UNIVERSITY OF CAPE COAST

INVESTIGATING THE USE OF ICT AS A CONSTRUCTIVIST APPROACH TO THE TEACHING AND LEARNING OF PHYSICS IN SOME SENIOR HIGH SCHOOLS IN AGONA EAST DISTRICT OF GHANA

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Dissertation submitted to the College of Distance Education, University of Cape Coast, in partial fulfilment of the requirements for award of Master of Education degree in Information Technology

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DECLARATION

Candidate's Declaration

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

Candidate's Signature …….. Date ……

Name: Frederick Turkson

Supervisors' Declaration

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

Supervisor's Signature ……. Date …….

Name: Dr. Valentina Akorful

ABSTRACT

Information and Communication Technology (ICT) has become a household name for any country that wants to develop Education. ICT has received significant attention from successive governments over the past decade at the Senior High school level. Teaching and learning have evolved over the years from the traditional instructivism, to the constructivism approach where learners have become active organism with expectations and the teacher becoming a facilitator. The aim of the study was to investigate the use of ICT as a constructivist approach to the teaching and learning of Physics in Swedru Senior High School. The study was underpinned by the constructivist theory. The study adopted a quantitative research approach and descriptive research design. The census method and simple random sampling techniques were used in this research. The sample size was 206 students randomly selected for the study and 8 science teachers were purposely selected. Questionnaire was used as a research instrument for data collection. Descriptive statistical tools were used in analysing the data into frequencies and percentages, means and standard deviations with the support of SPSS version 22.0. The study revealed that the use of ICT in the teaching and learning of Physics developed diverse learning, critical thinking and active student participation which improve student's performance in the subject. It was recommended that, the Government should adopt ICT as a constructivist approach to the teaching and learning of Physics in Senior High Schools by providing the necessary logistics and infrastructure so that they can use ICT resources to enhance teaching and learning.

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DEDICATION

To my wife Genevieve Kukua Turkson, father Jacob Fie Takyi-Turkson, my siblings and Mrs Alberta Obiriwa Rigg Stewart (Headmistress, SWESCO)

TABLE OF CONTENT

CONTENT	PAGE
DECLARATION	ii
ABSTRACT	iii
ACKNOWLEDGEMENTS	ivv
DEDICATION	v
LIST OF FIGURES	viii
LIST OF TABLES	ix
CHAPTER ONE	1
INTRODUCTION	1
Background to the Study	1
Statement of the Problem	7
Purpose of the Study	9
Research Questions	9
Significance of the study	10
Delimitations	10
Limitations	11
Organisation of the Study	11
CHAPTER TWO	13
LITERATURE REVIEW	13
Overview	13
Theoretical Framework	13
Teacher's Role in a Constructivist Environment	19
Chapter Summary	38
CHAPTER THREE	39
RESEARCH METHODS	39

Overview 39

Research Design 39

Population 40

Sample and Sampling Procedure 41

Data Collection Instruments 42

Validity and Reliability of Instrument 43

Data Collection Procedure 44

Ethical Considerations 45

Data Processing and Analysis 46

Chapter Summary 46

CHAPTER FOUR 48

RESULTS AND DISCUSSION 48

Overview 48

Demographic Data of the Respondents 48

CHAPTER FIVE 66

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS 66

Overview 66

Summary of the Study 66

Key Findings 67

Conclusions 69

Recommendations 71

Suggestions for Further Research 72

REFERENCES 73

APPENDIX A 83

APPENDIX B 88

LIST OF FIGURES

Figure 1- An adopted 5E Instructional Model by Bybee and Landes 15

Figure 2- The Four-Stage Constructive Learning Model 24

LIST OF TABLES

Table		Page
1	Background Information of Respondents	49
2:	Decision Rule for Means Values	51
3	Decision Rule for Standard Deviation Values	51
4	Availability of ICT tools and resources	52
5	Usefulness of ICT in teaching and learning of Physics	55
6	Competencies in the use ICT in teaching and learning	58
7	Challenges both teachers and students face in the use of ICT	62

CHAPTER ONE

INTRODUCTION

Background to the Study

Instructional activities are fulfilled by different methods adopted by teachers in the teaching of various subjects. These methods of teaching, which are backed by different learning theories and pedagogy, involve different levels of students' participation. Under the traditional view of teaching, teachers are seen as expository of all knowledge and the learner as 'empty vessels' waiting to be filled with knowledge. Consequently, under the traditional teaching methods, students only take on passive roles and the teacher does all the talking and deductions (Bell, 2008). According to Killen (2009), the traditional method of teaching, though one of the key strategies that promotes the ability of teachers to accomplish a speedy completion of syllabus, appears problematic as it negatively affects the perception and competence of students in subjects such as science which demand a lot of critical thinking, organization, modelling, interpretation, observation, experimentation and drawing of conclusion.

Teaching is no longer seen as simply a transmission of knowledge, but it is socially and individually constructed and at such, teaching must focus on development of suitable environment that fosters the construction of knowledge. Over the years, learning theories and pedagogy have therefore evolved progressively from instructivism to constructivism (Chi, 2001). Constructivism refer to student-centred learning, where there is teacher-student and student-student collaboration and co-construction of knowledge in contrast to the teacher-centred practices which involve explicit instruction,

knowledge transmission, linear knowledge development, and more directly observable learning outcomes (Chen, 2008; Killen, 2009). In constructivism, acquisition of meaningful competences in a realistic context is advanced through interactive and active learning and authentic experiences that dovetail with the interests of the learner; the learner becomes an active organism with expectations, unique background understanding and experiences (Audet & Paris, 1997). In constructivism, the teacher is a facilitator and an expert in providing that suitable environment for the 'active organism' to react and grow.

Information Computer Technology came into existence from the 1950s in America when it was used as a location device among the military. ICT was developed solely for military purposes by the American government. Its first mode was the ARPANET which was initiated in 1958 by Dwight Eisenhower through the creation of ARPA (Advanced Research Project Agency). It gave the American military a technological edge over other countries. ARPANET made computer networking possible for communication through exchange of information (Opoku, 2004). After world war two, the application of ICT to solve various problems became apparent. ICT today is used in all aspects of life through the establishment of internet protocols. The speed with which Information and Communication Technology (ICT) is developing and its influence and effectiveness on socio-economic activity cannot be over emphasized. ICT, according to the United Nations Development Programme (UNDP), has been defined to include the full range of electronic technology and techniques employed to manage information and technology (Opoku, 2004).

Today, ICT provides a ground-breaking platform that triggers constructivism in the field of science. Soby and Egeberg (2009) opined that ICT is enhancing both practical and theoretical aspects for the teaching and learning of science. The application of ICT in science education is enhancing students' participation in the teaching and learning process because ICT tools and infrastructure provides a wider access to tools for data capture, processing, databases, spread sheets, graphing tools and modelling environments which are useful for the promotion of scientific knowledge.

In the Netherlands, government policy has been geared towards the optimal integration of ICT in innovative learning processes (Coskun & Kinnisnet, 2009). As a result of this and other initiatives, Dutch schools are making increasing use of digital learning environments literacy as one of the five basic skills together with reading, writing, numeracy and oral proficiency and have created an independent agency to implement the government's ICT policy and to oversee the integration of ICT in education. As a result, it has placed a strong emphasis on ICT as an integrated part of the learning activities in all schools (Soby & Egeberg, 2009).

In the United Kingdom, the official view of ICT as potentially transformative of education has placed it at the centre of the national agenda for school reform (Deaney, Ruthven & Hennessy, 2006). As a result, the promotion of ICT in education has been a significant part of the UK government's policy in education since the 1980s with various programmes being implemented over the years. The 1998 National Grid for learning initiative witnessed "unprecedented levels of government spend" on computer

equipment, broadband Internet access and online resources for schools (Department for Education and Skills, 2003).

In addition, studies by Yusuf and Afolabi (2010) and Jayson (2008) argued that ICT helps to improve the quality of learning and educational outcomes. Other surveys by (Khan & Shah, 2004) argue that, in order to be successful, a country should improve its education system by implementing effective and robust ICT policies.

According to Data Development Group of the World Bank, ICT infrastructure in Ghana is progressing as compared to other developing countries globally and above 1.1 % average of the Sub-Sahara Africa (Opoku, 2004). Governments of Ghana, both past and present and other agencies have made several strides to develop ICT infrastructure in the country. This has been intended to bridge the digital gap between Ghana and the developed world. Prominent among these initiatives is the development of A National Fiber Optic Network called Voltacome Project by the Volta River Authority (Opoku, 2004).

Ghana has taken steps to introduce, better still, integrate ICT into the education sector. According to Ghana News Agency, on November 10, 2010, Ghana launched national Information and Communication Technology (ICT) connectivity project for colleges of education to ensure that teachers reappraise their methodologies to meet the learning needs of their students. The project covers thirty-eight (38) Colleges of Education, thirty-seven (37) Public Technical Institutions, five hundred public (500) senior high schools, and 23000 public basic schools with computing infrastructure. These schools have been supplied with computers, printers, scanners, projectors and servers

under a programme tagged "ICT School Connectivity Project. As at now, the use of ICT is becoming more pervasive in Ghana and the number of computers for educational purposes in our institutions is growing. In the process, there is a proliferation of equipment standards for seemingly different goals. This situation has arisen because even though government has come out with a national policy for ICT, there is the need for a well-defined policy direction in the development and exploitation of ICT in the arena of education. The field of education has been affected by ICTs which have undoubtedly affected teaching and learning (Yusuf, 2005). A great deal of research has proven the benefit of ICT to education (Al-Ansari, 2006). As Davis and Tearle (1999) put it, ICTs have the potential to innovate, accelerate, enrich and deepen skills to motivate and engage students, to help relate school experience to work practices, create economic viability for tomorrow's workers, as well as strengthening teaching and helping schools change. The use of ICT resources in education enables teachers to create interactive classes, make lessons enjoyable with improved students' attendance and concentration. According to Pugalee and Robinson (1998), in the teaching and learning process, the use of ICT resources has the potential to enhance students' learning outcomes and stimulate their motivation.

The International Conference on Teaching and Learning with Technology (March, 2010) stressed the pivotal role that ICT can play in transforming teaching and learning. ICT has the potential to enable teachers and students construct rich, multi-sensory, interactive environments with an almost unlimited teaching and learning potential (Balanskat, Blamire & Kefala, 2006). In an attempt to meet the millennium development goals,

countries worldwide have attempted to implement reforms aimed at embedding ICT in educational practice.

Computers and applications of technology became more pervasive in the societies which led to a concern about the need for computing skills in everyday life. Hepp, Hinastroza, Laval and Rehbein (2004) claimed in their paper "Technology in Schools: Education, ICT and Knowledge of Society" that ICTs have been utilized in education ever since their inception, but they have not always been massively present. Although at that time computers had not been fully integrated in the learning of traditional subject matter, the commonly accepted rhetoric that education system would need to prepare citizens for lifelong learning in an information society boosted interest in ICTs (Pelgrum & Law, 2003).

Likewise, multimedia tools/softwares for simulation of processing and carrying out virtual experiments are widely available and their use give science teachers the ability to arouse the interest and participation of learners in many areas of their scientific studies including experiments. For instance, with the use of ICT tools such as computers and projectors, science teachers are able to project and move back and forth the processes involved in the conduct of scientific experiments and present lessons in a less abstract but engaging manner. With this, students are able to grasp and keep in memory the underlying principles that underpin basic scientific concepts. With ICT infrastructure such as the internet/social media, collaborative learning among students is encouraged as students are able to engage in discussions with classmates over distant locations about home works/previous lessons learnt. ICT is enhancing science learning as the internet continues to provide students

access to wide variety of e-books and E-libraries where they are able to explore and find answers to their academic questions.

According to Cabero (2001), "the flexibilization time-space accounted for by the integration of ICT into teaching and learning processes contributes to increase the interaction and reception of information. Such possibilities suggest changes in the communication models and the teaching and learning methods used by teachers, giving way to new scenarios which favour both individual and collaborative learning. The use of ICT in the teaching and learning is a catalyst for understanding and motivation, independent and collaborative learning and thus 'education anywhere, anytime and anyplace with or without teacher' is a reality with the adoption of ICT in education". It is against this background that this research sought to investigate the use of ICT as a constructive approach in the teaching and learning of Physics in Swedru Senior High School.

Statement of the Problem

Since the inception of teaching of Physics in the senior high school curriculum, it has been perceived as difficult due to its abstract and broad nature. Most teachers face a lot of difficulties in teaching abstract concepts. This made the understanding of the subject very difficult because most of the teachers ended up teaching without any empirical evidence. Visualization of certain scientific concepts and phenomena therefore became difficult. This situation encourages rote learning on the part of students. Thus, students learn for examination purpose rather than understanding the scientific concepts as used in solving daily life's problems.

In an attempt to solve this problem, some teachers were ready to use ICT to facilitate the understanding of students. For as much as teachers were ready to use ICT to teach, the schools also lacked well equipped computer laboratories due to lack of funds from government, the Parent Teachers' Association (PTA) and Old Students Union. Another problem was the unavailability of internet connection. Again, the schools also lacked skilled personnel in managing computer laboratories. Furthermore, both the science teachers and students lacked the technical know-how to integrate the use of ICT even to the extent of using the constructivist approach in teaching and learning of Physics. Despite the growing acknowledgement of the role of Information Communication Technology in promoting constructivist teaching of science and the widespread availability of ICT tools and infrastructure in many senior high schools, science lessons are still presented in the traditional way where students struggle to conceptualize scientific basic concepts and principles.

The realization of a constructivist teaching approach based on the use of ICT cannot be overemphasized, however, despite the general acknowledgement of the positive outcome that ICT confers on the teaching and learning of science, little is known about the use of ICT as a constructivist approach in teaching and learning of Physics in Ghana. This creates a gap in Knowledge so far as Physics subject is concerned. Hence, to bridge this gap, the researcher sought to the use of ICT as a constructivist approach in teaching and learning of Physics in Swedru Senior High School in the Agona East District of Ghana.

Purpose of the Study

The purpose of the study was to investigate the use of ICT as a constructivist approach in the teaching and learning of Physics in Swedru Senior High School in the Agona East District of Ghana. Specifically, the objectives sought to:

i. Assess the availability of ICT tools and resources in teaching and learning of Physics in the Swedru Senior High School.

ii. Examine the usefulness of ICT as a constructivist approach in the teaching and learning of Physics.

iii. Evaluate the competence of both teachers and students in the use of ICT as a constructivist approach in the teaching and learning of Physics.

iv. Examine the factors that hamper teachers and students in the use of ICT as a constructivist approach in the teaching and learning of Physics.

Research Questions

The study was guided by the following research questions:

1. To what extent are ICT tools and resources available for the teaching and learning of Physics in Swedru Senior High School?
2. How useful is ICT as a constructive approach in the teaching and learning of Physics?
3. What are the competencies of both the teachers and the students in the use of ICT as a constructivist approach in teaching and learning of Physics?

4. What are the challenges facing the use of ICT as a constructivist approach for instruction in Physics?

Significance of the study

The findings from this study would inform various educational stakeholders as to the reasons behind teachers constantly using the traditional methods in teaching of Physics. Teachers would be guided on how to integrate ICT infrastructure (Labs) in the school into the teaching of science and the need to foster good relationship with ICT teachers who have constant access to ICT infrastructure and support systems. Students would be informed as to the various ways to access Physics related materials using ICT tools and resources. Teacher training institutions and colleges would be guided on the sort of training and pedagogical skills and training required by trainees before they are posted to schools. Curriculum planners and policy makers would be informed on what must be put in their curriculum planning and sort of equipment that must be supplied to senior high schools to help them deliver on national agenda of improving science and mathematics education. The findings of this research would also complement other studies on ICT and constructivism approach of teaching and learning of Physics. The research will provide literature so as to add more information on innovation of ICT in senior high schools to deliver lessons.

Delimitations

Due to the broad nature of the study, it was delimited to evaluating the availability of ICT tools and resources in teaching and learning of Physics; the usefulness of ICT as a constructivist approach in the teaching and learning; the

competence of both teachers and students in the use of ICT as a constructivist approach in the teaching and learning and the factors that hinder teachers and students in the use of ICT as a constructivist approach in the teaching and learning of Physics. In terms of location, it was delimited to only physics teachers in Swedru Senior High School and forms two students in the Agona East district of Central Region. The justification for the location of the study is because the investigator is a teacher in the school where the menace is prevailing.

Limitations

This study has its limitation, like any other research. The authenticity of informants' responses – participants' experiences, perspectives and explanations limited the degree to which the results could be transferred to other context. Factors such as age of participants, maturation, sex, grade level that may be responsible for conceptual change in the learners are not taken into consideration. Other factors other than the use of the ICT tools and technologies as an enhanced constructivist tool to promote constructivist learning of science are regarded as independent variables, like statistical problems, thus limiting the generalizability of the findings. In addition, the population from which the sample was drawn was limited as it excluded some teachers and students in the school which caused measurement issues.

Organisation of the Study

The overall study was organised into five main chapters. Chapter one dealt with the introduction of the study which consists of the background to

the study, statement of the problem, purpose of the study, research questions, and significance of the study, limitations and delimitation of the study. Chapter Two focused on the review of related literature. Besides, Chapter Three dealt with the research methodology of the study which comprises research design, population, sample and sampling procedure, research instrument, data collection procedure and data analysis. Chapter Four also covered on the results and discussion of findings of the study. The last chapter (five) dealt with the summary of the study and making conclusions based on the finding of the study as well as making recommendations based on the research questions raised. In the same chapter, suggestions were made for further research.

CHAPTER TWO

LITERATURE REVIEW

Overview

This chapter focuses on the review of literature pertaining to the topic under study. The chapter incorporates theoretical framework, conceptual and empirical issues. Under the theoretical issues, the constructivists theory of learning and the teacher's role in a constructivist environment were reviewed to aid the understanding of the study. The conceptual issues centred on the concept of the availability of ICT tools and resources and the nature of Science Education; the competence of both teachers and students in the use of ICT resources in teaching and learning and the factors hampering the use of technology in teaching. The empirical review on the other hand was devoted to reviewing the works done by others which are related to or have bearing on this study. This allows for comparison to be made between the findings that would emerge from this study and the earlier findings from previous studies.

Theoretical Framework

Learning is often defined as a relatively lasting change in behaviour that is the result of experience (Cherry, 2016). He continues to say that learning is often defined as a relatively lasting change in behaviour that is the result of experience and might be easy to fall into temptation of only considering formal education that takes place during childhood and early adulthood. Learning takes place throughout the life span of an individual. The consequences of your actions can also play a role in determining how and what you learn. Behaviourist B.F. Skinner noted that while classical

conditioning could be used to explain some types of learning, it could not account for everything. Instead, he suggested that reinforcements and punishments were responsible for some types of learning.

According to Neo (2005), a learning theory known as Constructivism is attributed to the works of Papert, Piaget, Bruner and Vygotsky in which the learner is viewed as an active participant in the learning process. Constructivism as a learning theory was based on the core idea that humans construct their own thinking and understanding of the world they live in (Gil-Perez et al., 2002; Graffam, 2003; Jones & Brader-Araje, 2002). The learner is seen as an active and engaging organism in this form of learning, who is ready to react, and formulate ideas and construct understanding. Students are not required to memorize and recite facts, but be able to relate it to previous knowledge and establish relations if any. Duit (1995) opined that one of the aims in creating constructivist instruction is to uncover students existing knowledge.

This suggests that the students have in built previous knowledge that must be uncovered by the help of the facilitator or the teacher. Crotty (1998) posits that constructivism is 'the epistemological considerations focusing exclusively on 'the meaning-making activity of the individual mind' and constructionism focuses on 'the collective generation and transmission of meaning. Ayo (2001) opined that in constructivism, knowledge is constructed individually and social learning is the acquisition of meaningful competences and skills in a realistic context, and is advanced through interactive and authentic experiences that dovetail with the interests of the student and through active learning.

The 5E model theory of constructivism as enforced by Jerome Brunner, Lev Vygotsky, Jean Piaget, David Isabel etc. is believed to be science friendly as it can be used in the science classroom to ensure good instructional processes. The 5E Instructional Model (Graffam, 2003) can be used to design a science lesson, and is based upon cognitive psychology, constructivist-learning theory, and best practices in science teaching.

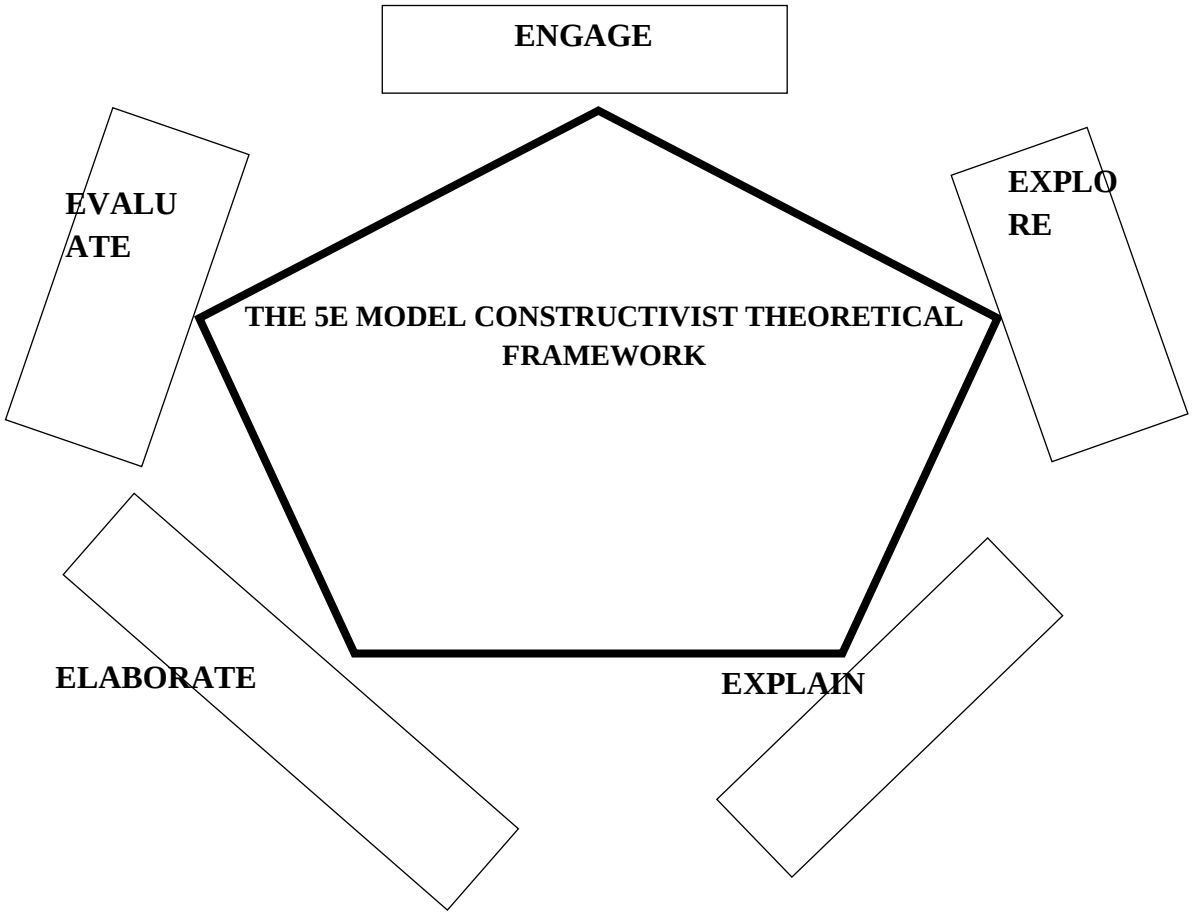

Figure 1- An adopted 5E Instructional Model (1990)

Graffam (2003) declares that "using this approach, students redefine, reorganize, elaborate, and change their initial concepts through self-reflection and interaction with their peers and their environment. Learners interpret objects and phenomena, and internalize those interpretations in terms of their current conceptual understanding. Science teachers and curriculum developers

may integrate or apply the model at several levels. The model can be the organizing pattern of a sequence of daily lessons, individual units, or yearly plans (Graffam, 2003).

Engage: In this first phase of the cycle, the teacher aims to assess student prior knowledge and/or identify possible misconceptions. This student-cantered phase should be a motivational period that can create a desire to learn more about the upcoming topic. Students may brainstorm an opening question or ask themselves. At this stage;

Make connections between past and present learning experiences

Anticipate activities and focus students' thinking on the learning outcomes of current activities.

Students should become mentally engaged in the concept, process, or skill to be learned.

Explore: Following an engagement phase that promotes a mental focus on the concept, the exploration phase now provides the students with a common, concrete learning experience. This phase is also student-cantered and incorporates active exploration. Students are encouraged to apply process skills, such as observing, questioning, investigating, testing predictions, hypothesizing, and communicating, with other peers. The teacher's role is one of facilitator or consultant. In addition, students are encouraged to work in a cooperative learning environment without direct instruction from the teacher.

At this stage;

Identify and develop concepts, processes, and skills

Students actively explore their environment or manipulate materials

Explain: A "minds-on" phase follows the exploration phase, and this is more teacher-directed and guided by the students' prior experience during the exploration phase. The explanation phase enables students to describe their understanding and pose questions about the concepts they have been exploring. It is likely that new questions will be generated. This phase includes clarification of student misconceptions that may have emerged during the engagement or exploration phases. The teacher may also decide to integrate video, computer software programs, or other visual aides to help with student understanding. The students should then be able to clearly explain the important concepts to the teacher and to their peers.

At this stage:

Explain the concepts they have been exploring

Opportunities to verbalize their conceptual understanding

Demonstrate new skills or behaviours

Opportunities for teachers to introduce formal terms, definitions, and explanations for concepts, processes, skills, or behaviours

Elaborate: The activities in this phase of the learning cycle should encourage students to apply their new understanding of concepts, while reinforcing new skills. Students are encouraged to check for understanding with their peers, or to design new experiments or models based on the new skills or concepts they have acquired. The goal of this phase is to help develop deeper and broader understandings of the concepts. Students may conduct additional investigations, develop products, share information and ideas, or apply their knowledge and skills to other disciplines. This is a great opportunity to

integrate science with other content areas. Elaboration activities may also integrate technology, such as web-based research.

At this stage:

Conceptual understanding

Practice skills and behaviours

New experiences

Develop deeper and broader understanding of major concepts

Obtain more information about areas of interest, and refine their skills.

Evaluate: Assessment in an inquiry-based setting is very different to that in traditional science lessons. Both formal and informal assessment approaches are appropriate, and should be included. During the lesson, assessment should be viewed as an ongoing process, with teachers making observations of their students as they apply new concepts and skills and looking for evidence that the students have changed or modified their thinking. Students may also have the opportunity to conduct self-assessment or peer-assessment. However, the evaluation may also include a summative experience such as a quiz, exam, or writing assignment.

At this stage:

Encourages learners to assess their understanding and abilities

Teachers evaluate students understanding of key concepts and skill development.

Although the 5E Model has just been explained in serial order, it is often necessary to reverse back into the cycle before again going forward. For instance, numerous explore/explain rotations may need to occur before the students are ready to transition to the elaboration phase. The teacher may

move back and forth several times within the Es, or may include an additional engagement prior to starting an elaboration phase. The cycle is very flexible and dynamic. It may take many days to complete the lesson or unit. It is not necessary to complete one learning cycle each day that science is taught. The model is designed to facilitate conceptual change and contribute to more consistent and coherent science instruction (Graffam, 2003).

Teacher's Role in a Constructivist Environment

Many teachers are in favour of adopting constructivist instructional approaches but are unsure of where to begin (Bruce, 2000). We are in the information age and our communities and societies have also become knowledge based. One of the major problems of facilitators or teachers is to cover more areas of knowledge within a short period of time. Teachers are to expect to be content based, social skills, academic skills, technology incline and even minimum level of spirituality. The behaviour of a teacher operating in a constructivist environment is like prairie coyote shrewdly moving around the environment in a haphazard manner, yet focused and purposeful in a prepared and productive manner. Teacher's role in a constructivist environment is to create learning situation and conditions that interactive, invigorating and informative (Schwartz, 1999).

Duit (1995) in a conversation with Paolo Freire, Brazilian philosopher, indicated that there's a lot of truth in saying that when you go to school, the trauma is that you must stop learning and you must now accept being taught. Carroll (as cited in Demirci, 2009) describes the function of a teacher as didactic and well-establish. The role of the teacher operating in a constructivist

environment is viewed through distinctive lens from different angles with different focused. Graffam (2003) commented that, in a constructive environment, the learning that takes place is considered to be student-centred, minds on, collaborative and action packed. Chung-Ho and Ching-Hsue (2013) stated that the teacher is a coach or facilitator. They do not possess all the knowledge the learners required. Graffam (2003) claims that the best hope for teachers or facilitator in a constructivist environment is in the intervention he/she provides in the learning that is taking place rather than being in control in the learning process. To move away from the traditional instructive approach of learning towards constructivist approach, Neo (2005) suggested the following twelve strategies; student' autonomy and initiative must be encouraged and accepted; raw data, primary source manipulative, physical and interactive materials must be used side by side. Encourage the of cognitive terminology such as create, analyse, predict and classify allow student responses to direct lessons, suggest instructional strategies and pedagogies, and alter content; students' understanding of concepts must be enquired before sharing their own understandings of those concepts; students must be encouraged to engage in dialogue and active conversation, both with the teacher and themselves; ask thoughtful and open ended questions to encourage student inquiry skills and encourage them to do same; elaboration of students' initial responses must be sought engage students in situations that might trigger contradictions to their initial hypotheses and responses and then encourage discussion; after posing a question, allow wait time allow time for students to construct relationships among situations and create metaphor; use learning cycle model to nurture students' natural curiosity

The facilitator must create opportunities like peer and teacher directed scaffolding that allows interactions that stimulates knowledge building and acquisition. A teacher who has operated in the traditional instructive is not often comfortable with this change. A constructivist teacher is especially interested in dialogues and consultations of this kind because they reflect more accurately than any written examination could do the kind of skills those learners have mastered as they achieve mastery over their environment. A constructivist teacher is an interested but nondirective listener who ideally remains "invisible" even as he or she draws informed conclusions about the quality of group work, about levels of participation, and about the qualities that individual learners bring to the task in hand (Jones & Brader-Araje, 2002).

Availability of ICT Resources and the Nature of Science Education

According to Burnie (2008), science made use of ICT tools in its studies. He stated that earlier computers, such as the electronic numerical integrator and computer (ENIAC), first introduced in 1946 by American physicist John W. Mauchly and American electrical engineer John Presper Eckert, Jr., used as many as 18,000 triodes and filled a large room. Science develops through objective analysis, instead of through personal belief. Knowledge gained in science accumulates as time goes by, building on work performed earlier. Some of this knowledge such as our understanding of numbers stretches back to the time of ancient civilizations, when scientific thought first began.

In physics, scientists study the relationships between matter, energy, force, and time in an attempt to explain how these factors shape the physical

behavior of the universe (Burnie, 2008). Scientists study the motion of objects, a huge branch of physics known as mechanics that involves two overlapping sets of scientific laws. The laws of classical mechanics govern the behavior of objects in the macroscopic world, which includes everything from billiard balls to stars, while the laws of quantum mechanics govern the behavior of the particles that make up individual atoms. The aims of the Senior High School Physics program as stated in the Ghana Education Service syllabus for Physics include the following (CRDD, 2010):

Provide, through well designed studies of experimental and practical physics, a worthwhile hand on educational experience to become well informed and productive citizens.

Enable the Ghanaian society function effectively in a scientific and technological era, where many utilities require basic physics knowledge, skills and appropriate attitudes for operations.

Recognize the usefulness, utilization and limitations of the scientific methods in all spheres of life.

Raise the awareness of inter-relationships between physics and industry, Information, and Communication Technology (ICT), Agriculture, Health and other daily experiences.

Develop in students, skills and attitudes that will enable them to practice science in the most efficient and cost effective way.

Develop in students' desirable attitudes and values such as precision, honesty, objectivity, accuracy, perseverance, flexibility, curiosity and creativity.

Stimulate and sustain students' interest in physics as a useful tool for the transformation of society.

Even though, one of the aims of science education in Ghana is to raise the awareness of inter-relations between other sectors and ICT, no direct emphasis was made on the use of ICT in the Teaching and Learning Activities (TLA) of the physics syllabus (CRDD, 2010). The availability of ICT resources plays a major role in provision of quality teaching and learning. It is a known fact that an effective teaching and learning stimulate intellectual curiosity and offer a sense of enjoyment that will move the students from the passive role of recipient of information to active role of builder of knowledge (Schwartz, 1999). Effective adoption and integration of ICT into teaching in schools depends mainly on the availability and accessibility of ICT resources such as hardware and software. Again, Omufwoko (2009) points out that, schools need to be equipped with modern ICT gadgets to enable them access internet effectively. The computers should have latest version and computer packages to enable students perform a variety of tasks. She notes that such hardware must be the latest multimedia with adequate storage capacity and memory.

A study by Kulshreta and Pandey (2013) in the Kisumu district of Nyanza province, Western Kenya on 'Application of computer based resources in Geography education in secondary schools' revealed that out of a total number of 80 schools, only 6 (8%) had computers whereas 74 schools (92%) did not have computers that could be used for Geography teaching and learning. Ayo (2001), in their research work in Kenya, contend that very few secondary schools have sufficient ICT tools for teachers and students. Even in schools that have computers, the student-computer ratio is 150:1. Most of the schools with ICT infrastructure had acquired it through initiatives supported

by parents, the government, non-governmental organizations (NGOs), or other development agencies and the private sector, including the NEPAD electronic school programme. The research further stated that about 10% of secondary schools with computers were able to share teaching resources via a Local Area Network LAN. The situation is not totally different in some parts of Ghana.

A research by Teye (2012) 'assessment of ICT situation in Senior High Schools: A case study in Lower Manya Krobo District' revealed that all the schools used in the study do not have enough computers for studies. In the researcher's interaction with some of the tutors at Akro Senior Secondary and Technical School, it came out that with a total student population of 1780, there were only twenty-eight (28) computers in their laboratory. The situation at the Akuse Methodist Senior High and Manya Krobo Senior Schools were not so different from that of Akro Senior Secondary and Technical School just that they have computers numbering 35 – 43 (Adebi-Caesar, 2012). The situation was different at the Krobo Girls Senior High School with a little of over fifty (50) computers in the school.

From the above review of some studies in schools, the researcher realizes that most schools challenged with inadequate ICT tools in teaching and learning hence for a successful use of ICT as a constructive approach, there should be enough ICT tools for each individual student. ICT tools would generate new ways of teaching and learning through computers. It would constitute a shift from teacher cantered to learner cantered pedagogy. It would decrease memorization and rote learning, increases critical thinking for learners, encourages activities in small groups of learner, also the pace activities would be determined by learners. Using ICT as a constructivist

approach in learning and teaching would encourage interaction and cooperation among students, teachers and expertise regardless of where they are. ICT would enhance integrative learning that is transforming theories to practice and active participation of learner rather than just telling them answers. In a conducive ICT learning environment, collaborative activities such as embed learning in a meaningful context and reflection on what has been learned through conversation with other learners is ensured. Cognitive tools with the help of the ICT tools are designed to make learners think harder about the subject matter being studied while generating thoughts that would be impossible without the tools.

This is best explained by adapting the framework used by Brodie and Pournraa (2005). To them, constructivism focuses on knowledge construction, not knowledge reproduction. It is a belief that one constructs knowledge from one's previous experiences. Everyone's view of the external world differs from others because of their unique set of experiences, the ideas and interests of children drive the learning process. Students construct new understandings using what they already know and prior knowledge influences what new or modified knowledge they will construct from new learning experiences. Learning in this case is active rather than passive. Students may need different experiences to advance to different levels of understanding.

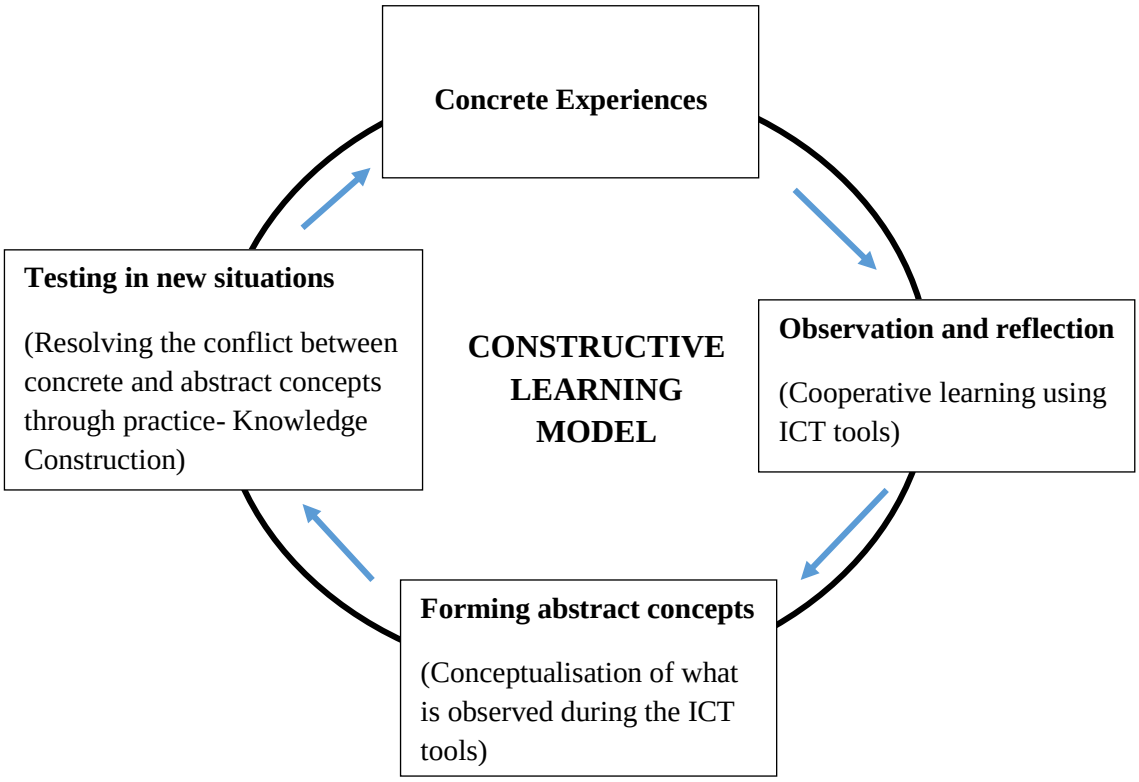

Figure 2- The Four-Stage Constructive Learning Model

Brodie and Pournraa (2005) explained, in grasping experience some students perceive new information through experiencing the concrete, tangible, felt qualities of the world, relying on their senses and immersing ourselves in concrete reality. Others tend to perceive, grasp, or take hold of new information through symbolic representation or abstract conceptualization – thinking about, analyzing, or systematically planning, rather than using sensation as a guide. Similarly, in transforming or processing experience some students tend to carefully watch others who are involved in the experience and reflect on what happens, while others choose to jump right in and start doing things. The watchers favour reflective observation, while the doers favour active experimentation. Each dimension of the learning process presents us with a choice. At this stage, a student form abstract conceptualization of what

he/she has observed and reflected upon. The student resolves the conflict between the concrete experiences and the abstract concepts learned through observation and reflection by putting them in practices. The student with the help of the ICT tools can now test using the tools and also using these tested principles in the real life situations.

Upon the study of the syllabus, the researcher considered the following ICT materials as generally useful for the teaching and learning of Physics in its IT lab:

Hardware

Computer System (with latest specifications)

Multimedia projector with accessories

Port Switches

UPS

Digital cameras

Scanners

Laser Printers

Touch Screens

Laptop with latest specifications

Software

Ms Office package latest version

Adobe Creative Suit (Latest Version)

Visual Studio 6.0 or (Latest Version)

Adobe Flash Professional

Adobe Flex (Latest Version)

Adobe Dreamweaver

Web Cameras

Antivirus (user License)

Usefulness of ICT as a Constructivist Approach in the Teaching and Learning of Physics

Information comes first, followed by questioning to determine student understanding and ending with some sort of problem-solving activity (Cherry, 2016). Presentation modality is what makes multimedia such a "powerful" medium as "it takes advantage of the full capacity of humans for processing information". The use of ICT in education in 219 studies, consistently found that students in technology rich environments experienced positive impact on achievement in all subject areas (Johnstone, 2004). There is overall effectiveness of technology in achievement of students in secondary school and college education in United Sates when compared to traditional instruction between 1970 and 1999 from meta-analysis on 42 studies (Lombe, 2010). continue Lombe to say that is more effective in physics than any of the sciences (chemistry and biology). Khine and Fisher (2003) also suggested, one sure way of bringing about change in learner is by the use of technology especially computers which are interactive in nature and has graphical user interfaces with scientific visualization for understanding concept in science.

According to Khan and Shah (2004), the web is where constructivist learning can take place. The web provides access to rich sources of information; encourages meaningful interactions with content; and brings people together to challenge, support, or respond to each other. Khan and Shah suggested that educators could deploy ICT to facilitate learning and critical

thinking. In agreement to Khine and Fisher (2003) posits that educators must use ICT as alternatives to teacher-based model. According to Lvin and Wadmany (2005), when technologies are inserted into the educational environment, they are meant to develop learning abilities in students. However, these technologies do not function in a vacuum. Instead they are coupled to existing tools and concepts in the setting. When teachers attempt to implement a technology innovation in the classroom, they naturally face the complex challenge of fitting together new ideas with deep-rooted pedagogical beliefs and practices.

ICT and constructivism are to create learning environment for effective teaching and learning. The technology may employ some combination of audio channels, computer code, data, graphics, video and text. The technologies may be tutorials, tools, communication and exploratory. ICT as diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information (Matzen & Edmunds, 2007). Tutorial uses are those in which the technology does the teaching, where system controls what materials will be presented to the learner. According to exploratory technology, the student is free to roam around the information displayed or presented in the medium and this promotes discovery approaches to helping students learn information, facts and procedure (Pruitt, 2011). They further indicated that tools helps students in the educational process by providing them with general-purpose applications to facilitate writing tasks, analysis of data, and the location of information resources. Examples are word processors and spreadsheet. Communication are those that allow students and teachers to send the receive messages and information to

another through networks or other technologies such as satellite, modems, and cable links (Pruitt, 2011).

The integration of ICT into the very idea of teaching and learning always places pedagogy over technology. It is not the only concern to master ICT skills, but rather it involves using ICT to improve teaching and learning (Richard, 2014). Training needs to continue to support innovative pedagogy (Underwood, 2004). However, Pedagogical practices of teachers using ICT can range from only small enhancements of teaching practices using what are essentially traditional methods, to more fundamental changes in their approach to teaching. ICTs can be used to reinforce existing pedagogical practices as well as to change the way teachers and students interact. Wong, Li, Choi and Lee (2008) outlined that new technologies in teaching stimulate the development of intellectual skills, contribute to the ways of learning knowledge, skills and attitude. Warschauer, Knobel and Stone (2004) posits that ICT aid in the preparing the learner's developmental cognitive skills, thinking, access information, evaluation and synthesis of skills and provide fast and accurate feedback to learners. Wilson, Teslow and Osman-Jouchoux (1995) suggested, learners who use ICT in learning are more successful in school and are motivated to learn more and develop self-confidence. The significance of these findings suggests that if ICT is properly used, students are able to construct their understanding and knowledge.

Looking at the difficulties of Physics concepts, Soby and Egeberg (2009) suggested that educational methods that make good use of modelling and visualization should be used to teach concept instead of the traditional teaching methods (Soby & Egeberg 2003). "visualisation tools such as

animations can be used to give an accurate and rich picture of the dynamic nature of molecules and molecular interaction, which are often very hard to grasp from text-based presentations of information' (Selwyn, 2008). Reeves and Reeves (1997) in their study observed that effect of visualization in learning molecular biology is in line with Physical Science concept. This was observed in their study of effect of substituting computers simulations for laboratory equipment. In the early days the use of ICT, science lessons where full of various innovations. To build better understanding of misconception by students, modelling was used. Computer-based modelling has contributed to science learning by pupils. Papet and Harel (1991) concluded in his earlier study in physics that computer aided modelling for students of ages 16-19years who at the upper level of secondary school worked in normal setting and serve as source for realistic examples and illustrations in a number of phenomena. He noticed that the situation helped to shift the view of physics from mathematical concept to concept of physical phenomena and help to adopt a teaching methodology that promote students' participation and involvement that help to students to construct and reconstruct their own meaning and understanding. This method has improved cognitive skills of students (Neo, 2005). Information and Communication Technology has proved to be a good facilitator of learning (Cookson, 2001).

Research have shown that use of ICT may be may be attributed and linked to performance. Becta (2004), analysis of results obtained from 2500 primary schools show that the statistical correlation that was found between the grade given by inspectors for ICT and attainment in science at Key Stage 2 was very significant (0.06). In another analysis, Becta (2004) found out that

there was consistent positive difference between the performance level of students in schools with good ICT infrastructure and usage than those with poor infrastructure and usage when data from 409 secondary school. Meta-analysis of data obtained in a study that focused on secondary education, using previous study that uses experimental, quasi-experimental criteria showed that the attainment and performance of students receiving computer- aided instruction was higher than those who use traditional instructive learning and that of ICT on science performance was greater than other subjects, when minimum sample size of 20 in control and experimental groups were used (Matzen & Edmunds, 2007).

The use of ICT promotes collaborative learning, help learners in role play, group problem solving activities and projects (LaMarca, 2011). All these enhance stimulation. Demirci (2009) confirmed that students found ICT enhanced classroom or environment more stimulating and better than normal traditional classroom. ICT encourages interaction and cooperation among students, teachers and expertise regardless of where they are. ICT provides a catalyst for rethinking teaching practice (McCormick & Scrimshaw, 2001). It also encourages interaction and cooperation among students, teachers and expertise regardless of where they are technology-based teaching may not be applicable in all cases, but the most effective, provision of relevant examples and demonstrations, flexibility of delivery and public demands for efficiency (Deaney, Ruthven and Hennessy, 2006). They further stated that due to technological advancement, ICT is now seen as instrument for globalization of education in his study of national and international policies for ICT in education. He further suggested that the desire to inspire towards global

information environment where information and resource can be freely available to hare between researchers, teachers and students is becoming a reality.

Competence of Teachers and Students in the use of ICT Resources in Teaching and Learning

Competency standards are concerned with application of professional knowledge and skills within the workplace and are underpinned by teachers' professional values (Kulshreta & Pandey, 2013). Competence is usually associated with highly professional performance and there is a direct link in the field of education between a teacher's professional competence and pupil performance. There are two distinct meanings of competence in education. From a theoretical point of view, competence is understood as a cognitive structure that facilitates specified behaviours. From an operational point of view, competence seems to cover a broad range of higher order skills and behaviours that represent the ability to deal with complex, unpredictable situations. This operational definition includes knowledge, skills, attitudes, metacognition and strategic thinking, and presupposes conscious and intentional decision making (Westera, 2001).

Meredyth et al., (1999) noticed that teachers who lacked skills necessary for basic computer operations ranges between 25% and 50% when they collected a data from 1258 teachers from government, Independent and Catholic schools in 1998. They noticed that teachers over 50 years, female teachers and primary school teachers were people who fit into that group. There have been several attempts, ranging from Workshops, Conferences and

in-service trainings to help heads, teachers and ICT coordinators implement and integrate ICT into school administration and teaching.

Computer competence is defined as being able to handle a wide range of varying computer applications for various purposes (Cox & Abbott, 2003). According to Chen (2008), teachers' computer competence is a major predictor of integrating ICT in teaching. Another report by Brodie and Pournara (2005), on 'accessibility and utilization of ICTs among secondary school teachers in Kenya. The findings of the survey revealed that majority of these teachers did not receive any prior ICT training during their formative years at the teacher training colleges or universities before joining the teaching profession. About 55% of the teachers stated that they did not receive any ICT training at all. Nevertheless, 51% of the teachers had taken the self-initiative to undergo ICT training over the past 3 years.

Ashiagbor, Anne, and Sodo (2013) from their work "The Effectiveness of the use of ICT Resources in the teaching and learning of Accounting in some selected Senior High Schools in the Cape Coast Metropolis", revealed that majority of the teachers they sampled (85%) agreed that they received formal training on the use of ICT resources in teaching and learning whiles (15%) of the teachers said they did not receive training. Their result further revealed that most of the teachers (80%) had their formal training in ICT resources usage from computer training schools while the rest had their ICT training from their current school.

In relation to students' competence, Dawda, Dadzie, Quaye and Amissah (2008) in their research work 'The use of Technology in teaching and learning' observed that out of the 60 students their research sampled in the

Aggrey Memorial Senior High School, all of them were familiar with the use of computers, television and radio. About 25% of them could use projectors whiles 33% could use the internet for learning. The research however revealed that, 75% of the students were not familiar with projector whiles 67% could not use the internet. The findings of Bekoe (2006), indicated that 60% of the students sampled for their study had formal training in the use of ICT resources, whilst 40% of the sampled students did not have formal training in the use of ICT resources, in learning. Majority of the students do not have the competence in the use of ICT resources in learning.

Factors hampering the use of ICT in teaching and Learning Physics

Information and Communication technology (ICT) is very important, and plays a major role in teaching and learning process with enormous benefits. In spite of all these benefits however ICT have not been effectively integrated and incorporated into teaching of science especially Physics in senior high schools in Ghana. Many factors have been identified and attributed to this. The aim of the researcher is to see if the outcome of this study would be consistent with these identified factors.

Perception teachers about the significance of ICT tools. Some teachers at all levels of pre-tertiary level of education do not regard computers and its related technologies to be of any importance to their teaching and learning process. BECTA (2004) identified this barrier in their review on factors hindering the use of ICT in instruction.

Attitude of teachers: Teacher's attitudes are major factor to the use of technology in instruction. Negative attitude would discourage him form

integrating it into teaching. Researches have established that some teachers especially pre-tertiary level are not easily adaptable to new trends of doing things because they simple want to continue with old method where they feel more comfortable. Teachers do not know and aware of what the change can offer them so they prefer sticking to their traditional methods of instruction.

Teachers' training: teachers and instructors do not have the basic requisite knowledge training to be able to use technology in their instruction. Guha in BECTA (2004) pointed that time and training are major obstacles to technology usage in teaching. Many teacher training colleges do not prepare and teach teachers to have basic skills enable them incorporate technology in their instruction. Committing time and resources into self-training in order to use ICT in preparation of lesson becomes difficult (Bello, 2006).

Organizational Attitude: The school or institution in which one works can affect his or her interest or motivation to use technology in instruction. If the management enforce polices and show commitment to the use of ICT in the day to day running of the school, teachers are likely to encourage to use ICT. Ayo (2001) stated that teachers cannot effectively use technology if they lack basic training, support and time. If all these factors are available, it is more likely for teachers to incorporated technology into instruction.

Access to technology: Studies have revealed that many classrooms in the United States and UK have computers and other technologies. Fabry and Higgs (1997) reported that Apple Classroom of Tomorrow was set up by Apple Computers in 1985 and their countless examples in Europe. The situation is different in Ghana. Fabry and Higgs (1997) stated that access "involves locating the proper amount and right types of technology where

teachers and students can effectively use them". When internet and other services are available in and outside the school, teacher would be able to locate relevant materials that could use for their lesson.

Cost: One major factor to the use of technology is the cost of procuring technology. Hardware, software, installation internet, maintenance required money. Approved computer few charged by the schools would not be sufficient to have any proper ICT facilities and technology. Coskun and Kinnisnet (2009) said $10 million is spent on classroom computers in New Jersey. Not many schools if any can spend such amount on computers alone in Ghana.

Learners' technology skill: Student's knowledge and ability level in the use of technology constitute an obstacle. Studies show that many students living in the rural areas lack exposure to computers and it related technology hence teachers do not see the need to use the technology since the students have to be trained before it can be used in the actual instruction. The Scottish HM Inspectorate of Education (2004:3) noted that "the pupils ICT skills should complement pupils' ICT-based coursework in a wide range of subjects".

Consequently, a research work by Thompson, Korlekwor, Nipah and Alhassan (2013), which was focused on finding out the use of ICT in Financial Accounting: A survey of selected Senior High Schools within the Cape Coast metropolis. In their research, the descriptive survey design was used as well as the use of the questionnaire as tool for data collection. With regards to findings, Bowling (2002) disclosed that government policy, erratic supply of power, students' background and misuse of the internet by students were major setback to the use of ICT resources in teaching and learning.

Chapter Summary

In summary, this chapter looked at the conceptual review as well as empirical review of various literatures which are related to this research work. The concepts of information and communication technology as well as the use of ICTs as a constructivist approach in the teaching and learning of Physics were looked at under the conceptual review and the needed comments on such concepts were given. With respect to the empirical review, some related previous works done by various researchers were reviewed with regards to their, population as well as their findings. These reviews helped me to properly analyse my work.

CHAPTER THREE

RESEARCH METHODS

Overview

The thrust of the study is to investigate the use of ICT as a constructivist approach to the teaching and learning of Physics in some Senior High Schools in the Agona East District. This chapter described how data was collected and discusses the procedures as well as techniques which was followed to conduct the study. It included research design, the target population, sample size and sampling technique, the research instrument, data collection procedures and data analysis.

Research Design

Nconco (2006) explained that a research design is the "blueprint or detailed plan for how a research study is to be conducted. This study was underpinned by quantitative approach in the positivism paradigm. Descriptive research design was employed in this study. According to Leedy and Ormrod (2005), descriptive research design involves studying and gathering information from or about groups of people in order to state their answers or responses; the ultimate goal of which is to make a generalization to the entire population. The reason for using descriptive design was to observe, describe and document an aspect of a situation as it naturally occurs. Thus, the use of this design enabled me to ascertain meaningful or useful diagnosis of the situation since it involves describing, recording, analysing and interpreting conditions that exist. Therefore, the descriptive survey was deemed an appropriate design for investigating the use ICT in teaching and learning of

Physics in some Senior high schools in the Agona East District. Amedahe (2002) maintains that in descriptive research, accurate description of activities of the processes and persons is the objective. The adoption of descriptive design ensured high level of objectivity in the study.

However, descriptive design cannot help the researchers to establish a causal relationship between variable and Creswell (2008) also noted that, survey data is self-reported information, reporting only what people think rather than what they do. In addition, Kelly, Clark, Brown and Sitzia (2003) opine that the private affairs of respondents may be pried into and there is therefore the likelihood of generating unreliable responses and difficulty in assessing the clarity and precision of questions that elicit the desired responses. In order to limit the influence of these weaknesses on the study, the respondents were assured that their responses would be treated with strictest confidentiality and were meant for academic purposes only.

Population

In every study, a researcher always has an interest in a group of people from whom he/she gathers data and draws conclusion. The larger interest group which one hopes to apply the results of a study is the population (Fraenkel & Wallen, 2006). The target population consisted of all students and teachers of Swedru SHS and Nsaba SHS in the Agona East District of Ghana. However, the accessible population were Form Two Science students and Teachers in these SHS. The population was 448. This consisted of 440 Physics students and 8 Physics teachers. The characteristics of the population included their gender, age, academic and professional qualification as well as years of teaching experiences of teacher. Emphasis was given to this population

because the topic under study focuses on the use of ICT as a constructivist approach in teaching and learning physics, hence science students who have experienced ICT mediated instruction in physics and the teachers who teach physics in the school were in the best position to provide the necessary data needed for the study.

Sample and Sampling Procedure

The sample size was 206 students and 8 teachers. The sample of the 200 students was determined through the Krejcie and Morgan's (1970) minimum sample size determinant. According to the Krejcie and Morgan sample size table, estimated population of N= 440 students gives a sample size of S= 205. In addition, one (1) was added to make 206 for fair representation. Since, the Physics teachers were not many, all of them were involved in the study.

Simple random sampling and census method were the two sampling techniques used in this research. Amedahe and Gyimah (2010) define a simple random sampling as a type of sampling which gives all units of the target population an equal chance of being selected. The reason for adopting the simple random sampling technique was to ensure fair representation of the accessible population. The random numbers method under the simple random sampling was used to give all units of the targeted population an equal chance of being selected. This was done by defining the sampling frame and after numbers were written on a paper from 1-60 which was the total number of one class (2 Science 1) and 1-55 for 2 Science 2. Then students were made to pick and all who fell within 1-51 were sampled from the two Science classes making 103. Same procedure was followed for the second school to select the

remaining 103. Census was used to involve all the physics teachers in the study. According to Harding (2013), an attempt made to collect data from every member of a population rather than choosing a sample is referred to as census. In addition, Bhanu (2011) held the view that however accurately a sample from a population may be generated, there will always be margin for error, whereas in the case of census, whole population is taken into account and as such it is most accurate. Hence, census was adopted because of the fact that the estimates are not subject to sampling error as stressed by Bhanu.

Data Collection Instruments

The research instrument that was employed in the study was questionnaire. Sidhu (as cited in Owusu & Asare-Danso, 2014) posits that a questionnaire is a form prepared and distributed to secure responses to certain questions. In addition, it is a systematic compilation of questions that are submitted to a sampling population from which information is desired. The questionnaire was used because it promises a wider coverage since researchers can approach respondents more easily and can be completed at the respondents' convenience. Though the use of questionnaire did not allow the respondents to express their views on the problem extensively; however, in line with Leedy and Ormrod's (2005) view, the questionnaire guaranteed confidentiality and anonymity of the respondents since it was generally self-reporting.

Thirty-eight (38) items were on each questionnaire which was made up of both closed-ended and open-ended questions (McBurney, 2007). Two sets of questionnaires were used, one set for the students and another set for the teachers. The questionnaire items for both students and teachers were grouped

into five sections. The Section 'A' dealt with the demographic data of the respondents while Section 'B' focused on the first research question which was on the availability of ICT resources in teaching and learning Physics. Section 'C' covered items on usefulness of ICT in teaching and learning Physics. Furthermore, the third research question which was on the competence of the teachers and students in the use of ICT was covered in Section 'D'. Then Section 'E' dealt with the challenges that affect the effective use of ICT in Physics lesson which was the fourth research question. Apart from the demographic data which was a mixture of open and closed ended questions, Sections B to E were designed on five-point Likert scale responses in a descending order from "Strongly Agree, Agree, Neutral, Disagree and Strongly Disagree". The Likert scale was appropriate because it is one of the most universal methods for survey collection and for that matter, is easily understood and get quick responses from respondents. In addition, the responses on the scale were easily quantifiable and good for computation of mathematical analysis as well as having high versatility which can be sent through mail or given in person (LaMarca, 2011).

Validity and Reliability of Instrument

The research instruments were subjected to a validity and reliability test. Validity refers to the degree to which evidence and theory supports the interpretations of test scores entailed by proposed uses of tests (Ary, Jacobs, Razavieh & Sorensen, 2006). It deals with the appropriateness and the usefulness of the results while reliability refers to the degree of consistency to which the instruments can yield comparable results. The face and content validity of the questionnaire and the interview guide questions were

determined through expert judgement by the investigator's supervisors and colleague researchers. The face validity ensured that the questions were clear, relevant and unambiguous for the respondents (Ary et al., 2006) while the content validity would judge the extent to which the content of an instrument appears logical in examining the full scope of the domains it intends to measure (Bowling, 2002). The suggestions given by the supervisors and experts were used to effect the necessary changes to improve upon the validity of the instrument.

Thereafter, a pre-test of the instruments was conducted on Form Science students of Nyankrom Senior High School to pave way for feedback on the completeness and the appropriateness of the items in the instruments. This was on done on the 20th July, 2019. The completed questionnaires were collected, edited, coded and analysed with the aid of computer software known as IBM Statistical Product for Service Solution (SPSS Version 22). Cronbach co-efficient alpha of 0.73 was established for the reliability of the instruments. Since, Cohen, Manion and Morrison (2007) pointed that a reliability co-efficient of .70 is considered high and therefore adequate, the 0.73 reliability of the instrument was considered sufficiently reliable and adequate.

Data Collection Procedure

The survey was carried out by the investigator himself. A letter of introduction was obtained from the Co-ordinator for Master of Education Information Technology, University of Cape Coast, this enabled the researcher to obtain permission from the heads of Swedru Senior High School and Nsaba Senior High School. After the green light was given by the head, I met the

students and briefed them as to what the study was about in order to get their understanding, attention, support and co-operation for the data collection. In addition, the respondents were assured of their confidentiality and they were given 30 minutes to fill or answer the questionnaire. The data collection exercise was started from 3rd-15th July, 2019. With respect to the teachers' questionnaire, they filled it alongside with the student's questionnaire filling. The teachers were given 20 minutes to fill the questionnaire. All the questionnaires for the Swedru SHS were retrieved the same day of its filling while the Nsaba SHS, the researcher had to go there another day for both students and teachers' questionnaire. I had 100% retrieval rate.

Ethical Considerations

Ethical issues concerning the right and confidentiality of the prospective respondents were addressed by the investigator, in order not to be accused of infringing upon the rights and privacy of the respondents. Firstly, the informed consent of the prospective respondents was sought to participate in the field study and provide them with an explanation of the purposes of the study and expected duration of their participation. Also, steps were taken to protect or prevent risk or harm to participants. For example, issues of embarrassment were presented by not disclosing their identities or not informing third party of the discussions. Confidentiality – thus, withholding real names and other identifying characteristics of respondents. The right of the respondents to veto the research results was upheld. Additionally, respect was accorded participants as subjects and not as objects to be used and then discarded. Participants were given a statement that participation was voluntary, refusal to participate involved no penalty or loss of benefits to

which the participants was otherwise entitled, and the participant may discontinue at any time without penalty or loss of benefits to which the participants was otherwise entitled.

Data Processing and Analysis

Since it was quantitative data, it was sorted, edited, coded and analysed. The editing of the questionnaires helped to remove uncompleted questionnaires while the coding aided in assigning numerals to the various responses of the items on the questionnaire and the Likert scale (SA=4, A=3, D=2, SD=1) type of responses. The data was run using the IBM SPSS (version 22). In this study, descriptive statistical tool was used in analysing the data into frequencies and percentages, means and standard deviations. The reason for using means and standards deviation was to enable the investigator to find the extent of agreements of the respondents' responses. Frequencies and percentages was used to analyse the demographic data of the respondents while mean and standard was employed in analysing the four research questions that guided the study.

Chapter Summary

The chapter focused on the research design used which is descriptive research design and Form Two Physics students and teachers formed the accessible population for the study. Simple random sampling technique and census method was adopted and questionnaire was used to gather data from respondents. On the collection of data, an introductory letter was obtained from the Co-ordinator for Master of Education Information Technology, University of Cape Coast which enabled me to obtain permission from the

Head of the school. Descriptive statistical tool such frequencies and percentages and mean and standard deviation was used to analyse the data.

CHAPTER FOUR

RESULTS AND DISCUSSION

Overview

The purpose of this study was to investigate the use of ICT as a constructivist approach in the teaching and learning of Physics in Swedru Senior High School in the Agona East District of Ghana. Questionnaire which contained 38 items for students and 42 items for teachers was employed for the study and these items were measured on varying Likert scale. In addition, simple random sampling and census methods were used in to select the Physics students and teachers respectively for the study. Descriptive statistics involving means, standard deviations, frequencies and percentages were used to analyse the data. This chapter deals with the presentation and discussion of the findings of the study. The findings were organized and presented in line with the research questions of the study. The chapter is divided into two sections. The first section focused on the demographic data of the respondents whilst the second aspect concentrated on the presentation and discussion of the main findings of the study.

Demographic Data of the Respondents

This section dealt with the information collected on the demographics of the respondents. The purpose for the discussion of the demographic characteristics of the respondents is to show that the right respondents who had relevant experience in the subject area were used. The characteristics of the respondents discussed in this section included; Gender, age, professional

qualification, academic qualification and teaching experience. The demographic data of the respondents is presented in Table 1.

Table 1: Background Information of Respondents

Variables	Sub-scale	N	%
Gender of Students	Male	121	58.7
	Female	85	41.3
Gender of Teachers	Male	8	100.0
	Female	Nil	Nil
Age of the Students	14-16 years	47	22.8
	17-19years	159	77.2
Form of Students	Form 2	205	99.2
	Form 3	1	0.5
Academic Qualification	First Degree	5	62.5
of Teachers	Master's Degree	3	37.5
Professional	Cert A	2	25.0
Qualification	B.Ed	6	75.0
Years of teaching	Less than 1 year	1	2.5
	1-5 years	3	37.5
	6-10 years	4	50.0

Source: Field survey (2019)

From Table 2, the results showed 121(58.7%) of the students' respondents were males whiles 85 (41.3%) were females. This shows that the student respondents in the selected schools in the Cape Coast Metropolis were not equally represented in the study in terms of gender. With regards to teachers' respondents, 8 (100.0%) were males while none of the teachers'

respondents were females. This implies that the study was dominated by male respondents for teachers. In terms of age, the study was dominated by students' respondents between the ages of 17-19 years and majority of the student respondents were in form 2, representing 205(99.2%). Besides, most of the teachers' respondents 5(62.5%) hold first degree as academic qualification while 3(37.5%) of the respondents hold masters' degree. Majority, 6(75.0%) of the teachers hold B.Ed. as professional qualification and 2(25.0%) of the teachers hold Cert A as professional qualification. This implies that most of the teachers in the Cape Coast Metropolis are professionals. In terms of number of years spent in the teaching profession, most of the teachers' respondents have been in the profession between the years of 6-10(50.0%) while next to the majority 3(37.5%) of the teachers were in the teaching profession between 1-5 years. It is important to note that only one of the teachers has been in the teaching profession for less than 1 year.

Discussion of Main Results

This part of the study covers the main findings that materialised from the study. The results are organized and discussed in accordance with the research questions guiding the study. This was done to ensure attainment of the various research questions set at the beginning of the study and to provide well organised discussions to enhance easy understanding of the findings of the study. Since, descriptive statistics such as mean and standard deviation were used in analysing the data, the decision rule that was followed is presented in the Tables 2 and 3.

Table 2: Decision Rule for Means Values

Mean	Scale
3.4-4.0	Strongly Agreed
2.6-3.3	Agreed
1.7-2.5	Disagreed
1.0-1.6	Strongly Disagreed

Source: Field survey, (2019)

From Table 2, the analysis and discussion of the study's finding using the mean values followed this interval. The responses between 1.0–1.6 were concluded to be Strongly Disagreed, 1.7–2.5 to be Disagreed whilst 2.6–3.3 denoted Agreed. Additionally, 3.4–4.0 signified Strongly Agreed. With respect to the standard deviation, the following decision rules were used to guide the study. Table 4 represents the decision for the standard deviation.

Table 3: Decision Rule for Standard Deviation Values

Standard Deviation Values	Interpretation
1 or greater than 1	Responses differ much from one another (Heterogeneous Responses)
Less than 1	Responses did not differ much from one another (Homogeneous Responses)

Source: Field survey, (2019)

From Table 3, when the standard deviation is less than 1, then it means the responses are homogenous, thus responses did not differ much from one another. However, in case the standard deviation is equal to 1 or greater than 1, then there is a heterogeneous response, meaning, the responses differ much from one another.

Research Question One: To what extent are ICT tools and resources available for the teaching and learning of Physics in Swedru Senior High School?

This question sought to find out ICT tools and resources available for the teaching and learning of Physics. Section B of the questionnaire contained items that helped provide responses to address this question. Items 4 to 13 under section B of the student's questionnaire and 5 to 14 of teachers' questionnaire were designed to assist in finding answers to this research question. The individual items relating to the research question were analysed using frequencies and percentages. Table 4 represents the result of both students and teachers.

Table 4: Availability of ICT tools and resources

ICT Tools	Respondents	Available N (%)	Not Available N (%)
Computer Laboratory	Students	203(98.5)	3(1.5)
	Teachers	8(100.0)	Nil
Computers	Students	197(95.6)	9(4.4)
	Teachers	8(100.0)	Nil
Internet Systems	Students	98(47.6)	108(52.4)
	Teachers	8(100.0)	Nil
Photocopier	Students	127(61.7)	79(38.3)
	Teachers	7(87.5)	1(12.5)
Educational software's for teaching Physics	Students	34(16.5)	172(83.5)
	Teachers	1(12.5)	7(87.5)
Overhead Projector	Students	177(85.9)	29(14.1)
	Teachers	8(100.0)	Nil
Printers	Students	142(68.9)	64(31.1)
	Teachers	8(100.0)	Nil
Digital Cameras	Students	83(40.3)	123(59.7)
	Teachers	7(87.5)	1(12.5)
Digital Video Recorder	Students	14(6.8)	192(93.2)
	Teachers	2(25.0)	6(75.0)
Televisions and Radios	Students	87(42.2)	119(57.8)
	Teachers	7(87.5)	1(12.5)

Source: Field survey (2019)

From Table 4, majority 203 (98.5%) of the students agreed that computer laboratories were available with furnished computers. This was affirmed by the teachers when all of them 8 (100.0%) noted that computer labs were available and furnished with computers. With regards to the availability of internet systems, 98 (47.6%) of the students said the internet systems were available while 108 (52.4%) said internet systems were not available. The teachers on the other hand, disagreed that internet systems were not available with all of them representing 8 (100.0%). The research also inquired if photocopier, overhead projector and printers were available. The responses from both students and teachers indicated that these ICT tools were available for teaching and learning. This is evident with 127 (87.5%), 177 (85.9%), 142 (68.9%) and 7 (87.5%), 8 (100.0%), 8 (100.0%) for both students and teachers, representing a greater percentage of the respondents indicating that these materials were available for teaching and learning.

This finding is in line with the findings of Opoku (2004) who said that the availability of ICT resources plays a major role in provision of quality teaching and learning. It is a known fact that an effective teaching and learning stimulate intellectual curiosity and offer a sense of enjoyment that will move the students from the passive role of recipient of information to active role of builder of knowledge. Effective adoption and integration of ICT into teaching in schools depends mainly on the availability and accessibility of ICT resources such as hardware and software.

Again, Chen (2008) pointed out that, schools need to be equipped with modern ICT gadgets to enable them access internet effectively. The computers should have latest version and computer packages to enable students perform a

variety of tasks. She notes that such hardware must be the latest multimedia with adequate storage capacity and memory.

This findings however, are not in line with the study of Harding (2013) in the Kisumu district of Nyanza province, Western Kenya on 'Application of computer based resources in Geography education in secondary schools' revealed that out of a total number of 80 schools, only 6 (8%) had computers whereas 74 schools (92%) did not have computers that could be used for Geography teaching and learning. Kinuthia (2009), in their research work in Kenya, contended that very few secondary schools have sufficient ICT tools for teachers and students. Even in schools that have computers, the student-computer ratio is 150:1. Most of the schools with ICT infrastructure had acquired it through initiatives supported by parents, the government, non-governmental organizations (NGOs), or other development agencies and the private sector, including the NEPAD electronic school programme.

Research Question Two: How useful is ICT as a constructive approach in the teaching and learning of Physics?

This question sought to find out from both students and teachers how useful is ICT as a constructive approach in the teaching and learning of Physics. Section C of the questionnaire contained items that helped elicited responses from the respondents. Items 14 to 22 and 15 to 23 under section C on both students and teachers' questionnaire were respectively designed to assist in finding answers to this research question. Table 5 depicts the results for both students and teachers.

Table 5: Usefulness of ICT in teaching and learning of Physics

ICT resources...	Students		Teachers	
	Mean	SD	Mean	SD
makes lessons more interesting	3.11	1.09	3.13	0.35
makes lessons more diverse	3.12	0.93	3.50	0.53
improves the presentation of materials for lessons	3.34	0.90	3.75	0.46
motivates students in their learning	3.32	0.85	3.63	0.52
helps to make effective use of instructional time	2.99	0.93	3.75	0.46
enables me to save time	3.00	1.07	3.38	0.52
increase productivity in preparing and updating daily lessons	3.14	0.95	3.25	0.46
makes meet the different needs of students	2.94	1.01	3.25	0.46
makes student attentive in the teaching learning process.	3.28	0.96	3.13	0.64

Source: Field survey (2019)

The results from Table 5 for both students and teachers in the selected senior high schools agreed that the use of ICT resources in teaching and learning makes lesson more interesting and also makes lesson more diverse, which teachers strongly agreed to this. This is evident in the values of (M=3.11, SD=1.09 and M=3.12, SD=0.93) for students' respondents and (M=3.13, SD=0.34 and M=3.50, SD=0.53) for teachers' respondents. With regards to whether ICT resources improve the presentation of materials for lessons and also motivate students in their learning, students' respondents agreed to these assertions with (M=3.34, SD=0.90 and M=3.32, SD=0.85). The teachers in the selected schools also affirmed this by strongly agreeing to

the statements. This is also evident with the values of (M=3.75, SD=0.46 and M=3.63, SD=0.52) respectively. Again, both students and teachers' respondents agreed that ICT resources enables time saving, increase productivity in preparing and updating daily lessons and makes meet the different needs of students. These were evident in the computed means and the standard deviation values, (M=3.00, SD=1.07, M=3.14, SD=0.95 and M=2.94, SD=1.01) for students respondents and (M=3.38, SD=0.52, M=3.25, SD=0.46 and M=3.25, SD=0.46) for teachers' respondents.

These findings are in line with Lombe (2010) study that the use of ICT in education in 219 studies, consistently found that students in technology rich environments experienced positive impact on achievement in all subject areas. Also, Bayraktar, (2001) concluded that there is overall effectiveness of technology in achievement of students in secondary school and college education in United Sates when compared to traditional instruction between 1970 and 1999 from meta-analysis on 42 studies. Bayraktar continue to say that it is more effective in physics than any of the sciences (chemistry and biology). Kulshreta and Pandey (2013) also suggested, one sure way of bringing about change in learner is by the use of technology, especially computers which are interactive in nature and has graphical user interfaces with scientific visualization for understanding concept in science.

Also, according to Khine and Fisher (2003), the web is where constructivist learning can take place. The web provides access to rich sources of information; encourages meaningful interactions with content; and brings people together to challenge, support, or respond to each other. Khine and Fisher suggested that educators could deploy ICT to facilitate learning and

critical thinking. According to Russell and Schneiderheinze (2005), when technologies are inserted into the educational environment, they are meant to develop learning abilities in students. However, these technologies do not function in a vacuum. Instead they are coupled to existing tools and concepts in the setting. When teachers attempt to implement a technology innovation in the classroom, they naturally face the complex challenge of fitting together new ideas with deep-rooted pedagogical beliefs and practices.

Research Question Three: What are the competencies of both the teachers and the students in the use of ICT as a constructivist approach in teaching and learning of Physics?

This question sought to find out from both students and teachers' competencies they have in the use of ICT as a constructivist approach in teaching and learning of Physics. Section D of the questionnaire contained items that helped elicited responses to answer this question. Items 23 to 29 and 24 to 30 under section D of students and teachers' questionnaire respectively were designed to assist in finding answers to this research question. The results of both the students and teachers are represented in table 6.

Table 6: Competencies in the use ICT in teaching and learning

Statements	Students		Teachers	
	Mean	SD	Mean	SD
I don't use computer as much as other resources like books, atlases for learning Physics.	3.15	1.01	3.00	0.53
I know how to use ICT in teaching and learning of Physics	2.62	1.10	2.75	0.46
I am aware of the opportunities that ICT offers	3.32	0.86	2.88	0.35
I am not sure that I am computer-literate to use computer in teaching and learning of Physics.	2.36	1.08	2.50	0.53
I am able use ICT tools like e-mail, forum and chat to make communication with my colleagues easier	3.10	1.01	2.88	0.64
I am able to use ICT tools like internet to easily access teaching and learning material/resources in Physics.	2.87	1.07	3.13	0.64
I am able to adopt different teaching and learning styles to teach and learn Physics by using ICT.	2.66	1.13	2.25	0.71

Source: Field survey (2019)

Both teachers and students earlier indicated the great importance and enormous contribution of ICT to teaching and learning and how these

resources are at their disposal at the selected schools, but it is quite surprising when both teachers and students again agreed to the statements that they do not use computer as much as other resources like books, atlases for learning Physics and also they know how to use ICT in teaching and learning of Physics. This is evident in the values of (M=3.15, SD=1.01 and M=2.62, SD=1.10) and (M=3.00, SD=0.53 and M=2.75, SD=0.46) for both students and teachers' respondents respectively in Table 6.

Again, both students and teachers' respondents agreed that they were aware of the opportunity's ICT offers and they were able to use ICT tools like e-mail, forum and chat to make communications with their colleagues. This is also evident in the values of (M=3.32, SD=0.86 and M=3.10, SD=1.01) for students' responses and (M=2.88, SD=0.35 and M=2.88, SD=0.64) for teachers' responses. Both respondents however disagreed that they were not sure that they were computer-literate to use computer in teaching and learning of Physics. This is also evident in the values of (M=2.36, SD=1.08) and (M=2.50, SD=0.53) for both students and teachers' responses respectively.

These findings are in the line with Kulshreta and Pandey (2013), who said that Competency standards are concerned with application of professional knowledge and skills within the workplace and are underpinned by teachers' professional values. Competence is usually associated with highly professional performance and there is a direct link in the field of education between a teacher's professional competence and pupil performance. There are two distinct meanings of competence in education. From a theoretical point of view, competence is understood as a cognitive structure that facilitates specified behaviours. From an operational point of view, competence seems to

cover a broad range of higher order skills and behaviours that represent the ability to deal with complex, unpredictable situations. This operational definition includes knowledge, skills, attitudes, metacognition and strategic thinking, and presupposes conscious and intentional decision making (Westera, 2001).

Khan and Shah (2004) further noticed that teachers who lacked skills necessary for basic computer operations ranges between 25% and 50% when they collected a data from 1258 teachers from government, Independent and Catholic schools in 1998. They noticed that teachers over 50 years, female teachers and primary school teachers were people who fit into that group. There have been several attempts, ranging from Workshops, Conferences and in-service trainings to help heads, teachers and ICT coordinators implement and integrate ICT into school administration and teaching.

According to Killen (2009) and Summers (as cited in Bordbar, 2010), teachers' computer competence is a major predictor of integrating ICT in teaching. Another report by Jones and Brader-Araje (2002), on 'accessibility and utilization of ICTs among secondary school teachers in Kenya. The findings of the survey revealed that majority of these teachers did not receive any prior ICT training during their formative years at the teacher training colleges or universities before joining the teaching profession. About 55% of the teachers stated that they did not receive any ICT training at all. Nevertheless, 51% of the teachers had taken the self-initiative to undergo ICT training over the past 3 years. This finding is not in line with the current finding since greater percentage of the teachers indicated their competency levels in the use of ICT tools to facilitate teaching and learning.

Research Question Four: What are the challenges facing the use of ICT as a constructivist approach for instruction in Physics?

Section E on the questionnaire was used to elicit the challenges both students and teachers encounter in the use of ICT as a tool for teaching and learning of Physics. Items 30 to 38 and 34 to 42 under section E of both students and teachers' questionnaire respectively were designed to assist in finding answers to this research question. The findings are presented in table 7.

Table 7: Challenges both teachers and students face in the use of ICT

Statements	Students		Teachers	
	Mean	SD	Mean	SD
Inadequate knowledge about the use of ICT resources	2.76	0.97	1.25	0.46
Inadequate time to prepare teaching and learning materials using ICT.	2.83	0.90	1.50	0.84
Inadequate technical knowledge about materials using ICT.	2.82	0.94	2.38	0.52
Poor technical and physical infrastructure of learning environments	2.77	1.02	2.50	0.53
Problems about accessibility to existing hardware (computer, overhead projector, printer, scanner etc.)	2.68	1.15	2.50	0.53
Lack of confidence	2.24	1.06	3.00	0.00
Lack of interest in ICT usage	1.77	0.96	2.25	0.46
Little experience on the use of ICT facilities	2.77	1.03	2.75	0.71
Irregular network support in accessing physics software to aid teaching and learning.	3.20	1.04	2.38	0.74

Source: Field survey (2019)

The results from Table 7 shows that the students' respondents encounter a lot of challenges when it comes to the use of ICT in learning compared to that of the teachers in the use of ICT resources in teaching Physics. For example, while the students agreed that they have inadequate knowledge about the use of ICT resources and also inadequate time to prepare teaching and learning materials using ICT resources, teachers however strongly disagreed to these statements. This is evident in the values of (M=2.76, SD=0.97 and M=2.83, SD=0.90) for students' responses and (M=1.25, SD=0.46 and M=1.50, SD=0.84) for teachers' responses. This implies that teachers in the selected schools were more knowledgeable in the use of ICT tools compared to that of the students in the selected schools. This is good news because the teachers are those positions to teach the students as to how to appropriately use these resources to enhance teaching and learning.

Again, students' respondents agreed to the fact that they have inadequate technical knowledge about materials using ICT and also Poor technical and physical infrastructure of learning environments but teachers again strongly disagreed to these assertions. This revelation came about after the computation of the values of (M=2.82, SD=0.94 and M=2.77, SD=1.02) and (M=2.28, SD=0.52 and M=2.50, SD=0.53) for both students and teachers' responses respectively. Their responses were also homogeneous in nature, indicating that they were all in agreement respect to the decisions they took. Teachers however agreed that they lack confidence and they also have little experience when it comes to the use of ICT resources in teaching and learning Physics. This is evident in the values of (M=3.00, SD=0.00) and (M=2.75, SD=0.71) for teachers' responses respectively.

This is not in line with the findings of BECTA (2004) regarding teachers that Some teachers at all levels of pre-tertiary level of education do not regard computers and its related technologies to be of any importance to their teaching and learning process. The findings also confirm that, teacher's attitude is major factor to the use of technology in instruction. Negative attitude would discourage him form integrating it into teaching. Fabry and Higgs (1997) grouped attitudes into; self-confidence with ICT, perceived relevance of ICT and innovativeness". This is very closely related to teacher's attitude towards the use of computers and technology in teaching. Researches have established that some teachers especially pre-tertiary level are not easily adaptable to new trends of doing things because they simple want to continue with old method where they feel more comfortable. Teachers do not know and aware of what the change can offer them so they prefer sticking to their traditional methods of instruction.

The finding on experience of teachers is also in line with BECTA (2004) who posited that that time and training are major obstacles to technology usage in teaching. Many teacher training colleges do not prepare and teach teachers to have basic skills enable them incorporate technology in their instruction. Committing time and resources into self-training in order to use ICT in preparation of lesson becomes difficult (Preston, 2003). If the management enforce polices and show commitment to the use of ICT in the day to day running of the school, teachers are likely to encourage using ICT. Selwyn (2008) stated that teachers cannot effectively use technology if they lack basic training, support and time. If all these factors are available, it is more likely for teachers to incorporated technology into instruction.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Overview

This chapter presents a summary of the study, key findings, and conclusions drawn from the findings, recommendations based on the conclusions drawn and suggestions for further research.

Summary of the Study

The purpose of the study was to investigate the use of ICT as a constructivist approach in the teaching and learning of Physics in some Senior High Schools in the Agona East District of Ghana. Specifically, it sought information to answer the following questions:

1. What ICT tools and resources are available for the teaching and learning of Physics in some Senior High Schools in the Agona East District?
2. How useful is ICT as a constructive approach in the teaching and learning of Physics?
3. What are the competencies of both the teachers and the students in the use of ICT as a constructivist approach in teaching and learning of Physics?
4. What are the challenges facing the use of ICT as a constructivist approach for instruction in Physics?

The study adopted the descriptive survey design. The population included a Physics teachers and students in the selected SHS in the Agona East District. Eight teachers and 206 students were selected for the study through a census method and simple random sampling technique. Data was

collected mainly through the use of questionnaire. Data was analysed using descriptive statistics. The data was organized into tables, frequencies, percentages and means in line with the research questions that guided the study.

Key Findings

The following key findings were found in the study

1. It was found from the study that computer laboratories were available with furnished computers in the selected senior high schools in the Agona East District. This was evident when majority 203 (98.5%) of the students agreed that computer laboratories were available with furnished computers. This was affirmed by the teachers when all of them 8 (100.0%) noted that computer labs were available furnished with computers. It also came to bear that student were of the view that they had access to internet systems but the teachers on the other hand, disagreed that internet systems were available. The research also inquired if photocopier, overhead projector and printers were available. It was found that these ICT tools were available for teaching and learning of Physics.
2. The results from the study indicated that both students and teachers in the selected senior high schools agreed that the use of ICT resources in teaching and learning makes lesson more interesting and also makes lesson more diverse. This is evident in the values of (M=3.11, SD=1.09 and M=3.12, SD=0.93) for students' respondents and (M=3.13, SD=0.34 and M=3.50, SD=0.53) for teachers' respondents. With regards to whether ICT resources improve the presentation of materials

for lessons and also motivate students in their learning, students' respondents agreed to this assertion which was also affirmed by the teachers.

3. It also came out from the study that both teachers and students do not use computer as much as other resources like books, atlases for learning Physics but they know how to use ICT in teaching and learning of Physics. This is evident in the values of (M=3.15, SD=1.01 and M=2.62, SD=1.10) and (M=3.00, SD=0.53 and M=2.75, SD=0.46) for both students and teachers' respondents respectively. The study also revealed that both students and teachers' respondents were aware of the opportunity's ICT offers and they were able to use ICT tools like e-mail, forum and chat to make communications with their colleagues.
4. It was also released that the students' respondents encounter a lot of challenges when it comes to the use of ICT in learning compared to that of the teachers in the use of ICT resources in teaching Physics. For example, the study revealed that while the students agreed that they have inadequate knowledge about the use of ICT resources and also inadequate time to prepare learning materials using ICT resources, teachers however strongly disagreed to these statements. This is evident in the values of (M=2.76, SD=0.97 and M=2.83, SD=0.90) for students' responses and (M=1.25, SD=0.46 and M=1.50, SD=0.84) for teachers' responses. This implies that teachers in the selected schools were more knowledgeable in the use of ICT tools to enhance teaching and learning.

Conclusions

Firstly, computer laboratory and other ICT tools such as photocopier, overhead projectors and many others were available in the selected schools for teaching and learning. Opoku (2004) said that the availability of ICT resources plays a major role in provision of quality teaching and learning. It is a known fact that an effective teaching and learning stimulate intellectual curiosity and offer a sense of enjoyment that will move the students from the passive role of recipient of information to active role of builder of knowledge. Effective adoption and integration of ICT into teaching in schools depends mainly on the availability and accessibility of ICT resources such as hardware and software. Hence, it can be concluded that the selected Senior High Schools have the available ICT resources and hence, constructive instructional approach is guaranteed.

Secondly, both students and teachers who took part in the study agreed that the use of ICT tools and resources makes learn more interesting and brings about diversity in the teaching and learning process. Khine and Fisher (2003) opined that web is where constructivist learning can take place. The web provides access to rich sources of information; encourages meaningful interactions with content; and brings people together to challenge, support, or respond to each other. Khine suggested that educators could deploy ICT to facilitate learning and critical thinking. According to Soby and Egeberg (2009), when technologies are inserted into the educational environment, they are meant to develop learning abilities in students. Therefore, it can be concluded that the use ICT in teaching and learning of Physics developed

diverse learning, critical thinking and active student participation which promote student's performance in the Subject area.

Thirdly, both students and teachers do not use ICT tools as much as textbooks and other traditional materials. Kulshreta and Pandey (2013), who said that Competency standards are concerned with application of professional knowledge and skills within the workplace and are underpinned by teachers' professional values. Competence is usually associated with highly professional performance and there is a direct link in the field of education between a teacher's professional competence and pupil performance. Therefore, it can be inferred that though the teachers are competent in the use of ICT in teaching and learning Physics but do not use it more often.

Finally, students encounter a lot of challenges when it comes to the use of ICT in learning compared to that of the teachers in the use of ICT resources in teaching Physics. BECTA (2004) who posited that time and training are major obstacles to technology usage in teaching. Many teacher training colleges do not prepare and teach teachers to have basic skills to enable them incorporate technology in their instruction. Committing time and resources into self-training in order to use ICT in preparation of lesson becomes difficult (Yusuf & Afolabi, 2010). If the management enforce polices and show commitment to the use of ICT in the day to day running of the school, teachers are likely to encourage using ICT. Wong, Choi and Lee (2008) stated that teachers cannot effectively use technology if they lack basic training, support and time. Hence, time, training and supports service are critical challenges teacher face with the use of ICT in teaching and learning of Physics within the study area.

Recommendations

Based on the findings, the following recommendations are made for policy and practice;

1. Since ICT tools are available in most of the schools, in-service training, seminars, workshops, conferences on the need, and how to appropriately use ICT devices should be organized by Ghana Education Service and Heads of Schools on regular basis to empower teachers in knowledge, skills and competence. This will have a multiplier effect of reforming the teaching-learning process in the sampled schools.
2. Since the teacher plays a major role in the teaching and learning process, Ghana Education Service, Head of schools and Curriculum planners should invest in the professional development of the teacher. This could be done through, workshops and seminars. This will increase the competence and varying of teacher's ability, and also increase the confidence level in the use of these resources.
3. Government through the Ministry of Education and the Ghana Education Service should provide a conducive environment for teachers by providing the necessary logistics and infrastructures so that they can frequently use these ICT materials to enhance teaching and learning than relying on the traditional method of textbooks.
4. Ghana Education Service, Head of schools and Curriculum planners should understudy the shortcomings of Physics as a subject and how technology can strategically help to alleviate this menace.

Suggestions for Further Research

The purpose of the study was to investigate the use of ICT as a constructivist approach in the teaching and learning of Physics in Swedru Senior High School in the Agona East District of Ghana.

Further research can be done on the following:

1. Factors militating against the successful integration of ICT into the Senior High School Physics syllabus.
2. The challenges and constraints of Physics curriculum implementations in the Senior High Schools within the District or other areas
3. Improvisation of instructional resources for effective teaching and learning of Physics in the Senior High Schools in the Agona East District.

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APPENDIX A

UNIVERSITY OF CAPE COAST

COLLEGE OF DISTANCE EDUCATION

QUESTIONNAIRE FOR STUDENTS

This questionnaire aims at investigating the use of ICT as a constructivist approach in the teaching and learning of Physics. We will be very grateful to have you participate in this research by answering the following questions. Information solicited would be used purely for academic purposes and respondents will be treated with utmost confidentiality.

Section A: Demographic Data of Respondents

Gender: Male [ ] Female [ ]

Age: 14-16 years [ ] 17- 19 years [ ] 20 years and above [ ]

Form /class: Form 2 [ ] Form 3 [ ]

Section B: Availability of ICT Resources for Teaching and Learning of Physics

Indicate your response by ticking (√) the appropriate column making use of the following key: *1- Available and 2- Not Available* to determine the availability of the following ICT resources.

No.	ICT Resource	Available	Not Available
4	Computer Laboratory		
5	Computers		
6	Internet Systems		
7	Photocopier		

8	Educational software's for teaching Physics		
9	Overhead Projector		
10	Printers		
11	Digital Cameras		
12	Digital Video Recorder		
13	Televisions and Radios		

Others, please specify.....

Section C: Usefulness of ICT in the Teaching and Learning of Physics

Please indicate your reaction to each of the following statements by ticking (√) the column that represents your level the level of agreement and disagreement with it. *SD = Strongly Disagree, D = Disagree, A = Agree and SA = Strongly Agree*

No.	Statement *Preamble:* ICT resources……	SD	D	A	SA
14	makes Physics lessons more interesting to me				
15	makes lessons more diverse.				
16	improve the presentation of materials for lessons our teacher use.				
17	motivate our in our learning of the subject				
18	gives our teacher more confidence in the teaching activity				
19	enables our teacher to save time				

20	increase our teacher's productivity in preparing and delivery of the lesson				
21	makes our teacher to meet our different needs in the lesson				
22	makes me attentive in the teaching learning process.				

Others, please specify.....

Section D: Competencies of Students in using ICT in Learning of Physics

Please indicate your reaction to each of the following statements by ticking (√) the column that represents your level the level of agreement and disagreement with it. *SD = Strongly Disagree, D = Disagree, A = Agree and SA = Strongly Agree*

No.	Statement	SD	D	A	SA
23	I don't use computer as much as other resources like books, atlases for learning Physics.				
24	I know how to use ICT in learning Physics				
25	I am aware of the opportunities that ICT offers.				
26	I am not sure that I am computer-literate to use computer in learning Physics.				
27	I am able use ICT tools like e-mail, forum and chat to make communication with my colleagues' students easier				

28	I am able to use ICT tools like internet to easily access learning material/resources in Physics.				
29	I am able to adopt different learning styles to learn Physics by using ICT.				

Section D: Challenges facing the use of ICT in Teaching and Learning Physics

Please indicate your reaction to each of the following statements by ticking (√) the column that represents the level of agreement and disagreement with it. *SD=Strongly Disagree, D=Disagree, A=Agree and SA = Strongly Agree*

No.	Statement	SD	D	A	SA
30	Inadequate knowledge about the use ICT resources				
31	Inadequate time to prepare instructional materials using ICT.				
32	Inadequate technical knowledge about preparing Instructional materials using ICT.				
33	Poor technical and physical infrastructure of learning environments				
34	Problems about accessibility to existing hardware (computer, overhead projector, printer, scanner etc.)				
35	Lack of confidence				
36	Lack of interest in ICT usage				
37	Little experience on the use of ICT facilities				

38	Irregular network support in accessing physics software to aid teaching and learning.				

Others, please specify.....

APPENDIX B

UNIVERSITY OF CAPE COAST

COLLEGE OF DISTANCE EDUCATION

QUESTIONNAIRE FOR TEACHERS

This questionnaire aims at investigating the use of ICT as a constructivist approach to teaching and learning of Physics. We will be very grateful to have you participate in this research by answering the following questions. Information solicited would be used purely for academic purposes and respondents will be treated with utmost confidentiality.

Section A: Demographic Data of Respondents

Gender: Male [ ] Female [ ]

Academic qualification: First degree [ ] Master's Degree [ ]

PhD Degree [ ]

Professional Qualification: Cert 'A' [ ] PGDE [ ] B. Ed [ ]

M. Ed/ MPhil. [ ] Non-Professional [ ]

How long have you been teaching Physics?

Less than 1 year [ ] 1-5 years [ ] 6-10 years [ ] 11 years and above [ ]

Section B: Availability of ICT Resources for Teaching and Learning of Physics

Indicate your response by ticking (√) the appropriate column making use of the following key: *1- Available and 2- Not Available* to determine the availability of the following ICT resources.

No.	ICT Resource	Available	Not Available
5	Computer Laboratory		
6	Computers		
7	Internet Systems		
8	Photocopier		
9	Educational software's for teaching Physics		
10	Overhead Projector		
11	Printers		
12	Digital Cameras		
13	Digital Video Recorder		
14	Televisions and Radios		

Others, please specify.....

Section C: Usefulness of ICT in the Teaching and Learning of Physics

Please indicate your reaction to each of the following statements by ticking (√) the column that represents your level the level of agreement and disagreement with it. *SD= Strongly Disagree, D = Disagree, A=Agree and SA = Strongly Agree*

No.	Statement *Preamble:* ICT resources……	SD	D	A	SA
15	makes lessons more interesting to students				
16	makes lessons more diverse.				
17	improve the presentation of materials for				

	lessons				
18	motivate student in their learning				
19	helps to makes effective use of instructional time				
20	enables me to save time				
21	increase productivity in preparing and updating daily lessons				
22	makes me to meet the different needs of my student				
23	makes student attentive in the teaching learning process.				

Others, please specify.....

Section D: Competencies of Teachers in using ICT in Teaching and Learning of Physics

Please indicate your reaction to each of the following statements by ticking (√) the column that represents your level the level of agreement and disagreement with it. *SD=Strongly Disagree, D=Disagreed, A = Agree and SA = Strongly Agree*

No.	Statement	SD	D	A	SA
24	I don't use computers as much as other resources like books, atlases for instructional purposes.				
25	I know how to use ICT in Physics instructional activities				

26	I am aware of the opportunities that ICT offers.				
28	I am not sure that I am computer-literate to use computer in my Physics class.				
29	I am able use ICT tools like e-mail, forum and chat to make communication with my colleagues and students easier				
30	I am able to use ICT tools like internet to easily reach instructional resources in Physics.				
31	I am able to handle different learning preferences of my students having different learning styles by using ICT.				

32. Do you have any formal training in the use of ICT resources like computers?

Yes [ ] No [ ]

33. If yes, where did you have the training?

……

Section E: Challenges facing the use of ICT in Teaching and Learning Physics

Please indicate your reaction to each of the following statements by ticking (√) the column that represents your level the level of agreement and disagreement with it. *SD=Strongly Disagree, D=Disagree, A = Agree and SA = Strongly Agree*

No.	Statement	SD	D	A	SA
34	Inadequate knowledge about the use ICT resources				
35	Inadequate time to prepare instructional materials using ICT.				
36	Inadequate technical knowledge about preparing Instructional materials using ICT.				
37	Poor technical and physical infrastructure of learning environments				
38	Problems about accessibility to existing hardware (computer, overhead projector, printer, scanner etc.)				
39	Lack of confidence				
40	Lack of interest in ICT usage				
41	Little experience on the use of ICT facilities				
42	Irregular network support in accessing physics software to aid teaching and learning.				

Others, please specify.....

Thank you