels in Ghana. With such a high percentage of students responding that computer laboratories are present at their schools it can be seen that such facilities being available would augment the integration of ICT in teaching in such schools.

Findings on the availability of computers in laboratories can be found in Table 15.

Table 15: Availability of ICT Resources in Schools

	Response		
Range	Computers in the School Lab	Computers in good use	Computers connected to the Internet
None	2 (1.1)	2(1.1)	122 (66.3)
1 – 9	5 (2.7)	25 (13.4)	33 (18.0)
10 – 19	19 (10.3)	66 (35.5)	8 (4.3)
20 – 29	91 (49.2)	53 (28.5)	8 (4.3)
30 – 39	29 (15.7)	10 (5.4)	4 (2.2)
40 – 49	17 (9.1)	24 (12.9)	3 (1.6)
50 – 59	10 (5.4)	3 (1.6)	3 (1.6)
60 and over	12 (6.5)	3 (1.6)	3 (1.6)

Field source: Rapheal Data

The number of computers available in computer laboratories of the various schools had a highest response as seen from table 15 for the range of 20 – 29 computers being available. The next highest percentage result for computer availability was recorded for the range of 30 – 39 computers being available. This was followed by 10 – 19 computers being available. From table 15, only two individuals responded as to there being no computers available in their school laboratories. The ranges of 30 – 39, 40 – 49 and over with regards to

number of computers being available accounted for responses below the 20% mark.

From these results it can be deduced that schools involved in the study are not adequately supplied with enough computers in relation to their school populations. Most senior high schools have student populations numbering in the hundreds. However from the table, it is realized that the number of computers present in the school computer laboratories will not be adequate enough for effective use and practice by the student populations of these schools.

It was realized from the figures in table 15 that not enough computers are available for the student populations of the various schools. However of those computers available not all are in usable condition as the results in table 15 illustrate.

Information on computers connected to the internet were also presented in Table 15. From the table it can be discerned that the greater percentage of responses was for computers not connected to the internet at 66.3%. The next highest response was for 1 – 9 computers being connected to the internet (18%). An examination of the data in table 15reveals that the remaining ranges for number of computers connected to the internet each accounted for responses under 5%. It is clearly evident that most of the computers being used by students are not connected to the internet.

The number of times students attend ICT classes is presented in table 16.

Table 16: ICT Class Attendance of Senior High School Students

Item	Response	Percentage
Everyday	19	9.5
Once a week	140	70.0
Once a month	8	4.0
Once a term	6	3.0
Never	27	13.5
Total	**200**	**100%**

Field source: Rapheal Data

ICT class attendance of the senior high school students was investigated using the queries of everyday, once a week, once a month and so forth as presented in table 16. Students who attend ICT class once a week accounted for 140 (70.0%) of the responses. The next highest response was 27 (13.5%) of students claiming they never attend ICT classes.

Students attending ICT classes everyday accounted for only 19 (9.5%) of the responses rendered in table 16. There is the need for an increase in tuition on a more regular basis for students with regards to ICT. Having ICT classes once a week, or less is certainly not enough if suitable strides are to be made in ICT integration in education.

The availability of the computer laboratory to students after classes was also of concern. The information is presented in table 17.

Table 17: Student use of Computer Laboratory after Classes

Item	Response	Percentage
Yes	51	25.5
No	149	74.5
Total	**200**	**100%**

Field source: Rapheal Data

Table 17 illustrates the responses of students on their access to the computer laboratory after classes. Of the students involved in the study 149 (74.5%) responded they did not have access to computer laboratories after classes. These students as seen from the table above clearly made up the greater majority.

Table 18 below shows the number of hours students spend at the laboratory if they are allowed to use the ICT laboratory after classes.

Table 18: Number of hour's students are allowed to spend at ICT lab after classes

Item (hours)	Response	Percentage
None	71	50.0
0 – 1	60	42.3
1 - 2	9	6.3
2 – 3	2	1.4
Total	**142**	**100%**

Field source: Rapheal Data

50% of the responses were made up of students not being allowed to spend time in ICT labs after classes. The next highest response was for up to 1

hour being allocated to students to use computers in the laboratory after classes. The time range of 2 hours – 3 hours accounted for only 1.4 percent of responses.

Clearly most students do not even have access to computers after class in order to practice and learn with them. Further suitable time frames such as being allowed two hours or more of practice with computers after class accounted for less than 2% of the responses.

Table 19 below shows information on whether students are allowed to use the laboratory during weekends.

Table 19: Students allowed to Use the Computer Laboratory during Weekends.

Item	Response	Percentage
Yes	6	3.3
No	192	96.7
Total	**198**	**100%**

Field source: Rapheal Data

Table 19 investigated accessibility of the ICT labs to students during the weekends. From the results in table 19 most of the students responded they did not get access to computer laboratories during the weekend. These students accounted for 96.7%. Those who had access to the computer laboratories during the weekends made up a just 3.3% of respondents.

Table 20 presents information on the number of hours students can use the ICT laboratory during weekends.

Table 20: Hours students can use ICT Laboratory during the weekends

Item	Response	Percentage
None	102	96.2
1hr	3	2.8
2hrs		
3hrs		
4hrs	1	1.0
Total	**106**	**100%**

Field source: Rapheal Data

Table 20 outlined the responses on number of hours spent by students in schools that allowed the use of computer labs during the weekends. As seen in table 20 only 4 students responded they were allowed to use the labs during the weekends.

The highest response for students who actually had access to labs during the weekend was 2.8% as realized from the table above. This response was for the students allowed 1 hour to use computers in their laboratories. The next highest response was for 4 hours which had a percentage score 1.0. 4 hours of practice in the computer laboratory during the weekend is an ideal scenario for students to gain more computer knowledge, however the number of students enjoying such a provision is clearly low.

The data in tables 21to 22 below are the results of investigations of the senior high school students' possession of mobile phones, their usage of these mobile phones outside school hours and if the students employed the calculator software installed on their phones for mathematical calculations.

Table 21: Student Use of their Mobile phones at Home

Do you use a mobile phone at home	Response	Percentage
Yes	196	98.0
No	4	2.0
Total	**200**	**100%**

Field source: Rapheal Data

Of students using mobile phones at home there was 196(98.0%) response. Only 4 (2%) of students claimed not to use mobile phones at home.

Table 22 below presents information on whether students use calculators on their phone.

Table 22: Student use of Calculator software Installed on their Phone

Use of calculators in mobile phone	Response	Percentage
Everyday	106	54.1
Once a week	43	22.0
Once a month	13	6.6
Once a term	3	1.5
Never	31	15.8
Total	**196**	**100**

Field source: Rapheal Data

Student use of calculators on their phones showed that 54.1% used their phone calculator's everyday as the highest response. This was followed by once a week at a percentage score of 22.0. Students who claimed to never use their calculators accounted for 15.8% of respondents.

It can be assumed that by most of the students employing the use of their mobile phone calculators either on a daily basis (54.1%) or at least at some time during the week (22.0%). They are utilizing technology in the solving of mathematical problems. Such a characteristic of the sample population can be also attributed to the larger population of students of schools selected for the study.

This demonstrates that students are already inclined to the use of technology in relation to solving mathematical problems. Encouraging them by the provision of adequate numbers of computers, classes in ICT, and the use of other technological tools will help further implement ICT in teaching in senior high schools. Further education and encouragement could be given to students as in the case of the 15.8% who never use calculators on their phones, in order to enable them realize the benefits of the use of such software on their phones.

Students getting access to computers in their homes was also investigated. Table 23 gathered information on it.

Table 23: Students with Access to Computers at Home

Item	Response	Percentage
Yes	156	78
No	44	22
Total	**200**	**100**

Field source: Rapheal Data

The number of students with access to computers at home is detailed in table 23. The greater number of students claimed to have access to computers at home; this is represented by 78%. However, the number of students with access to computers which have access to the internet was a low percentage

score of 23.5%. Over 75% of students claimed their computers at home did not have access to the internet. Provision of internet facilities in domestic homes is a costly venture.

Despite the importance of the internet as a tool for incorporating ICT in teaching at senior high schools, it must be borne in mind that its introduction not only in schools but in domestic homes will most likely be a slow and gradual development due to the high costs required for it being made available. Most homes are not able to afford internet facilities. Such features could have contributed to the low number of computers with internet access at home.

Student's access to computers with connectivity to the internet is presented in Table 24.

Table 24: Students with Access to Computers at Home which are connected to the Internet.

Item	Response	Percentage
Yes	47	23.5
No	153	76.5
Total	**200**	**100**

Field source: Rapheal Data

The queries of the questionnaire related to table 24 were used to investigate the availability of computers to students that are connected to the internet at home. Out of the 200 students, 47 (23.5 %) responded as having internet on their computers at home. A majority of 153 students (76.5) did not have computers that are connected to the internet at home

The various uses of computers by students to perform certain functions related to science is presented in Table 25.

Table 25: -Student Use of Technology in School

I use computers	Every day	%	Once a week	%	Once a Month	%	Once a term	%	Never	%
To investigate the nature of graphs of functions	8	(4.0)	12	(6.0)	3	(1.5)	26	(13.0)	151	(75.5)
To draw graphs of grouped data	10	(5.0)	17	(8.5)	7	(3.5)	30	(15.0)	136	(68.0)
To draw graphs of logarithmic functions	4	(2.0)	8	(4.0)	7	(3.5)	1	(0.5)	176	(88.0)
To draw graphs of trigonometric functions and find their solutions	6	(3.0)	6	(3.0)	7	(3.5)	6	(3.0)	175	(87.5)
To draw scatter diagrams for bivariate distributions	5	(2.5)	5	(2.5)	4	(2.0)	5	(2.5)	173	(86.5)
I use Calculators										
To express recurring decimals as common fractions	108	(54.0)	42	(21.0)	6	(3.0)	4	(2.0)	33	(16.5)
To calculate the mean, median and standard deviation	85	(42.5)	60	(30.0)	9	(4.5)	4	(2.0)	42	(21.0)

Field source: Rapheal Data

Items in terms of technology usage, items 1 to 5 as illustrated in table 25 related to the use of computers by the students. 6 and 7, were related solely to the use of calculators by the students. The results were used to generate a column table in order to better interpret the data collected in table 25.

Table 25 showed that only a handful of the students could use the computer to carry out specific learning tasks in table 25 which are all found in the Science syllabus. Only 8 students (4.0%) could use the computer to investigate the nature of graphs of functions. A majority of 151 students (75.5%) had never used the computer to perform that function.

Also, 10 students (5.0 %) responded to the use of computers every day to draw graphs of grouped data. 136 students (68.0%) of the students had never used computers to perform that function. On the drawing of graphs of logarithmic functions and graphs of trigonometric functions, only 4 students (2.0%) and 6 students (3.0%) respectively responded to use it every day to perform those specific functions. The ability to draw scatter diagrams for bivariate distributions with a computer resulted in 5 students (2.5%) responding to perform that task daily, 5 students (2.5%) responded to use it once a week, 4 students (2.0%) responded to use it once a month, 5 students (2.5%) used it once a term and a majority of 173 students (86.5%) had never used the computer to undertake such learning tasks with the use of computers.

It can be inferred from the data above in relation to table 25 that students involved in this study are not adequately trained in the use of computer and software in solving mathematical problems.

However, they did show considerable use of their calculators in solving other Science related problems. This is possibly due to the students having

longer hours of investigating the uses of calculators on their phones. It may also be due to such technological tools being easily accessible to them compared to computers which are not so easily accessible and whose software programs use require some instruction from teachers to be well understood by the students.

The findings revealed that the students often use calculator to express recurring decimals as common fractions, to calculate the mean, median and standard deviation. This finding is consistent with the findings of Kaino and Salani (2004) who revealed that majority of students in Botswana used and enjoyed working with calculators.

The finding further revealed that the students overall use of technology in general computer applications and in learning Science was very low. This finding is in consonance with the findings from Boakye and Banini (2008) who concluded that SHS student use of technology in academic purposes and research is very low.

Faekah and Ariffin (2005) also found that students were not skillful in computing. Very few of them send messages via e-mail, search for information on the web and print documents or images.

It is not surprising that the extent to which the students use technology in learning Science is very low, the questionnaire revealed that the students were not allowed to use the computer laboratory after classes and during weekends. However, the students were only allowed to use the computer laboratory once every week. Besides, the extent to which the Science teachers use technology in teaching is very low and this might affect the students' use of technology in learning science.

Chu (2004) argued that students' perceived usefulness of technology in learning is highly dependent on teachers' actual implementation of technology in the Science classrooms. He further argued that students would not be motivated to use technology unless they have had enough hands-on experience in using some Science software or websites in the school.

The findings further revealed that availability of technology resources statistically influence students technology use in learning Science. This finding is consistent with the findings of Mereku et al (2009) who found that the availability of technology resources such as ICT syllabuses/manual, computers and computer laboratories have a significant influence in students technology use at the SHS level in Ghana.

Research Question 5: **Which factors influence the use of technology among students in learning Science?**

This research question sought to examine the factors that will influence the use of technology among students in the learning of science. This gave an insight into what will most likely to happen in the classrooms of these students if technology is introduced.

Table 26 gives data on the answers provided by the student respondents on factors which would make students most likely to use computers in the classroom.

Table 26: Factors which would make students most likely to use computers in the classroom

	I would use computers in the classroom	Yes	%	No	%
1	If every student would use computer during the class	185	(93.4)	13	(6.6)
2.	If teacher use technology (computer)in their lesson delivery	175	(88.8)	22	(11.2)
3.	If every student provided their own computer	70	(35.5)	127	(64.5)
4.	If I could receive more training on how to use them in teaching Science	184	(92.9)	14	(7.1)

Field source: Rapheal Data

Majority of the respondents (93.4%) indicated that they would be encouraged to use computers more in class if every student had his or her own computer. With regards to inquiries on if teachers making computer use compulsory would affect their usage of computers, 175 (88.8%) of students responded yes.

If every student provided their own computers, resulted in 127 (64.5%) of students responding no to that being a factor that would encourage them to make more use of computers in class. Finally, the question on more training of the students in the use of computers in relation to science yielded 184 (92.9%) of the students responding yes that such a development would increase their use of computers in class.

From table 26, it was realized thatstudents recognize the importance of availability of computers as an encouragement in learning Science. Also,

teachers are seen as being important in contributing to students being instructed and made to use computers and ideally the majority of students would prefer if they are given additional tuition in how to use computers in relation to learning Science.

Table 27 relates to data gathered on the impact of technology on teaching and learning of science as perceived by students involved in this study.

Table 27: Most likely to happen if Technology is introduced into the Delivery of Science Classes

	Item	Yes	%	No	%
1.	My knowledge of computers would increase through continued use	196	(99.0)	2	(1.0)
2.	It would create more work for students in science class	90	(45.5)	108	(54.5)
3.	Students will become lazy when it comes to doing mental calculations	80	(40.0)	120	(60.0)
4.	Students would get distracted in class	66	(34.0)	128	(66.0)
5.	Students would find more practical uses for mathematical principles they are taught	189	(94.5)	11	(5.5)
6.	The increased cost of learning will put off students in learning Science at a higher level	158	(79.0)	42	(21.0)
7.	Students will learn mathematical concepts quicker and understand complex calculations better.	195	(98.5)	3	(1.5)

Majority of the students (99.0%) responded yes that their knowledge of computers would increase with the implementation of technology in teaching

and learning of science. With regards to whether implementation of technology would create more work for students in class, 108 (54.5%) of students responded no. Students becoming lazy when it comes to doing mental calculations had a response of 120 (60.0%) of the students answering no, whilst 80 (40%) responded yes it would make students lazy.

Students getting distracted in class had 128 (66.0%) of students answering no, whilst with regards to students finding more practical uses for mathematical principles taught them had 189 (94.5%) of students answering yes.

Increased cost of learning putting off students from learning Science at a higher level realized158 (79.0%) of students answering yes in agreement. Finally, 195 (98.5%) of students answered yes in agreeing that technology would enable them learn mathematical concepts quicker as well as understand complex calculations better.

Research Question 6: **What impact does the use of technology have on the teaching and learning of science?**

This research question assesses the impact that the use of technology have on teaching and learning in a Science classroom. Part C of the teacher's questionnaire provided knowledge on this research question and the results tabulated in table 28 below.

Table 28: The perceived impact of technology on teaching and learning.

	Item	Yes	%	No	%
1.	Creation of lesson plans will be more complicated	15	(38.5)	24	(61.5)
2.	My knowledge of computers would increase through continued use	36	(92.3)	3	(7.7)
3.	It would create more work for teachers	12	(31.6)	26	(68.4)
4.	Most teachers would have to be restrained	36	(92.3)	3	(7.7)
5.	Students will become lazy when it comes to doing mental calculations	12	(30.8)	27	(69.2)
6.	Students would get distracted in class	22	(56.4)	17	(43.6)
7.	Students would find more practical uses for the mathematical principles they are taught.	32	(82.1)	7	(17.9)
8.	The increased cost of learning will put students off the further pursuit of Science	16	(41.0)	23	(59.0)
9.	Students will learn abstract concepts quicker and understand complex calculations better.	38	(97.4)	1	(2.6)

Field source: Trede SHS

Table 28 is a summary of the data collected on the responses of the teachers regarding their views on the impact of technology on teaching and learning in class. The response of teachers on creation of lesson plans becoming more complicated shows that 24 (61.5%) did not agree with such a view.

With regards to their knowledge of computers increasing as an impact of technology being used to teach Science, 26 (92.3%) agreed yes it would increase their computer knowledge. Majority of the teachers responded no to technology use increasing their work load with regards to teaching of science (68.4%).

Furthermore, majority of the teachers as illustrated in table28 responded no to students becoming lazy if technological aids were used in the teaching of science. There was a smaller gap in the responses with regards to students getting distracted; 22 (56.4%) of teachers responded yes to students getting distracted whilst 17 (43.6%) responded no. Perhaps there is relevance in these results considering use of computers and other technological tools by students during classes.

Games and other applications installed on computers and tools could possibly distract the students during class. However, one would like to believe that with the right kind of guidelines and instructions from adequately trained teachers, these distractions and other negative effects can be curtailed during the implementation of technology in teaching.

Finally, the greater majority of teachers thought students would learn abstract concepts quicker along with them being better able to understand complex calculations if technological aids were employed in the teaching of science.

Summary of Results

In summary, the discussion of the results presented in this chapter helped shed light on challenges and constraints facing teachers and students in the implementation of technology in educational systems specifically in the teaching and learning of Science in the Atwima KwawomaDistrict in the Ashanti Region of Ghana. Also views or perceptions of teachers and students were obtained and discussed in relation to ICT implementation in the teaching and learning processes at the various senior high schools.

It is realized from the data collected that both teachers and students are faced with similar challenges or constraints with regards to getting access to computers. Low figures were recorded in the study for computers in good use which would be available for teachers and students to make use of in improving their computing skills and knowledge.

In a similar vein, the levels of adequate training of teachers in the use of computers as teaching tools were found to be quite low. In the study's finding on teacher participation in professional development courses related to the integration of ICT in teaching and learning of science, 84.6% of teachers responded no to having taken part in any ICT courses. This does not auger well for the implementation of ICT in teaching and learning of science in classrooms.

Teachers need to be equipped with the requisite skills and knowledge with regards to ICT implementation if any meaningful grounds are to be covered in this aspect of education. This lack of technological tools and training is underlined by Norris et al (2003), who identified appropriate access to technology infrastructure and training as a key factor in effective technology integration processes.

A similar situation was revealed with regards to training or classes in ICT for students involved in the study. Table 16 to table 20 indicate that the greater numbers of students involved in the study were not getting adequate training in ICT.

In defense of the teachers and students it is not for a lack of interest in such training courses. Most of the teachers and students indicated that they would prefer the option of being given training or being given appropriate tuition in ICT.

In a positive light, it was realized that most of the teachers and students involved in the study owned or had access to computers at home. This can be seen as an advantageous event in improving ICT implementation. With the greater number of teachers and students already owning computers, they would be more familiar with the use of such technology and ready to accept and adapt to its implementation in the classroom environment.

It was realized that there is the need for teachers and students to be adequately trained in the use of software which would aid in teaching and learning of science. The results in tables 25 revealed that students were not readily using computers to solve more difficult mathematical problems on a day to day basis. For teachers a similar trend was realized. Most of the teachers were noted to use computers for searching on the internet, messaging, communicating, but in relation to activities such as using excel spread sheets, creating databases, investigating the nature of graphs of functions there was a lot of room for improvement in terms of the low figures registered for teachers who used computers for such activities.

Another feature noted in the study and results as presented in chapter four was the lack of specialized software for teaching Science. These results can be examined in table 7, in which it was shown that most of the teachers (97.5%) responded no to presence of specialized software for teaching Science being installed on the lab computers.

In relation to the views of teachers and students on the implementation of technology in teaching and learning, both teachers and students from the data demonstrated stood in favor of ICT integration as well as those seeing benefits from it in the learning process.

Clearly the highlights of chapter four can be pointed out as there being a lack of adequate computer and other technology facilities, along with training and apportioned time in the senior high schools for both teachers and students of science for which ICT can be implemented effectively.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This chapter presents a summary of the findings, conclusion and outlines recommendations including areas for further research.

Summary

The study investigated the extent of technology use among Ghanaian Science teachers and students specifically in the Atwima Kwawoma District at the SHS level. Specifically, it explored the SHS Science teachers and students general technology use; computer and calculator use in teaching and in learning science.

Science teachers and students in the Atwima Kwawoma District in Ashanti region were used for the study. Stratified sampling technique was used to select 40 SHS Science teachers and 200 students for the study.

Self-administered questionnaire was used as an instrument for the study. The questionnaire was mainly based on the technology requirements in the SHS Science syllabus.

Literature on the use of technology in the teaching and learning of Science in Senior High Schools in Ghana were also reviewed. Valsiner's (1997) zone theory was adopted as the theoretical framework to investigate Science teachers and students' technology use and factors influencing their use at the SHS level. Drawing on the zone theoretical framework, possible relationships between SHS Science teachers and students' use of technology and factors known to affect this use were investigated:

1. Zone of Proximal Development – self-perceived efficacy in technology use;

2. Zone of Free Movement – availability of technology resources, age, gender, school location;
3. Zone of Promoted Action – teaching experience, number of years in school.
4. The literature highlighted on the following areas:
5. The extent of technology usage by Senior High School Science teachers in Ghana.
6. The various factors influencing the use of technology amongst teachers in the Senior High Schools of Ghana.
7. Teachers' perception on the role of technology in teaching Science in Senior High Schools in Ghana.
8. The extent of technology usage by Senior High school students in learning Science.
9. The factors influencing the use of technology amongst students in learning Science in Senior High Schools in Ghana.
10. The impact of technology usage in teaching and learning Science in Senior High Schools in Ghana.

The data collected were analyzed using both qualitative and quantitative methods. Descriptive statistics was adopted for presenting and analyzing the data in this study.

Major Findings of the Study

It was found in this study that the extent to which SHS Science teachers use technology in teaching Science was very low. The study revealed that majority of the Science teachers use technology for general applications such as finding information on the internet for teaching, communicating with colleagues

and students, sending emails, attaching files to email messages and preparing notes for teaching. But the extent to which the teachers use technology in teaching Science as suggested by the SHS Science syllabus is very low.

Also, the study revealed that teachers involved in the study are willing to employ technology use in teaching Science in class, provided there is adequate provision of related tools such as computers, projectors, software's, etc. Organization of professional courses, in- service training of science teachers on the integration of technology in teaching Science is also essential.

Clearly, the majority of science teachers are of the conviction that technology use has many advantages in the teaching and learning process as compared to the traditional method of teaching Science. It will aid teachers in conveying and presenting abstract concepts and examples better for easy understanding by students.

Besides, the study also revealed that although majority of the students use the calculator in expressing recurring decimals as common fractions, calculating the mean, median and standard deviation very few of them use technology in learning Science with applications such as Microsoft Excel, Math-Teacher, Furbles etc.in learning Science.

The study further revealed that gender and self-perceived efficacy in technology use influence SHS Science teachers' technology use in teaching. However, teachers' age, teaching experience, and availability of technology resources did not influence their technology use in teaching Science.

Finally, the study indicated that both Science teachers and students perceived that the usage of technology in teaching and learning will make teaching and learning much easier, facilitate better and quicker understanding

of concepts in science and make it more enjoyable if the provision of requisite hardware's, software's and adequate training are catered for.

Conclusions

The study revealed that the extent to which SHS Science teachers use technology in teaching was very low even though majority of the respondents believed that technology plays an important role in teaching and learning Science. This was found to be due to the fact that the Science teachers lack the skills to effectively integrate technology in their teaching since they have had little or no opportunity to participate in professional development courses related to ICT integration.

The study also revealed that the extent to which SHS students use technology in learning Science was very low. This was also found to be due to the fact that majority of the students were not allowed to use the computer laboratory after classes and during weekends but only allowed to use the laboratory once every week. It was also attributed to the low technology use in teaching among science teachers which consequently affects the students' use of technology in learning science.

The extent to which the science teachers and students use technology in teaching and learning science was crucial because the knowledge gained could provide insights into teachers and students technology use at the SHS level that could be sustainable and transferable to other levels of educational institutions.

Besides, the study also provided empirical evidence on the factors that influence technology use in teaching and learning science at the SHS level in Ghana. This knowledge gained could provide guidance for policy makers and

stakeholders in education when structuring and introducing ICT integration policies in the Senior High Schools.

Recommendations

Considering the findings and conclusions drawn from the study, the following recommendations are made:

The Heads of the various SHS should organize in-service training in professional development courses related to the integration of ICT in teaching and learning science for their teachers.

Also, the Curriculum Research Development Division (CRDD) of the Ghana Education Service in collaboration with the related agencies in the Ministry of Education should carry out research to review critically the Science curriculum and revise the existing syllabus to explicitly state what ICT tools must be used and how it should be used in the teaching and learning process.

The Heads of the institutions should make budgetary allocations annually to maintain, replace and expand ICT facilities and resources in the schools in order to promote effective integration in the teaching and learning process.

In addition, the Ministry of Education should endeavor to equip both rural and urban SHS with well-furnished computer laboratories to enable both the teachers and students to get high access to technology resources.

Finally, Heads of the institutions in collaboration with the Heads of Departments should emphasize the use of the computer laboratory during weekends and after classes as part of the co-curricular activities in the secondary schools. This will enable the students to get enough time to use the laboratory computers in learning Science.

Recommendations for Further Research

The following are recommended for further studies:

It is suggested that this study should be replicated to include both private and public SHS in other district and regions of Ghana.

Also, similar study should be conducted in other regions of Ghana with the basic instruments of this study and the results compared.

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APPENDIX

UNIVERSITY OF CAPE COAST

COLLEGE OF

DEPARTMENT OF INFORMATION TECHNOLOGY

QUESTIONNAIRE FOR TEACHERS

This questionnaire is designed for academic purpose only as part of the requirements for the award of M.ED. Degree in the University of Cape Coast. The research topic is "ICT use among Ghanaian SHS science teachers and students and factors that influence it". Your candid and objective response is highly needed. I would like to assure you that any information provided would be treated with the strictest confidentiality and anonymity. Please make a tick the appropriate column you agree.

Section a: bio data of respondents

Please tick (√) the responses applicable to you

1. Gender Male [ ] Female[ ]
2. Age

   25years and below [ ]

   26-30 [ ]

   31-35 [ ]

   36-40 years [ ]

   41-45years [ ]

   46-50years [ ]

   51 years and above [ ]
3. Level of education

   (a) SSS/SHS/0'LEVEL [ ]

(b) A'LEVEL/Post-Secondary [ ]

(c) Diploma/HND [ ]

(d) First Degree [ ]

(e) Master's Degree [ ]

4. Others (please specify).....

Number of Years of service [ ]

(b) 5years or less [ ]

(c) 6-10 years [ ]

(d) 11-15 years [ ]

(e) 16-20 years [ ]

(f) More than 20 years [ ]

5. Staff Designation

(a) Subject teacher [ ]

(b) Class teacher [ ]

(c) Form Master/Mistress [ ]

(d) House Master/Mistress [ ]

6. Student by Department

(a) General Science [ ]

(b) Home science/Home Economics [ ]

(c) General Arts [ ]

(d) Visual Arts [ ]

(e) Business [ ]

SECTION B

LEVEL OF TEACHERS AND STUDENTS KNOWLEDGE ON ICT IN EDUCATION

Key: SA (Strongly Agree) A (Agree) D (Disagree) SD (Strongly Disagree)

Statement	SA	A	U	SD	' D
1. ICT in education is the use of computer hardwares and software in education					
2. ICT in education is the use of local area networks and wide area networks that allow computer systems, teachers and learners to communicate with each other.					
3. The term ICT in education means the use of technologies that can facilitate learning and instruction					
4. Components of ICT in education include giving immediate feedback, diagnosing students' needs, providing effective remediation, assessing learning and storing examples of student work					
5. ICT in education is defined as the full gamut of electronic tools by which teachers and students are able to gather, record, store and disseminate information					

6. It can be interpreted as the use of tools that enable capturing, interpreting, storing andtransmitting information in a fast and easy way					
7. Tools for ICT in education include television, radio, scanners, computers printers, projectors, CD's, DVD's, mobile phones, tablets, Wi-Fi, internet, flash drives, hard disk drives, sensors, computer games and digital cameras.					
8. ICT in education involves online learning which stimulates active learning in the lecture theatre and motivates students to learn beyond the confines of thelecture theatre					

Thank You