UNIVERSITY OF EDUCATION, WINNEBA

THE PERCEPTION OF ICT ON THE TEACHING AND LEARNING OF KINEMATICS GRAPHS: A CASE STUDY

AMADZOR WILHELMINA ESI

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A THESIS IN THE DEPARTMENT OF SCIENCE EDUCATION, FACULTY OF SCIENCE EDUCATION, SUBMITTED TO THE SCHOOL OF GRADUATE STUDIES, UNIVERSITY OF EDUCATION, WINNEBA, IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF EDUCATION OF SCIENCE DEGREE

DECEMBER, 2016

DECLARATION

Student's Declaration

I, Wilhelmina Esi Amadzor**,** declare that this project work, with the exception of quotations and references contained in published works which have all been identified and duly acknowledged, is entirely my original work and has not been submitted either in part or whole, for another degree in this University or elsewhere.

Signature: ……

Date: ……

Supervisor's Declaration

I certify that the preparation and presentation of this project work was supervised by me in accordance with the guidelines for supervision of project work laid down by the University of Education, Winneba.

Supervisor's Name: ……

Signature: ……

Date: ……

ACKNOWLEDGEMENTS

I thank God for how far He has brought me. I owe the writing of this project work to the wisdom, knowledge and the understanding God has granted me. Glory and honour be unto His name. My sincere appreciation goes to Dr. Victor Antwi, my supervisor for his time, tolerance, patience, guidance and advice in writing of this project work.

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DEDICATION

I count it a real joy and a privilege to dedicate this project work to God Almighty, my supervisor Dr. Victor Antwi and my family who have played major roles in my life.

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ABSTRACT

The purpose of this study was to investigate the perception of ICT on the teaching and learning of Kinematics graphs among SHS 2 science students of Saint Roses Senior High school, Akwatia-Eastern Region. A descriptive survey design using quantitative approach was employed in this study. Purposive and simple random sampling procedures were used on fifty-four (54) participants. Structured questionnaire was the instrument used to collect data in this study. Descriptive statistics tools (frequency and per cent) were used to analyze the data gathered and the findings were that; Physics teachers at St. Roses SHS used more of the lecture method of teaching as compared to the inquiry method. Also, the use of ICT in teaching Kinematics graphs at St. Roses SHS, Akwatia enabled Physics students to have a better understanding of the topic. It was concluded that teaching and learning of Kinematics graphs by Physics teachers at St. Roses Senior High School was based mostly on the chalk-and-talk method of teaching. Again, the use of ICT in teaching Kinematics graphs enabled students to have a better understanding of the topic. It was recommended that in-service training should be organized for Physics teachers at St. Roses Senior High School for them to realize the need to use ICT more in the teaching and learning process. Likewise, the school management should ensure that the ICT laboratory is well equipped in order to encourage Physics teachers to use it more in teaching and learning.

CHAPTER ONE

INTRODUCTION

1.0 Background of the Study

The study of Physics is crucial to understanding the world around us, the world inside us, and the world beyond us (Gibbs, 2003). In many respects, Physics is the most basic and fundamental natural science. It involves universal laws and the study of the behaviour and relationships among a wide range of important physical phenomena (Cutnell & Johnson, 2007). It encompasses the study of the universe from the largest galaxies to the smallest subatomic particles. Moreover, it is the basis of many other sciences, for example chemistry, oceanography, seismology, astronomy etc. All are easily accessible with a bachelor's degree in Physics (American Physics Society, 2008). The Physics learning experiences in schools provided by Physics teachers, to which Ghana is no exception, are therefore very important.

Researchers over the years have maintained that teachers form a strong causal factor in defining the quality of education in schools (Golla, de Guzman, Ogena, & Brawner, 1998; Hake, 1998; Archibald, 2006). Teachers see to it that students have acquired creative and critical thinking abilities ready to face the realities of life. Central to acquiring creative and critical thinking abilities is the ability of teachers to design teaching sequences that develop among the students the abilities to respond to situations that beset them in aspects that make their learning meaningful (Darling-Hammond & Baratz-Snowden, 2005). This suggests that teacher' abilities to create an enabling atmosphere that allows meaningful classroom interaction with students cannot be underestimated. More so, the types of classroom interactions created by the teacher and the types of questions he/she uses to structure his teaching plays an

important role in the kinds of thinking skills learners employ, the range of information to be covered and the thinking skills they may learn (Smart & Marshall, 2012).

With the advent of a new philosophy towards Information and Communication Technology (ICT) and its role in education, a wide body of research has developed investigating the role of ICT and its effect in developing an interactive education environment. Many of these studies have provided evidence of the significant contribution that ICT makes to improving methods of teaching and positively impacting the learner (Kennewell, Tanner, & Beauchamp, 2007). The presence of ICT in the interactive educational environment can help to develop thinking skills and make classrooms an environment for educational growth. ICT also helps students to develop new thinking skills which may transfer to different situations which may require analysis and comprehension skills, and consequently critical skill development (Al Hudhaifi & Al Dughaim, 2005).

Some schools of thought are of the view that ICT does not play a role in students' achievement. For instance, Coates and Humphreys (2004) surveyed three matched pairs of face-to-face and online principles of economics courses taught at three different institutions. The students' score in the Test of Understanding College Level Economics (TUCE) given at the end of the term was used as the measure of learning outcomes. After taking into account selection bias and differences in student characteristics, they report that the average TUCE scores were almost 15% higher for the face-to-face format than for the online format. Similarly, Rivkin, Hanushek and Kain, (2005) surveyed two matched pairs of on-campus and online courses, one in statistics, and the other in managerial economics. They reported that after taking into account student's characteristics and selection bias, students in the online format of the statistics class exam scored 14.1% less than in the traditional format, whereas, for

the managerial economics class, the test scores within both formats were not significantly different.

Science subjects play a key role in the scientific, technological and industrial development of every country (Wang, 2011). Physics being the bed rock of science and technology that is destined to play a more significant role in spurring technological development ways and means should be found to improve performance of learners in the subject (Wang, 2011). According to a survey done by Strengthening Mathematics and Science in Secondary Education (SMASSE) project, one of the causes of poor performance in science subjects and Physics in particular is the theoretical approach to teaching and learning of concepts in these subjects (SMASSE Project, 1998). Given that some of the concepts taught in Physics are abstract, learners find it difficult to conceptualize when taught theoretically. This has made learners to develop a negative attitude towards the subject leading to poor performance. It has led to fewer learners, often the bright ones, choosing to pursue Physics which is an elective subject from SHS 1-3 in quite a number of schools.

Kinematics according to Etkina, (2010) is considered a rich topic for investigation as a context for modeling primarily for two reasons:

1. Kinematics provides a very natural context in which to place teachers and students in a familiar activity.
2. Historically, ideas related to kinematics have supported the development of many important fields in Mathematics including Algebra and Calculus (Etkina, 2010), two domains that are also prominent in Physics textbooks. Kinematics, therefore, is a fundamental area of study that links important mathematics and science fields. Hence the need for this research.

1.1 Statement of the Problem

From teaching experience at Saint Roses Senior High school, Akwatia, one thing was apparent to the researcher; the researcher's students have a difficult time in understanding some topics in Physics such as Kinematics graphs. Their difficulties were not only at a certain SHS level but were school wide, and persisted each year. These difficulties were evident in the school's base assessment (SBA) scores. The researcher therefore became curious: why was Kinematics graphs so difficult to such a broad spectrum of students and what remedy could she implement in her class to correct this problem?

Why does Kinematics graph matter anyway? This topic is a sub-topic under Physics and therefore is a part of science class. More importantly, we are living in a very technical world today and failure to be able to create or understand a topic such as Kinematics may inhibit one's ability for advancement in the workforce. Additionally, graphs are used everywhere. Every industry and business makes use of graphs in some form. For example, the news shows trends in world events by using graphs. Weather graphs show us trends in temperature, rain fall and even hurricane patterns. Medical graphs show how new medicines are working to fight different diseases. Every form of business has sales graphs to show if there is actually success in selling what they are producing. Graphs show trends throughout history, political polling data or even engine readings on an automobile or airplane. Graphs are not just a part of science; they are an essential skill to master.

The question was: why was Kinematics graphs the most difficult topic for SHS 2 science students of Saint Roses Senior High School, Akwatia in particular? It is not that the researcher's students were not good at all in Physics. They could manage to understand some aspect of this topic to some level but when it gets into

kinematics graphs, then, their problems become evident. Were the students lacking prior knowledge about graphs in Kinematics, or was their prior knowledge wrong and hindering their understanding in Kinematics graphs? The researcher's first belief seemed obvious; it had to be from previous years of teaching. Students must not have received a proper amount of exposure to the topic Kinematics graphs. How far back could this lack of understanding go? What kind and how much work is done at the lower primary, junior high and senior high school levels in relation to Kinematics graphs? But, conclusions cannot be drawn based on guesses; hence, the need for this study to be conducted.

1.2 Purpose of the Study

The purpose of this study was to investigate the perceptions of ICT on the teaching and learning of Kinematics graphs among SHS 2 science students of Saint Roses Senior High school, Akwatia-Eastern Region so that findings of this study would bring to book the main causes of SHS 2 students' lack of understanding on Kinematics graphs.

1.3 Research Objectives

The objectives of this study were to:

1. Identify the teaching methods used by Physics teachers in St. Roses SHS, Akwatia.
2. Investigate the role of ICT in the teaching and learning of Kinematics graphs among SHS 2 science students in St. Roses SHS, Akwatia.
3. Examine factors that prevent Physics teachers in using ICT to teach Kinematics graphs to SHS 2 science students in St. Roses SHS, Akwatia.

4. Find out the attitudes of Physics teachers towards the use of ICT in teaching and learning of Kinematics graphs in St. Roses SHS, Akwatia.

1.4 Research Questions

The following research questions guided this study:

1. What teaching methods are used by Physics teachers in St. Roses SHS, Akwatia?
2. What role does ICT play in the teaching and learning of Kinematics graphs among SHS 2 science students in St. Roses SHS, Akwatia?
3. What factors prevent physics teachers in using ICT to teach Kinematics graphs to SHS 2 science students in St. Roses SHS, Akwatia?
4. What is the attitude of Physics teachers towards the use of ICT in teaching and learning of Kinematics graphs in St. Roses SHS, Akwatia?

1.5 Significance of the Study

The findings of this study could be useful to various stakeholders in education. For example, findings of this study could inform Ministry of Education (MoE), Board of Governors, Non-governmental Organizations (NGOs), individuals, philanthropic and Parent Teachers Association (PTA) about the status of ICT facilities in Akwatia SHS. This could help them to make informed decisions on provision and maintenance of such facilities. Next, the findings could help Physics teachers to re-evaluate themselves if they are adequately prepared to use ICT in teaching and learning of Physics and if not; the kind of skills upgrading that would suit them.

Moreover, findings from this study would provide science educators, science curriculum planners and government with detailed picture of science (Physics) teaching and learning and educational practices in SHS in Ghana and ways of

improving the situation. This in turn would help them come up with policies that would promote the use of ICT in teaching and learning. To add to the above, the findings could inform both the in-service and pre-service providers of areas to focus on in future trainings that could ensure teachers have the necessary skills to integrate ICT in teaching and learning of Physics. Lastly, findings from this study could be used by other researchers as a baseline study for future studies in the area.

1.6 Limitation

Public SHS used in this study was taken from a list of public SHS in the Eastern Region. This "selective" sampling may decrease the generalization of the findings. Therefore, findings of this study could not be generalized to all the public SHS that are not in Eastern Region.

1.7 Delimitations

This study was delimited to the perceptions of ICT on the teaching and learning of Kinematics graphs among SHS 2 science students of Saint Roses Senior High school, Akwatia. This study was also delimited to integration of ICT in teaching and learning of Physics. Also, this study was delimited to Physics teachers and SHS 2 Physics students of Saint Roses Senior High school, Akwatia. Besides, narrowing the scope of the study was therefore a practical consideration. Furthermore, the term "ICTs" has been used in its narrow sense to denote the use of computers and the internet. Even though there is more to ICT than the use of the latter two, the research does not, in any way, investigate how other forms of ICTs are used at Saint Roses Senior High school, Akwatia.

1.8 Operational Definition of Terms

Kinematics Graphics: Kinematics graphics are position versus time, velocity versus time, and acceleration versus time graphics.

ICT: Computer hardware, software and networks, and any communication device or application, encompassing: radio, television, and cellular phones, among others. A number of acronyms are used, including IT, NT and IS. The term ICT is becoming more and more common in science, in Open and Distance Learning, and in Pedagogical Integration of ICT.

ICT Competence: ICT knowledge and skills possessed by an individual.

Effect: Ability to have the power to affect something in a given way.

Physics: One of the subjects taught in the Ghanaian secondary school curriculum that is concerned with the study of matter in relation to energy.

Teacher's ICT Experience: Number of years the Physics teacher has been using ICT tools especially the computer, related hardware and software.

Internet: Connection to a very large number of computers using communication networks, such as telephone lines, to exchange information worldwide. The Internet is, however, distinct from the World Wide Web (www), which, like email, is only one of the principal services available through the Internet.

E-Learning: is a term used to refer to learning which takes place online. Self-directed learning plays an important role in this type of education, demanding an increased level of learner autonomy. E-learning programs can be completed remotely using the Internet, or can include short sessions of face-to-face teaching.

Pedagogical Integration of ICT: It includes the use of technology in schools to improve learning and to facilitate educational development.

Software: These are programs initially conceived to facilitate consumer use of ICT. There are various types of programs used in the Pedagogical Integration of ICT including learning, open source and "free" software.

Attitude: A way of thinking or feeling about something or somebody usually reflected in a person's behavior when she or he reacts towards or against some situation, person or object in a particular manner.

SHS: Senior high school.

1.9 Organization of the Study

This study report was made up of five chapters. Chapter one focused on the introduction which was discussed under the following sub-headings; background of the study, statement of the problem, the purpose and objectives of the study. Moreover, it dealt with the research questions, significance, delimitations, and operational definition of terms and organization of the study. Chapter Two dealt with review of related literature while Chapter Three dealt with the methodology of the study. Thus, Chapter Three discussed the research design, population, sample and sampling procedures. It also discussed the research instrument, validity of the instrument, reliability of the instrument, data collection procedures, method of data analyzed and ethical considerations. Chapter Four focused on data analysis and discussion of results. Finally, Chapter Five dealt with the summary, conclusions, and recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.0 Overview

This chapter focused on the literature review. Reviewing the existing literature around the topic of research interest is vitally important because it helps in understanding not only the body of knowledge that relates to the research topic but also in developing an argument about the relevance of the research. Literature review also serves as a roadmap that aids the reader in understanding where the researcher is headed in his/her argument (ibid). Literature review in this study was discussed under the following sub-headings; theoretical framework, concept of teaching methods, role of ICT in the teaching and learning of science, factors that influence the use of ICT in teaching and learning, attitude of Physics teachers towards the use of ICT in teaching and learning, graphs and graphing ability in Kinematics and empirical review.

2.1 Theoretical framework

The study was underpinned by two theories–constructivism and cognitive apprenticeship model.

2.1.1 Constructivism

Constructivism is characterized by the view that knowledge is not transmitted directly from one person to another, but is actively built up by the learner (Driver, Asoko, Leach, Scott, & Mortimer, 1994; Cobern, 1998). Cobern (1998) argues that constructivism is an avenue of research that directs attention to the role of culture in the learning process. Cobern, (1998) writes that students come to the classroom with a variety of world-views and preconceptions and such views must be acknowledged. He believes that a constructivist classroom is one in which people are working together to

learn. To him, such a classroom will be a place where inquiry is conducted. Discourse will be the mode by which participants engage in negotiations of meaning. Cognitive, social and cultural differences among students will be honored and alternative world-views respected (Cobern, 1998).

Conner, (2014b) also accentuates that a constructivist classroom is a learner-centred environment which acknowledges and brings to the fore the past experience of students. She articulates that in constructivist classrooms, learning is "reflective, interactive, inductive and collaborative, and questions are valued as a source for curiosity and focus for finding out information". Constructivism as a theory, has evolved from not only learning about declarative knowledge (knowing what) but also knowing "how and when" to learn in different ways (Conner, 2014b). In such classrooms, the teacher acts as a facilitator or mediator of learning rather than someone who only takes on the role of imparting knowledge.

Over the last two decades, many learning theories, including the cognitive development theories of Piaget, Vygotsky and Bruner, have been implemented in different instructional models in learning environments. Piaget indicated that social interactions create disequilibrium to encourage growth in knowledge. He emphasized that the individual learners construct their knowledge through the process of adaptation – which can be accomplished in two ways:

(1) accommodation, where existing schemes are modified so that new information can fit in, and (2) assimilation, where new information is modified to fit in the existing schemes (Hoy, 2010; Eggen & Kauchak, 2013). According to Piaget, social interactions can reinforce this mechanism but it is the learners themselves who play the major role in developing their knowledge.

Vygotsky, on the other hand, promoted the dominant influence of social interactions. In his well-known sociocultural learning theory. Vygotsky suggested that social interaction leads to continuous step-by-step changes in learners' thought and behaviour that can vary greatly from culture to culture (Hoy, 2010). This learning process involves three key elements–culture, language and "zone of proximal development". Vygotsky believed that when learners interact with peers they can actively participate in dialogues, discover how others think about their experiences and then incorporate the ways others interpret the world into their own ways of thinking. By this way, learners are able to develop their knowledge towards more complex and sophisticated structure (Hoy, 2010; Eggen & Kauchak, 2013).

Bruner also suggested that instruction follows a sequence of three stages. The basic stage is called enactive stage where learners manipulate objects to learn about the world around them. The next stage is iconic stage where learners represent experiences and objects as concrete images. In the last stage, the symbolic stage, learners are able to think in abstract terms with symbols (Cahyadi, 2007). The principle of progressing towards a higher level of thinking process has a lot of applications. Two prominent ones are the spiral curriculum (were concepts are developed from simple forms involving concrete objects and experiences to a high level of abstraction) and discovery learning (where learners work from examples to find general principles on their own (Cahyadi, 2007).

The ideas in these cognitive learning theories are in line with constructivism in the sense that learners construct their knowledge and/understanding on their own, rather than knowledge being transmitted by someone else. Though these theories have been used in different instructional models in learning environments, constructivist theory has been found to be more related to instructional methods, and can be used to

improve teaching in certain scientific subjects taught in schools to which Physics is no exception. It encourages students to use active techniques (e.g. experiments, real-world, problem solving) to create knowledge, reflect on, talk about what they are doing and how their understanding is changing (Keser, Akdeniz, & Yyu 2010; Conner, 2014b). The constructivist theory of learning also applies to teachers' learning when learning to teach.

2.1.2 Cognitive Apprenticeship Model

The cognitive apprenticeship model also presumes that learners should be exposed to the teaching methods that give students the chance to observe, engage in, invent, or discover expert strategies in context (Breslyn, & McGinnis, 2012; Buabeng, Conner, & Winter, 2015). According to Buabeng, (2012), the teaching methods should "systematically encourage student exploration and independence" (p. 5). It believed that teachers only coach – "offering hints, feedbacks, and reminders; provide 'scaffolding' (support for students as they learn to carry out tasks); and 'fade' – gradually handing over control of the learning process to the student" (p. 5). More so, the learning environment should reproduce the technological, social, time, and motivational characteristics of real world situations with varying levels of difficulty to enable students to work with their peers in finding solutions to problems as experienced in the real world (Brekke, 2009; Chandra & Watters, 2012).

Empirical studies show that the cognitive apprenticeship model and/or constructivist theory is an accurate description of how learning occurs and the instructional strategies can be designed into formal learning contexts with positive effect (Dennen & Burner, 2007; Keser *et al.,* 2010; Chandra & Watters, 2012; Conner, 2014b). With these two theories (constructivist and cognitive apprenticeship) teachers acknowledge they cannot mandate what students learn. They design learning

activities that are informed by what students already know and believe, and actively encourage students to reflect on and manage their own learning.

2.2 Concepts of teaching methods

The term teaching methods according to Dusting (2002), refer to the general principles, pedagogy and management methods used for classroom instruction. The teachers' choice of teaching methods depends on what fits his or her–educational philosophy, classroom demography, subject area(s) and the schools' mission statement. Teaching strategy is a generalized plan for a lesson which includes structure, desired learner behavior in terms of goals of instruction and outline of planned tactics necessary to implement the strategy (Ell & Grudnoff, 2013).

Delacruz (1997: 23) defines teaching method as "a comprehensive instructional approach that can be used to shape subject matter, design instructional materials and events and guide students" activities". Method therefore is the systematic way teachers go about their teaching. As Delacrux (1997) points out, there are two general methods of teaching: the direct and indirect methods.

1. Direct Method: - It is an approach in which pupils are told what they need to know. This method is effective for explaining ideas, dealing with abstractions that cannot be shown through concrete lectures and demonstrations which are the most direct and formal teaching methods.

2. Indirect Method: - In this method pupils are challenged to examine, investigate and explore. This method is called inquiry or discovery method. Here the teacher's role is to organize a series of activities in which the pupils are to investigate to resolve a problem.

Techniques are activities performed to achieve the method. It is a change of stimulus variation as a lesson progresses (Delacrux, 1997). According to Edusei (2001), stimulus variation refers to teacher actions, both planned and spontaneous, that develops and maintains a high level of attention on the part of the students during the course of the lesson. A teacher can use the technique of pupils' active participation in projects, group or role plays successfully in problem solving method. Hence methods and techniques of teaching are related.

Delacrux, (1997) further describes instructional strategy as detailed smaller scope of specific instruction behaviour. In other words, strategy is the sequencing or ordering of the techniques that teachers select to teach a particular lesson (Barth, 1990: 370). According to Dynneson and Gross (1999), strategies used by teachers normally clarify and expand pupils' understanding and enhance pupils' active participation in the learning process. What this means is that in a lesson, the strategy could be a brief story-telling, followed by grouping, discussing and role play.

2.2.1 Types of teaching methods

Education plays a huge role in peoples' lives by preparing an individual to face real-world challenges in life (Tamakloe, Atta, & Amedahe 1996). Due to the broad diversity of students, whose personalities and abilities differ from each other, teachers face several challenges in teaching them a huge amount of knowledge. Imparting information to a room full of students can be very difficult, but by using a selection of proven teaching methods, it can be manageable. Teaching theories primarily falls into two categories or approaches; namely: teacher-centered and student-centered approaches (Tamakloe, Atta, & Amedahe, 1996).

a. Teacher-centered approach to learning

In this model, teachers are the main authority figure. Students are viewed as "empty vessels" whose primary role is to positively receive information through lectures and direct instruction with an end goal of testing and assessment. It is the primary role of teachers to pass knowledge and information onto their students. In this model, teaching and assessment are viewed as two separate entities. Student learning is measured through objectively scored tests and assessments.

Findings of this study reach agreement with the findings of Chonjo, Osaki, Possi and Mrutu, (1996). Their study findings revealed that traditional teacher-centered lecture (chalk-and-talk) approach, which emphasizes the transfer of knowledge and skills and rewards memorization, is the predominant teaching format used in secondary schools in Tanzania. Their study findings further revealed that in using this approach, teachers talk most of the time, while students jot down notes mainly for the purpose of passing exams. This method does not allow much room for critical analysis of issues but it makes students to duplicate the notes given back to the teacher. Also, findings of this study confirm the study findings of Osaki (2000) who found that, most teachers used transmission (chalk-and-talk) rather than interactive, learner-centered pedagogy. Likewise, findings of teacher-initiated and dominated teacher-student interaction and lecture method as major methods of teaching agree with the study findings of Ajaja, (2009) who made similar findings in different public schools in Delta State, Nigeria.

Furthermore, findings of this study show that pattern of interaction in most classrooms was teacher initiated and dominated teacher-student interaction. This finding is not in consonant with international standards which recommend that

teachers should plan inquiry-based programs for their students and should also interact with students to focus and support their inquiries, recognize individual differences and provide opportunities for all students to learn (Bybee, Carlson-Powell & Trowbridge, 2008; Centre for Inspired Teaching, 2008; Bencze, Alsop & Bowen, 2009). Also, findings of this study fall short of the recommendation of teaching for effective learning (learning with understanding) where students take responsibility of their own learning through active construction and reconstruction of their own meanings for concepts and phenomena (Brass, Gunstone & Fensham, 2003; Borich, 2007).

b. Student-centered approach to learning

While teachers are an authority figure in this model, teachers and students play an equally active role in the learning process. The teacher's primary role is to coach and facilitate student learning and overall comprehension of materials. Student learning is measured through both formal and informal forms of assessment, including group projects, student portfolios and class participation. Teaching and assessment are connected and student learning is continuously measured during teacher instruction.

1. Activity Method

According to Tamakloe, Atta, and Amedahe (1996), activity method is a method of teaching where pupils are engaged in activities during the lesson. He maintains that this method appeals to many of the child's senses. On the approach to the use of the activity method, he cautions the need for outlining definite goals that should be purposeful and the use of effective teaching and learning aids combined with desirable class activities.

Asafo-Adjei (2001) also describes activity method as the method of teaching in which the child is placed at the centre of the teaching and learning process. In such situations, all pupils in the class are made to interact with materials provided either by the teacher or by the pupils to discover concepts and facts unaided or with teacher's minimum interference. The learning outcomes of an effective use of this method include:

- Children do not easily forget what they have been taught;
- Learning become more pleasurable and not boring; and
- The method fosters cooperation among learners.

2. Experiential Approach

According to Amenuke, Dogbe, Asare, Ayiku, and Baffoe, (1991), this method involves the direct experience with materials, tools and processes during teaching and learning. They note that it is an exploration approach in which pupils develop the ability to think, feel, and act creatively, resulting into the development of desirable values such as cooperation, affection and endurance. It encourages learning by doing which leads the learner to researching, discovering, inventing and innovation.

3. Discovery Learning

It is a situation in which the student achieves the instructional objectives with limited or no guidance from the teacher (Arend, 2000: 354). Advantages of this method are as follows:

It gives opportunity to students to search for knowledge.

- It enables students to explore and search for materials and know their environment.
- As the teacher does not answer for the student, it teaches them a style of problem solving.
- Retention is better as students discover knowledge themselves.
- Students acquire positive learning attitudes.
- It also helps students to learn to make personal decisions and become less dependent on others.
- It promotes creativity in students as they are able to think critically.
- It also helps students to be able to reason and develop mental and physical coordination.

Farrant, (1996) suggests that in order to achieve effective learning through discovery learning, the following teaching strategies are worthy of consideration:

- Making advance preparation and having achievable aim;
- Working with the whole class;
- Encouraging students to work in pairs or as a team;
- Helping individual students;
- Making effective use of teaching aids;
- Making use of the chalkboard;
- Actively involving students in learning;
- Motivating the students; and
- Encouraging learning outside the classroom

4. Demonstration

According to Farrant (1996:122), demonstration involves showing pupils how something ought to be done. Demonstration is a highly visual method of teaching, a process in which both the teacher and pupils are actively involved. The procedures involved are as follows:

- Teacher explains the purpose of the demonstration;
- Teacher demonstrates procedure or new behaviour;
- Pupils ask questions and engage in discussion;

As the UCEW Out Segment Handbook, (2001, p. 46) indicates, the purpose of this method is to allow pupils to witness a procedure or an act and to practice it.

5. Lecturettes

Lecturette is a short form of the lecture method which is used to highlight key points of content. Unlike the traditional lecture, this method often involves participant interaction and, at times, seen as a discussion. Usually it is very brief and serves as useful introduction to topics and lead-ins' to experiential activities. The primary purpose of this method is to provide pupils with specific information and set the stage of an experiential activity (UCEW Out Segment Handbook, 2001, p. 46).

6. Cooperative Learning

In cooperative learning pupils work as teams or groups (Arend 2000: 125). Slavin, (1995) also refers to cooperative learning as instructional method in which students work together in small groups to assist one another to learn. They stay together as a group for a short or long period of time working together. The advantages of this method (Arend, 2000) include the following:

- It increases the level of activity as students are actively involved in the lesson.
- It increases the level of learning in that partners learn more if they are given opportunity to share discuss and challenge each other's ideas.
- It improves the learning of weaker students since it encourages peer–tutoring.
- It also improves students' communication skills such as listening, then relaying and talking and explaining, giving instructions, questioning, persuading, thinking, categorizing, getting information from texts, analyzing and comparing.

McDonald, Larson, and Danserau, (1985) assert, that students who study this way learn and retain more than students who study on their own or simply read the materials. The discussion on teaching shows that proper adaptation of the right teaching strategies will whip up the interest of pupils. Rightful choice of teaching modules coupled with stimulating activities would encourage pupils' active participation in the lessons to promote good retention. It would also motivate pupils to develop positive learning habits.

2.3 Role of ICT in the teaching and learning of science

In fact, a considerable body of literature exists on the use of ICT in science subjects across a range of topics and age levels. Furthermore, research indicates that ICT can play a major role in enhancing and extending practical work.

For example, in a study of 300 students (males and females), Al Essa, (1993) compared the use of ICT in teaching and learning, in science, to the use of traditional methods. The study sample was divided into two groups: the first group was experimental and consisted of 150 students who studied through the use of ICT, while the other was a control group consisting of 150 students who studied using traditional

methods. The results indicated that statistically significant differences were shown in the immediate achievement using simulation strategy implemented by using ICT, with a greater impact for male students. But, Al Essa's (1993) study was on science in general but the current study is on Physics in particular. The question now is: would the findings of Al Essa's (1993) study be the same as the current study? This and many other questions would be addressed at the end of this study.

In a study related to Science, Scardamalia and Bereiter (2000) investigated how to utilize ICT as a knowledge-supporting material in science lessons. The study involved 1110 primary and secondary school students who were divided evenly into two groups according to their stages. The study was conducted in Seoul, South Korea. The effectiveness of using ICT as a knowledge-supporting material was evaluated. The experiment lasted three years, and the findings indicated that 76% of the students increased their interest in obtaining knowledge through using ICT. In addition, the primary school students showed dramatic improvements in terms of memorizing, retrieving information, and using computers, greater than the impact on their peers in high school.

Sangraa, and Mercedes, (2010) aimed to identify the effect of ICT on achievement among eighth grade students in science subject matter learning through the use of ICT, compared with traditional methods. In addition, the study addressed the effect of gender as well as the interaction between teaching method and gender on the students' achievement. The study population consisted of all eighth grade students enrolled in Al Mafraq Directorate of Education, Jordan. The study sample consisted of 180 students enrolled in schools within Al Mafraq City during the first semester of the Academic year 2005/2006. The sample was selected and distributed randomly into six groups: two control groups that comprised 60 male and female students taught

using traditional methods, the first two experimental groups that comprised 60 male and female students, who were taught using the ICT, and the second two experimental groups that comprised 60 male and female students who were taught using the Internet. The study instruments included unit 5 (earth and space sciences) from the science curriculum as a study material. This unit was taught for five lessons a week, for four weeks.

After the completion of teaching unit 5, an achievement test was introduced in order to assess achievement. The test consisted of 30 multiple choice questions. To assure the instrument's validity, it was introduced to 10 arbitrators. Also the test reliability was assured relying on Richardson-Kuder equation (KR-20) where the reliability coefficient equaled 0.89. With respect to results, the study showed that there were significant differences in favor of the two experimental groups. In addition, there were statistically significant differences in relation to the interaction between teaching method and gender, that is, there is a statistically significant interaction between gender and the method of teaching in its impact on the dependent variable. But, Sangraa, and Mercedes' (2010) study was not conducted here in Ghana and perhaps lack the necessary evidence on the role of ICT in physics among SHS students and therefore, the need for this study to be conducted in order to bridge the gap in literature.

In a study related to chemistry, Paddy (2001) indicated that there were no statistically significant differences in achievement among students who have learned through ICT and those who have learned through traditional methods. Furthermore, and unexpectedly, there were no statistically significant differences in achievement among students who studied through ICT and those who studied through traditional methods regarding retaining information.

Against all the expectations, the study of Al Hudhaifi and Al Doghaim (2005), also highlighted that there were no difference between the achievements of students studying through ICT and those not, according to the scientific thinking scale for the second secondary grade students in chemistry. Additionally, there were no statistically significant differences between an experimental and control group scores in the hypothesis testing skill and interpretation skill. There were, however, statistically significant differences in generalization skill according to scientific thinking.

In another study concerning chemistry, Al Omar, (2001) sought to identify the effect of ICT on direct and delayed achievement among the first-year secondary grade students, at scientific branch, in chemistry. The study population consisted of all first-year secondary grade students enrolled in public schools located in First Irbid District in Jordan. The sample consisted of 114 students from two schools, one group for boys and the other for females. Two classes were selected by simple random method from each school. The researcher used computerized learning software that included unit 1 from chemistry textbook for first secondary grade, an achievement test, and pre-prepared notes related to the teaching of modern atomic theory and the periodic table.

The researcher found a statistically significant difference, at the significance level $\alpha \leq 0.05$, on the direct achievement in relation to the teaching method, in favor of the experimental group. Also there were statistically significant differences, at the significance level $\alpha \leq 0.05$, in relation to gender in favor of females. No significant differences were found, at the significance level $\alpha \leq 0.05$, in the direct achievement amongst students in relation to the interaction between teaching method and gender.

With respect to the delayed achievement, statistically significant differences were found in delayed achievement in relation to the teaching method in favor of the experimental group, while no significant differences were found in delayed

achievement in relation to gender or the interaction between teaching method and gender.

In his experimental study related to chemistry, Shepr, (2003) aimed to identify the effect of using ICT in helping students to learn chemistry. The study sample was comprised of 106 first secondary grade students enrolled in Bahraini schools. The study findings indicated that the performance of students who learned using ICT within the two experimental groups had increased in comparison with the students' performance within control groups at a statistically significant level of $\alpha = 0.01$. The findings indicated that the using of ICT was highly effective in helping students to learn Chemistry.

Interestingly, Paddy's (2001), Al Hudhaifi and Al Doghaim's (2005), Al Omar's (2001), and Shepr's (2003) studies were conducted outside Ghana and also among chemistry students. But, the current study is among physics students; hence, his findings might not necessary be the same as that of the current study.

In a study related to physics, Al Mustafa, (2000) investigated the effect of using teaching methods reliant upon ICT on the achievement among ninth grade students in physics, compared traditional teaching methods. The study sample consisted of 80 students (40 males and 40 females) who were selected from two schools located in the county of Northern Jordan Valley, Jordan. An achievement test was used that related to the topic of "electromagnetic induction" from the national curriculum. The test consisted of 20 items, where 9 items were right/wrong questions, and 11 multiple-choice. The researcher developed a measuring instrument to investigate the changes brought about by the computerised teaching method on the students' attitudes, which comprised 30 items. Also, learning software was designed

on the topic of electromagnetic induction. The achievement test was applied before and after intervention.

The study revealed statistically significant differences, at significance level α = 0.05, on the achievement amongst ninth grade students in physics relating to the teaching method, in favour of the experimental group that studied by computer. There were no statistically significant differences on the achievement among ninth grade students in physics, in relation to gender or the interaction between the teaching method and gender.

In another study concerning Physics, Al Sharhan (2002) explored the effect of using ICT on the achievements of first-year secondary graders enrolled in one of Riyadh schools in KSA, in Physics, investigating the skills of remembering, understanding, and application. The study sample was divided into two groups: an experimental group that comprised 25 students who studied relying on ICT, and the control group that comprised 25 students who studied relying on traditional methods. The results showed that there were no statistically significant differences, at the level α = 0.05, in the remembering level between the two groups of study, while he found a statistically significant differences, at the level α = 0.05, in the understanding and application levels, in favour of the experimental group.

By focusing on Optics, a major field in Physics, Jaber (2004) studied the effect of a teaching method using ICT on teaching the conceptual change model amongst eighth-grade students studying "light as a field of optics" within a public school located in Irbid, Jordan. The study sample consisted of 52 female students who were distributed randomly into two groups: A control group that was taught according to the conceptual change model and an experimental group that was taught according to conceptual change model coupled with the use of ICT. The findings did not indicate

of the existence of statistically significant differences at the significance level $\alpha = 0.05$ between the control and experimental groups, in relation to the variation in teaching methods. Though the above studies were on physics, they were carried out outside Ghana and therefore lack the needed evidence on the effects of ICT on physics.

In a study concerning earth sciences, Liao, (1999) conducted a study to clarify the effect of ICT problem-solving methods on the achievement amongst tenth grade students in earth sciences subject matter in Taiwan. The study sample consisted of 78 male students and 78 female students who were distributed into four experimental subgroups, while 69 male students and 69 students were distributed into four control subgroups. The two groups were taught the same subject (floods), using problem-solving methods for the experimental group and lecturing methods for the control one. The researcher found statistically significant differences among the tenth grade students, in favour of the experimental group.

With respect to ICT and Biology, Lutfi and Al Ajlouni (2003) conducted a study to investigate the effect of using ICT as method for teaching biology on the achievement of tenth grade students, in comparison with traditional methods of teaching. The study sample consisted of 68 students, 39 male and 29 female, enrolled in two private secondary schools located in Amman, Jordan, for the academic year 1999/2000. The sample was divided into two groups: a control group that included 20 male students and 14 female students with total number of 34 students, and an experimental group that included 19 male students and 15 female students with a total number of 34 students. In both groups, males and females studied separately. Within this study, an achievement test was used for Biology subject matter, which included 33 multiple-choice items. The test was applied prior to and after the intervention. In

addition, an achievement computerized programme in biology was used to study genetics and then was applied on students within the experimental group. The findings indicated that statistically significant differences were found in students' achievement in biology, in favour of the groups using ICT. In this study, no statistically significant differences were found in students' achievement in relation to gender. Finally, a positive change was found in students' attitudes towards ICT after intervention, compared with the control group.

In general, most of the research related to ICT and science showed the positive effects of using ICT on students' achievement in science. This type of usage, in turn, is assumed to enable individuals to raise their learning in the different aspects of science.

2.4 Factors that influence the use of ICT in teaching and learning

According to Maithya and Ndebu (2011), there are a number of factors that influence the use of ICT in teaching and learning. But, for the purpose of this study, the factors are grouped into school and teacher related.

2.4.1 Teacher-Related Factors

Teacher related factors determine to great extent the success of computer projects in education (Kavagi, 2010). Teachers play a very important role in the teaching-learning process, they must be able to prepare young people for the knowledge society in which the competence to use ICT to access information is very important (Samah, Afshari, Su Luan, & Fooi, 2009). According to literature reviewed, there are a number of teacher related factors that influence the use of ICT in teaching science. They include:

a. Teaching Experience

Some research findings show that teachers' adoption of new technology is influenced by age. Studies conducted by Roberts, Hutchinson and Little, (2003) revealed that teachers who were educated 20 years ago were trained by people who themselves were trained before the arrival of computers in educational institutions and therefore such teachers were unlikely to use ICT in their classrooms. However, a study carried out by Albirini, (2006) found that age did not significantly influence teachers' attitude towards the use of ICT. These two contrasting findings call for further research on age factor as a predictor of teachers' use of ICT. Though most of the Physics teachers of St. Roses SHS are young, it is perceived that most of them have less experience in the use of ICT. But, conclusions cannot be made based on perceptions; therefore, there is the need for this study to be conducted.

b. Teachers' ICT Experience

Several studies show that teachers who are inexperienced in using ICT will most likely avoid using it in the classroom for fear of failure. According to Balanskat, Blamire, and Kefala, (2006) and (Bingimlas, 2009), limitations in teacher's ICT knowledge makes them feel anxious about using ICT in the classroom and thus not confident in using it in their teaching. This is in line with findings of a study by Becta (2004) who found that many teachers who do not consider themselves to be well skilled in using ICT feel anxious about using it in front of a class of children who perhaps know more than they do.

c. Teacher Competence in ICT Use

Teachers are key to the success of ICT integration in education. They must be equipped with basic ICT skills to meet their individual administration and teaching

requirements. In addition, teachers have to undergo ICT based pedagogical training so as to ensure effective use of technology in teaching and learning (MoE, Singapore, 2008).

Research studies in Australia found that teachers who lacked knowledge and skills to use computers were not enthusiastic about integrating ICT in teaching and learning (Newhouse, 2002). Research done in developing countries revealed that lack of technological knowhow is the main obstacle to acceptance and adoption of new technology by teachers in classroom instruction (Pelgrum, 2001). Further, studies conducted in Bungoma by Wanjala, Khaemba and Mukwa, (2011), confirmed that indeed to adopt any educational technology effectively, teachers must feel confident in its operation and their own ability to use it in classroom instruction. But, the purpose of this study was to examine SHS Physics teachers' use of ICT in instruction.

d. Teachers' Perceptions

The role and importance of attitude and beliefs in education is a very well documented area in educational research. This is also true when it comes to studying the relationship between attitudes and the usage (or lack of usage) of ICT in education (Ertmer, 1999; Jegede, 2008).

Teachers' attitude determines the extent of ICT use in the teaching and learning process as revealed by a number of studies. According to Gakuu (2006), as cited in Maithya, and Ndebu, (2011), how people perceive and react to technologies is far more important than technical obstacles in influencing ICT implementation and use.

Watson (1998), an Australian researcher argues that integrating new technologies into educational settings requires change and different teachers will handle the change differently. Drent and Meelissen (2007) conducted a study on the use of ICT by teachers in classroom instruction in Netherlands and found that positive

ICT attitude has direct positive influence on the innovative use of ICT by the teacher. Educational theorists and researchers have alluded to the fact that teacher's attitude is an important factor in the adoption of new technologies in classroom instruction (Koohang, 1989). It has also been argued that attitudes towards ICT not only affect teachers' use of computers in the classroom but also their likelihood of benefiting from training (Kluever, Lam, Hoffman, Green, & Searinges, 1994). In addition, Tay (2012:7) asserts that:

> *Teachers have very often been identified as one of the most significant resources in the integration of technology into schools but they could also be one of the main barriers. The teacher's attitude, knowledge, and skills in the use of computer for the purpose of teaching and learning have a considerable impact on the outcomes to be achieved.*

However, a study conducted in Ghana to establish the relationship between teachers' perception and ICT integration in teaching and learning brought to the fore contradicting results. The Study revealed that teachers' perceptions with regards to the use of ICT were positive and low but not statistically significant (Buabeng, 2012). This revelation casts doubts on other findings which have reported that teachers' actual ICT use related to their perceptions (Keengwe & Onchwari, 2008; Lau & Sim, 2008).

This finding, on the other hand, is in agreement with Eugene (2006) who explored the effect of teachers' beliefs and attitudes towards the use of ICT in classrooms. The study revealed that there was inconsistency between teachers' beliefs and their actual use of technology in classroom. Teachers' beliefs and teaching practices were found not to match. The inconsistency between teachers' actual use of

ICT and perception can be attributed to inadequate supply of ICT resources, lack of access to the right kinds of technology, inadequate ICT pedagogical training and insufficient administrative support.

2.4.2 School-Related Factors

a. Time

Studies carried out by various scholars indicate that availability of time, determines the use of ICT in teaching and learning of mathematics and science (Becta, 2004). According to Kozma, McGhee, Quellmalz, and Zalles, (2004), lack of time available in classes, and in teachers' own schedules for planning is a major factor influencing ICT integration in teaching science subjects. Further, a study carried out in Saudi Arabia shows that time is an important factor affecting the application of new technologies in science education and is attributed to busy school schedules since teachers work from about 7.00 am to 2.00 pm and have on average 18 lessons per week (Al-Alwani, 2005). Both teachers and students have little time to work on integrating ICT in science education.

b. Access to ICT Facilities

Access to ICT facilities is an important factor that could influence the teachers' use of ICT in conducting science lessons. Various research studies show that barriers related to accessibility to new technologies for teachers are wide spread and differ from country to country. A study conducted in Europe found that lack of access is the largest barrier to using ICT. Teachers gave reasons such as: lack of computers and related hardware, lack of appropriate software, slow Internet (Bingimlas, 2009).

Further, a study carried out at the Kenya Technical Teachers College revealed that most lecturers (96%) had ICT skills but many (75%) had difficulties in

integrating ICT into their subjects. The lecturers cited lack of sufficient Internet facilities for this scenario (Maithya and Ndebu, 2011). Keiyoro (2010:175) conducted a case study involving Cyber and NEPAD E-schools on factors influencing ICT integration in teaching science subjects curriculum. From his findings, he asserts that there is no point in spending any time and effort in equipping teachers with necessary skills to integrate ICT into their teaching if schools do not have computer laboratories and other ICT resources necessary to put those skills into practice with learners.

c. Technical Support

Good technical support both in the classroom and in the whole school resources will help the teachers to overcome the barriers preventing them from using ICT (Lewis, 2003; Bingimlas, 2009). According to Sicilia (2005), technical problems were found to be a major barrier for teachers. Such technical problems include: waiting for website to open due to slow Internet, failing to connect to Internet, malfunctioning computers and printers as well as old and slow computers. These barriers affected the smooth delivery of lessons or natural flow of classroom activities. Gomes (2005) argues that ICT integration in science teaching needs a technician and if one is not available, lack of technical support can be an obstacle.

d. Management Support

Successful integration of ICT in the teaching and learning depends to a large extent on the support given by the school management to the teachers and students. It plays a significant role in adoption of technology as part of the school culture and which in turn influences people's perception. Maithya and Ndebu, (2011) argues that culture developed within an institution can act as a barrier to change. This is further supported by Gakuu (2006) who cites organizational culture as playing a key role in

implementing change in an organization. According to Kara (2008), management of ICT should involve continuously reviewing and putting in place the most appropriate ways of exploiting ICT, acquisition and utilising new ICT required by an organization. The institutional management should also ensure that the capacity of the staff is enhanced, monitor and ensure effectiveness of ICT usage in the institution.

2.5 Attitude of Physics teachers towards the use of ICT in teaching and learning

Whilst much of the research that has been considered in this thesis includes an analysis of the variation of impact on males and females (of using ICT related teaching methods), here the research considers studies that have explicitly sought to identify the gender gap in ICT use.

Several studies were carried out over time in an attempt to find an answer on the issue of differences between the two genders with regard to attitudes towards ICT and its use (Boser, Palmer & Daugherty, 1998; Liao, 1999). Most researchers in early studies found out that attitudes towards technology varies significantly between males and females, as males showed more interest and knowledge, with the exception of Liao (1999). A majority of researchers who studied students' attitudes towards the use of ICT confirmed that males have a more positive attitude towards ICT, and that they used it more often than females. Other researchers also found out that females view technology as more difficult and less interesting in comparison to males (Boser, Palmer & Daugherty, 1998).

Nevertheless, the difference in attitudes between the two genders towards technology is not attributed to their biological nature, but to the social and cultural construction. The differences in attitude can be attributed the person's specific status and the use of computers or ICT in education, as those machines were essentially used

in research and administrative offices by white males (Linn, 1999). Differences can also be the result of males' dominant culture in technological domains, as males use computer machines more than females in the workplace (Hill, Loch, Straub & Elsheshai, 1998). Additionally, differences can result from a direct effect of the technological environment inside the house. A lot of males and females view their houses as more technological, and they assess their parents' professions as more technological (Bame & Smith, 1993).

Sharp (2005) identified other possible reasons for the difference in attitude and capability in ICT use:

1. Most computer games are characterized by violence and attract males.
2. Computer machines are connected with mathematics and sciences, which are domains dominated by males.
3. Magazines and newspapers depict the man as using the computer more than the woman.
4. When women are using the computer machine it would normally appear in the working office role.
5. And a lot of teachers encourage children to use computer machines at the same time females are discouraged from doing so (Sharp, 2005: 405).

The question now is: would the findings of Sharp's (2005) study be the same as the current study? Answers to this question and many other were the focus of this study.

In some studies, it has appears that attitudes between the two genders towards computer machines are no longer greatly different. Female participants in a group which focused on a study carried out by the American Association for the Education Foundation of University Women' found that they enjoy using computer machines,

but that they use it in a different manner from males (Bain & Rice, 2006). Since gender difference has an effect on attitudes, conceptions and the use of technology, it is important to understand the differences between the two genders in this context.

Vekiri, (2010) carried out an explorative study within the context of an intermediate computer school in Greece. This study sought to examine the values and beliefs of both genders in relation to computer machines and ICT, parents' conscious support, teachers' expectations, and conceptions of the nature of teaching ICT. Over 300 students participated in the study, and answered a self-report questionnaire.

The analysis showed that the teacher's expectations were positively connected with students' beliefs of ability, and that the conceptions of the educational activities were creative and effective on a personal level, and greatly influenced students' interest in the field of IT. Also, parents' support was connected with students' values and beliefs on the efficiency of ICT. Contrary to earlier studies, the findings of this study did not support the claim that males excel females in relation to the personal values and beliefs connected with ICT. Moreover, the study pointed out that males' and females' beliefs are influenced differently by parents, teachers and the school teaching of informatics.

More studies continued on addressing the effect of teacher's attitudes towards ICT on students' learning. For example, Sangràa and Mercedes (2010) investigated four different schools and they noted that there is a favorable opinion from a large group of teachers regarding the use of ICT in education. Furthermore, they suggest that it is very useful for students and has helped in the development of learning processes such as attention-visualization and response mechanism-application learning and also the understanding and transmission of information to facilitate zof expression and communication skills that suggest that not all teachers are wholly

embracing ICT. As conclusion, the teacher's attitude is vital in the educational process and the lack of interest shown by some teachers has an adverse effect upon the educational process in the classroom.

Some studies addressed that the teacher is a key to the organization and orchestration of ICT in the classroom since both components have an enormous impact upon how a student learns (Sang, Valcke, Van Braak, & Tondeur, 2010) and can influence the students' perception of ICT in the classroom. Furthermore, this source raises the argument that teachers' attitudes should be challenged (Livingston & Rae, 2006). Similarly, Condie (2005) supports the view of Sang *et al* (2010) by using the analogy of either paddling at the water's edge or actually swimming. Hence, this evidence seems to suggest that the teacher's input is essential when examining the use of ICT in the classroom. Sang *et al.,* (2010) take this a step further by suggesting that wading at the edge is not enough and reflects upon teaching competency.

However, one specific pattern of ICT-based studies has recently received a tremendous amount of attention from educational professionals and researchers. For example, the study of Al Khateeb (2000) was conducted to identify the attitudes of teachers in Irbid Governorate, in Jordan, towards instructional technology in relation to some independent variables such as gender, specialization and years of experience. The study sample consisted of 139 teachers (male and female) in public schools located in Irbid Governorate. The researcher used a questionnaire comprising 40 items, allocated equally into positive and negative attitudes, during the academic year 1998/1999. The results indicated the presence of positive attitudes among teachers within the study population regarding instructional technology. The results also showed that there are significant differences between teachers' trends toward instructional technology and the scientific qualification, in favor of those who are

holding an undergraduate degree (BA) over those holding a College diploma (two years of study). Furthermore, the results indicated that there are no significant differences regarding the attitudes of teachers towards instructional technology between gender, specialization and experience. But, that study was conducted outside Ghana and therefore lack the necessary evidence on the attitude of physics teachers in Ghana precisely St. Roses SHS in Akwatia, Eastern Region.

In an overview of good practice in the use of ICT-based technology, Ng and Gunstone, (2003) sought to identify the attitudes of science teachers within public secondary schools in Victoria State, Australia. Their investigation examined science teachers' attitudes towards the use of ICT in learning. In order to answer this question, the views and observations of science teachers regarding their teaching science in public schools in Victoria were collected. Within this study, the obstacles that restricted the implementation of these technologies in the classrooms were addressed and discussed. The results showed that a majority of the teachers participating were interested in introducing such technologies within their schools. The results showed also that despite this positivity, teachers were infrequent in implementing this technology in the classroom. This study can be considered as diagnostic in presenting the obstacles that limit implementing ICT-based technology during learning. However, it neglected the students' views. To be more specific, no suggestion is presented about what technologies to use within classrooms, or beyond, to increase the students' interest and their achievement with implementing such technologies. Findings of Ng and Gunstone's (2003) study might not necessary be the same as the current study as a result of cultural differences between public secondary schools in Victoria State, Australia and St. Roses SHS, Akwatia, Ghana. There was therefore the need for this study to be conducted.

Similarly, in her study, Abdullah, (2012) aimed to identify the degree of using ICT-based technology by teachers at early primary levels in the learning process, as well as identifying the teachers' attitudes toward this technology. Moreover, the study aimed to establish whether there are any differences amongst teachers' attitudes regarding the variables of gender, place of working (governorate), academic qualification, length of service and training courses. The researcher relied on an analytical descriptive method. A random sample was selected and consisted of 250 teachers and 90 administrators (principal, librarian, computer lab technician) enrolled in public schools located in Damascus and Al Qunaitera.

The study findings revealed that: (a) teachers use ICT-based technology for learning process and administrative affairs moderately, (b) the degree of using ICT-based technology as learning aids by teachers was low, (c) the ICT-based impediments perceived by administrators and teachers were high, (d) the teachers have high positive attitudes toward using ICT-based technology in learning, (e) many schools lacked for ICT tools, (f) the students usage for ICT-based technology was ineffective at both schools, (g) the teachers' gender has no effect on the degree of using ICT-based technology, (h) the variables of "governorate", "degree of qualification", "length of service", and "enrolling in training courses" have significant effects on the degree of using ICT-based technology by teachers, and (i) the teachers indicated a significant contradiction between their attitudes toward ICT-based technology and the degree of their usage for it in favour of their attitudes. In fact, this study diagnosed the various factors that may influence the teachers' attitudes towards ICT. However, it failed to consider the students' views of which this study would do in order to bridge the gap in literature.

2.6 Graphs and graphing ability in Kinematics

Fey (as cited in Kwon, 2002) states that there are three mathematical representations of real–world data: (a) tabular representations, (b) algebraic representations, and (c) graphic representations. Tabular representations are useful in showing data with varying parameters. Algebraic representations specify the exact relationship between variables, but neither give a simple example nor a visual image (Beichner, 1994). Graphical representations, however, provide an image within the limits of the graph. Graphing representations are frequently used, since they provide a vulnerable alternative to verbal and algebraic description by offering students another way of interpreting data and developing concepts (Padilla, McKenzie, & Shaw, 1995). Graphs provide an invaluable aid in solving arithmetic and algebraic problems and representing relationships among variables. Graphs display mathematical relationships that often cannot be easily recognized in numerical form (Dick, & Dunham, 2000). Also graphs display trends as geometric patterns that our visual systems encode easily (Pomerantz, 1997). Graph construction and interpretation skills are obviously important for the development of scientifically literate individuals (Ates & Truman, 2003). Hardal, (2003) stated that a graph is an important tool in enabling students to predict relationships between variables and to make the nature of these relationships concrete. Graphs also provide a powerful tool for studying complex relationships, and there are useful means of communicating otherwise difficult to describe information (Norman, 1993).

Kirean (as cited in Kwon, 2002) stated that graphs were rarely taught with purpose of viewing the whole picture; instead, they were often used as another way of representing a relationship that was initially depicted in an algebraic representation in the past. Therefore, most graphical interpretation activities involved the use of point –

wise methods applied to basic functions, such as linear, quadratic, and trigonometric equations. Also students mainly learned to construct a graph from a given set of ordered pairs, without reasoning about the physical context in which the number pairs were introduced, and computing function values.

The ability to comfortably work with graphs is a basic skill of the scientist. "Line graph construction and interpretation are very important because they are an integral part of experimentation, the heart of science". A graph depicting a physical event allows a glimpse of trends which cannot easily be recognized in a table of the same data. Adie, (1998) notes that graphs allow scientists to use their powerful visual pattern recognition facilities to see trends and spot subtle differences in shape. In fact, it has been argued that there is no other statistical tool as powerful for facilitating pattern recognition in complex data. Graphs summarize large amounts of information while still allowing details to be resolved. The ability to use graphs may be an important step toward expertise in problem solving since "the central difference between expert and novice solvers in a scientific domain is that novice solvers have much less ability to construct or use scientific representations". Perhaps the most compelling reason for studying students' ability to interpret kinematics graphs is their widespread use as a teaching tool.

2.6.1. Difficulties in Kinematics Graphing Skills

Ates and Truman, (2003) studied on difficulty in connecting graphs to physical concepts and difficulty in connecting graphs to the real world. Ates and Truman, (2003) categorized 10 difficulties students had in the graphing of kinematics data under two main categories.

1. Difficulties in connecting graphs to physical concepts:

- Discriminating between the slope and the height of a graph.
- Interpreting changes in height and changes in slope.
- Relating one type of graph to another.
- Matching narrative information with relevant features of a graph.
- Interpreting the area under a graph.

1. Difficulties in connecting graphs to real world:
   - Representing a continuous motion with a continuous line.
   - Separating the shape of a graph from the path of the motion.
   - Representing a negative velocity on a velocity versus time graph.

Some other difficulties were noted (Quesada & Mary, 1994; Rieff, Doerr, & Tabor, 1999; Olme, 2000; Saeki, Ujiie, & Tsukihashi, 2001) that students perceive graphs as a picture, they confuse slope with the height of the graph and they also confuse the shape of the graph and the path of the motion.

In addition to above, Beichner, (1994) studies on the process of developing and analyzing a test in order to report students' problems with interpreting kinematics graphs shown that students also have problems on recognizing the meaning of areas under the kinematics graphs. Students successfully find the slope of lines which pass through the origin but they have difficulties in determining the slope of a line if it does not go through the origin. One another difficulty is distinguishing between distance, velocity and acceleration (variable confusion). They often believe that graphs of these variables should be identical and appear to readily switch axis labels from one variable to another variable without recognizing that the graphed line should also change.

2.7 Empirical review

Little research has addressed the practices of using ICT in teaching and learning of physics. Ahaji, El Hajjami, Ajana, Mokri, and Chikhaoui, (2008) affirm that the integration of ICT has a positive effect in teaching and learning in geometrical optics. Mahdi, Chekour, and Laafou, (2014) also affirm that the Distance training for teachers can help them improve their methods and teaching strategy by updating their knowledge in science (Mahdi, *et al.,* 2014), Also, most research on the use of ITC simulations has been approached without consideration of the possible impact of teacher support, the lesson scenario and the role of computer simulation in the program (Rutten, van Joolingen, & van der Veen, 2012). These factors may increase the performance of learners in the acquisition of concepts and physics phenomena.

On the other hand the results of Alj and Benjelloun (2013) show that 94.4% of teachers surveyed expressed great interest in the use of ICT in their teaching practices. However, only 8% of them integrate ICT in the classroom on a regular basis (Alj Omar & Nadia Benjelloun, 2013). While Biaz after a survey shows that the percentage of teachers who have received training in ICT "in the context of continuing training courses" does not exceed 20% (Biaz, Ahmed Bennamara, & Talbi, 2009).

Some researchers addressed the teachers' views toward ICT and Science by aiming to provide an accurate statistical data related to ICT and science teaching. For example, Al-Hadlaq (2003) explored the extent of recognising and using ICT in teaching science within Kuwait by sciences teachers, male and female. The study sample consisted of 145 science teachers who taught the stages in Kuwait during the academic year 1999/2000.

The study's findings showed that most commonly used computer programmes were animation programmes and word processing programs, while the least commonly used were electronic scientific encyclopaedias and learning software such as modelling and simulation programs. Moreover, no differences were found between male and female science teachers in Kuwait with regards to: (a) their general use of ICT, (b) teaching computerised course(s), and (c) the usage of ICT by their students within science lessons. Furthermore, a number of differences were found between male and female teachers in regard to their use for ICT within science lessons, in favour of male teachers.

The study concluded a number of recommendations of which, suggesting that teachers' pre-service training should include studying more a minimum of two computerised courses and that computerised courses provided to teachers in pre-service training should include an explanation of how to integrate ICT within various educational materials, in particular in science. The most interesting thing with all of these studies that they bring with them, cumulatively, challenges which may have resulted in innovative responses and activities underlying great benefit for the development of ICT skills among both teachers and students. As it stands now, it is not clear whether findings of the above study would be the same as the current study; therefore, there is the need for this study to be conducted.

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter presented and discussed the research methodology. The sub-headings discussed were; research design, population, sample and sampling procedures. It further discussed the research instrument, validity of the instrument and reliability of the instrument. Finally, the chapter discussed data collection procedures, method of data analysis and ethical considerations.

3.1 Research design

According to Bryman (2008), research design provides the framework for the collection and analysis of data. A research design refers to a detailed plan of how a research study is to be conducted by operationalizing variables to be measured, selecting samples of interest, and process of data collection to answer research questions and testing hypothesis, and the analysis of data (Creswell, 2003).

This research used an action research design. An action research allows classroom and other school related problems to be studied with the aim of providing immediate interventions to them. Action research is an interactive inquiry process that balances problem solving actions implemented in a collaborative context with data-driven collaborative analysis or research to understand underlying causes enabling future predictions about personal and organizational change (Reason, and Bradburry, 2006). Likewise, an action research represents a growing field of educational research whose chief identifying characteristics is the recognition of pragmatic requirements of educational practitioners for organized reflective inquiry into classroom instruction (Hodson, 1993).

Ackummey (2005) also defines action research as a reflection on one's present educational practices, identifying specifics contextual problem and developing and implementing approaches that would lead to the solution of the problems, all in the effort of improving the quality of education either individually or in group. She added that action research has the following characteristics; it requires a variety of mechanisms such as questionnaires, interviews, observations to;

i. Constantly monitor the step-by-step process involved over a varying period of time,
ii. It involves accurate observation and description,
iii. It is concerned with diagnosing a problem in a specific context and attempting to solve it in that context,
iv. It is usually collaborative (that is team work),
v. Findings are applied immediately or in the short term and
vi. It is very flexible and adaptable (Ackummey, 2005: 232)

Also, the nature of this study necessitates the use of quantitative research approach which suites the descriptive survey design for a proper extraction, reliability and validity of the findings (William, 2006). Quantitative research approach uses objective and statistical analysis of numerical data to understand and explain phenomenon (Twumasi, 2001). This approach was chosen because the problem under investigation cannot be directly observed.

3.2 Population

A population is a group of elements or causes, whether individuals, objects or events, that conform to specific criteria and to which we intend to generalize the results of the research (McMillan & Schumacher, 2001). Thus, a population is the

universe of units from which a sample is collected (Bryman, 2004). The population for this study was one hundred and eight (108) people which comprised four (4) Physics teachers (3 males and 1 female) and 104 SHS 2 Physics students of St. Roses Senior High school, Akwatia-Eastern Region.

3.3 Sample and sampling procedures

Kothari, (2011) defined sample as the number of items to be selected from the universe. According to Gay and Airasian (2003), 30% to 50% of the population is a perfect sample when using survey design. As a result, 54 participants were selected for this study which included 4 Physics teachers and 50 SHS 2 Physics students of St. Roses Senior High school, Akwatia-Eastern Region.

A combination of purposive and simple random sampling procedures was used to select participants for the study. Purposive sampling technique was used to select 4 Physics teachers for this study. The power of purposive sampling is to select information-rich participants. For purposive sampling to be effective, participants must be identified based on qualifications and characteristics they possess, related to the study; hence, the use of this technique to select Physics teachers (Sidhu, 2002).

Moreover, simple random sampling was used to select fifty (50) SHS 2 Physics students of St. Roses Senior High school, Akwatia-Eastern Region. Seidu, (2002) defined simple random sampling as the process of giving every member of the population the probability of being selected to represent the population. He argues further that the simple random sampling technique provides an unbiased cross-section of the population to represent the population. In the process of using the simple random sampling technique, “Yes” and “No” were written on pieces of papers. These pieces of papers were then folded and placed in a basket where students were asked to

pick only one of the papers from the basket. Those who picked "Yes" were made to write the pre-test and to respond to the questionnaires. In summary, fifty-four (54) participants were selected for this study; 4 Physics teachers and fifty (50) SHS 2 physics students of St. Roses Senior High school, Akwatia-Eastern Region.

3.4 Research instrument

Structured questionnaire was the instrument used to collect data for this study. Questionnaire was selected because all the participants were literate and they were able to read and respond to items on the questionnaire. Also, questionnaires were answered more easily and quickly by participants (Ary, Jacobs, Razavieh & Sorensen, 2006). Moreover, due to the large number of participants, interviewing all of them would be unlikely; therefore, the use of questionnaire. Not only this but also, the instrument enabled participants, in their own way and at their own convenience, to complete the items by way of sharing their views and ideas about the topic under investigation.

Two sets of questionnaires were designed for this study; one for Physics teachers and the other for SHS 2 physics students. Both sets of questionnaires were designed to contain only close-ended items. The questionnaire comprised only one part which was related to the research questions. Participants were asked to use 4-points Likert scale to respond to the items and they were weighed as follows: Strongly disagree=1, Disagree=2, Agree=3 and Strongly agree=4.

3.5 Validity of the instrument

Validity of the instrument in this study was tested through face and content validation procedures. In testing the face validity, the questionnaire was given to the researcher's colleague students and friends to go through. In doing so, language bias,

too much use of negative statements, and so on were examined by researcher's colleagues, students and friends. Comments from them on the questionnaire were used to effect the necessary corrections before it was administered.

On the other hand, content validity of the instrument was determined by the researcher's supervisor. This was achieved by examining the research objectives and questions alongside with each item on the questionnaire to find out in whether the instrument actually measures what it was supposed to measure. Comments from the expert (researcher's supervisor) on the instrument were affected before it was administered.

3.6 Reliability of the instrument

The instrument was pre-tested on Physics students of St. Roses Senior High School, Akwatia. Thus, fifty four (54) questionnaires were administered; four (4) for Physics teachers and thirty (50) for SHS 2 Physics students. Cronbach alpha reliability coefficient was calculated for items in part two of the questionnaires and Table 3.1 shows the result after the reliability was calculated.

Table 3.1: Cronbach alpha reliability coefficient for the Pre-test

S/No.	Category	Number of Items	Cronbach alpha value
1.	Research Question One	1-7	0.72
2.	Research Question Two	8-14	0.71
3.	Research Question Three	15-21	0.73
4.	Research Question Four	22-26	0.75

Source: Field data, 2016

It could be envisaged from Table 3.1 that, each set of items was reliable (Amin, 2005). This was because according to Amin (2005), a Cronbach alpha reliability

coefficient of 0.7 and above means the instrument is reliable. Cronbach's alpha reliability was selected because according to Amin (2005), it is a much more general form of internal consistency than the other forms of test reliability such as split half.

This pre-test conducted helped in ascertaining the reliability of the instrument. Also, any deficiencies in the pre-test such as inaccurate directions, insufficient space to write the responses, clustered questions and wrong phrasing of questions were detected. Similarly, unclear questions were identified and appropriateness of the anticipated analytical technique was ascertained. Above all, piloting the instrument helped to determine the reliability of the instruments.

3.7 Data collection procedures

The researcher sought permission with the school the authorities, Physics teachers and SHS 2 Physics students to ask for their cooperation to conduct this study. After the sampling, the researcher discussed with the participants the purpose of this study and also sought for their assistance in data collection.

The researcher used the first two minutes to discuss social and environmental issues in the school in an attempt to establish rapport with the participants. The researcher then explained the nature of the instrument to participants and how to respond to it. Data collection took place during break time; hence, did not affect instructional period. Forty-five (45) minutes was given to participants to respond to the questionnaires. To ensure a 100% return rate, the researcher collected the questionnaire on the same day after participants have finished responding to them; hence, 100% return rate was achieved. The researcher scanned through completed questionnaires to check if there were any items participants did not complete but none was found.

3.8 Method of data analysis

Data collected was analyzed using descriptive statistics such as simple frequencies and percentages. Also, Statistical Package for the Social Sciences version 21 was employed to aid in the interpretation of statistics. The analyzed quantitative data were presented on Tables in Chapter Four.

3.9 Ethical considerations

According to Cohen, Manion and Morrison (2000), if researchers intend to probe into the private aspects of individual lives, their intentions should be made clear and consent should be sought from those who are involved. For this reason, an official introductory letter was obtained from the Department of Science Education of the St. Rose's SHS, Akwatia to the headmaster and participants introducing the researcher and the purpose of the study.

Sikes, (2004) opines that research is an activity that affects people's lives; therefore, researchers should be ethical. In this sense, the researcher obtained verbal consent from all the participants before they participated in this study. Leary, (2001) further argues that obtaining informed consent indicates that the researcher respects participants' privacy and provides them with required information, which could help them decide whether to agree or decline to participate in the study. In agreement with this opinion, the researcher assured participants that their views would be absolutely anonymous and confidential. This was ensured by asking participants not to write their names on the questionnaires. Again, all references were acknowledged in this study to avoid plagiarism.

CHAPTER FOUR

DATA ANALYSIS AND DISCUSSION OF RESULTS

4.0 Overview

The purpose of this study was to investigate the perceptions of ICT on the teaching and learning of Kinematics graphs among SHS 2 science students of Saint Roses Senior High school, Akwatia-Eastern Region. This chapter discussed the data analysis and discussion of results.

4.1 Results of the research questions and discussion of findings

4.1.1 Research Question One

The first research question was: "What teaching methods are used by Physics teachers of St. Roses SHS, Akwatia?"

Items 1-7 on both the questionnaire for Physics students and teachers were used to answer this question. The results after the analysis were shown in Tables 1.

Table 4.1: Students' results on teaching methods used by their Physics teachers

Item No.	Items	Strongly Disagree		Disagree		Agree		Strongly Agree	
		f	%	F	%	f	%	f	%
1.	My physics teacher leads the discussion throughout the lesson	4	8	6	12	13	26	27	54
2.	My physics teacher does not involve us during teaching and learning	3	6	2	4	18	36	25	50
3.	I become inactive student during teaching and learning	1	2	2	4	10	20	37	74
4.	My contributions are regarded during teaching and learning	28	56	14	28	3	6	5	10
5.	I play a key role during teaching and learning	31	62	13	26	3	6	4	8
6.	I am engaged in practical activities during teaching and learning	16	32	23	46	4	8	7	14
7.	My physics teacher allows me to have direct experience with materials, tools and processes during teaching and learning	25	50	18	36	3	6	4	8

Source: Field data, 2016. Key: f=frequency, %= percent (Total number of student=50)

Result from Table 4.1 shows that, most of the students strongly agree that their Physics teacher does not involve them during teaching and learning (37, (74%)), followed by my Physics teacher leads the discussion throughout the lesson (27, (54%)), I become an inactive student during teaching and learning (25, (50%)), I am engaged in practical activities during the lesson (7, (14%)), my contributions are regarded during teaching and learning (5, (10%)), and my Physics teacher allows me to have direct experience with materials, tools and processes during teaching and learning (4 (8%)).

On the other hand, the results from Table 1 further shows that, most of the students strongly disagree to the statement that they play a key role during teaching and learning (31, (62%)), as compared to my contributions are regarded during teaching and learning (28, (56%)), my Physics teacher allows me to have direct experience with materials, tools and processes during teaching and learning (25, (50%)), I am engaged in practical activities during the lesson (16, (32%)), my Physics teacher leads the discussion throughout the lesson (4, (8%)), my Physics teacher does not involve us during teaching and learning (3, (6%)), and I become an inactive student during teaching and learning (1, (2%)). These results suggest that there was the likelihood that, Physics teachers do not actively involve the students during teaching and learning of Kinematic graphs.

Additionally, items 1-7 on the questionnaire for physics teachers were used to answer research question one and the results were shown in Table 2.

Table 4.2: Teachers' results on teaching methods used they use

Item No.	Items	Strongly Disagree		Disagree		Agree		Strongly Agree	
		f	%	f	%	f	%	f	%
1.	I lead the discussion throughout the lesson	2	50	2	50	0	0	0	0
2.	I do not involve the students during teaching and learning	3	75	1	25	0	0	0	0
3.	Students become inactive during teaching and learning	3	75	1	25	0	0	0	0
4.	Students' contributions are regarded during teaching and learning	0	0	0	0	1	25	3	75
5.	Students play a key role during teaching and learning	0	0	0	0	0	0	4	100
6.	Students are engaged in practical activities during teaching and learning	0	0	0	0	2	50	2	50
7.	Students are allowed to have direct experience with materials, tools and processes during teaching and learning	0	0	0	0	1	25	3	75

Source: Field data, 2016. Key: f=frequency, %= percent (Total number of teachers=4)

Results from Table 4.2 indicate that most of the teachers strongly agree to the statement that, students play a key role during teaching and learning (4, (100%),

followed by students are allowed to have direct experience with materials, tools and processes during teaching and learning and students' contributions are regarded during teaching and learning (3, (75%)), students are engaged in practical activities during teaching and learning (2, (50%)), and I lead the discussion throughout the lesson, I do not involve the students during teaching and learning, students become inactive during teaching and learning (0, (0%)).

But, the result further shows that, most of the Physics teachers strongly disagree with the statement that, I do not involve the students during teaching and learning and students become inactive during teaching and learning (3, (75%)), as compared to I lead the discussion throughout the lesson (2, (50%)), and students' contributions are regarded during teaching and learning, students play a key role during teaching and learning, students are engaged in practical activities during teaching and learning and students are allowed to have direct experience with materials, tools and processes during teaching and learning (0, (0%)). These results therefore suggest that, Physics teachers used child-centred approach in the teaching and learning process.

Results from the students depart from that of the teachers. Thus, results from the students suggest that, their Physics teachers do not use inquiry method or child centred approach in teaching and learning. But, results from the teachers imply that, they use child centred approach. Differences in the results could mean that, perhaps, physics teachers did not want to reveal their weaknesses in their teaching practices; hence, they gave that response. It was therefore concluded that, physics teachers at St. Roses SHS used more of the lecture method of teaching as compared to the inquiry method.

Findings of this study reach agreement with the findings of Chonjo, Osaki, Possi and Mrutu, (1996). Their study findings revealed that traditional teacher-centered lecture (chalk-and-talk) approach, which emphasizes the transfer of knowledge and skills and rewards memorization, is the predominant teaching format used in secondary schools in Tanzania. Their study findings further revealed that in using this approach, teachers talk most of the time, while students jot down notes mainly for the purpose of passing exams. This method does not allow much room for critical analysis of issues but it makes students to duplicate the notes given back to the teacher.

Also, findings of this study confirm the study findings of Osaki (2000) who found that, most teachers used transmission (chalk-and-talk) rather than interactive, learner-centered pedagogy. Likewise, findings of teacher-initiated and dominated teacher-student interaction and lecture method as major methods of teaching agree with the study findings of Ajaja, (2009) who made similar findings in different public schools in Delta State, Nigeria.

Furthermore, findings in this study show that pattern of interaction in most classrooms was teacher initiated and dominated teacher-student interaction. This finding is not in consonant with international standards which recommend that teachers should plan inquiry-based programs for their students and should also interact with students to focus and support their inquiries, recognize individual differences and provide opportunities for all students to learn (Bybee, Carlson-Powell & Trowbridge, 2008; Centre for Inspired Teaching, 2008; Bencze, Alsop & Bowen, 2009). Also, findings of this study fall short to the recommendation of teaching for effective learning (learning with understanding) where students take responsibility of their own learning through active construction and reconstruction of their own

meanings for concepts and phenomena (Brass, Gunstone & Fensham, 2003; Borich, 2007).

4.1.2 Research Question Two

The second research question was: "What role does ICT play in the teaching and learning of Kinematics graphs among SHS 2 science students of St. Roses SHS, Akwatia?"

Items 8-14 on both the questionnaire for physics students and teachers were used to answer this question. The results after the analysis were revealed in Tables 3 and 4.

Table 4.3: Students' results on role ICT play in teaching and learning of Kinematics graphs

Item No.	Items	Strongly Disagree		Disagree		Agree		Strongly Agree	
		f	%	f	%	f	%	f	%
8.	My interest in obtaining knowledge is increased through the use ICT in physics lessons	4	8	6	12	12	24	28	56
9.	There is no difference in my academic performance in Physics whether the Physics teacher uses ICT in teaching or not	3	6	2	4	18	36	25	50

10.	The use of ICT is highly effective in learning Kinematics graphs	1	2	2	4	11	22	36	72
11.	The use of ICT has helped me increase my understanding and application levels in learning Kinematics graphs	28	56	14	28	3	6	5	10
12.	I am able to memorize and retrieve information as a result of the use of ICT in learning Kinematics graphs	30	60	14	28	3	6	4	8
13.	The use of ICT offers me another way of interpreting data and developing concepts in learning Kinematics graphs	15	30	24	48	4	8	7	14
14.	The use of ICT helps me to solve arithmetic and algebraic problems during Kinematics graphs	25	50	18	36	3	6	4	8

Source: Field data, 2016. Key: f=frequency, %= percent (Total number of student=50)

Results from Table 4.3 show that, most of the students strongly agree that the use of ICT is highly effective in learning Kinematics graphs (36, (72%)), followed by my interest in obtaining knowledge is increased through the use ICT in Physics lessons (28, (56%)), there is no difference in my academic performance in Physics whether the Physics teacher uses ICT in teaching or not (25, (50%)), the use of ICT

offers me another way of interpreting data and developing concepts in learning Kinematics graphs (7, (14%)), the use of ICT has helped me increase my understanding and application levels in learning Kinematics graphs (5, (10%)) and I am able to memorize and retrieve information as a result of the use of ICT in learning Kinematics graphs and the use of ICT helps me to solve arithmetic and algebraic problems during Kinematics graphs (4, (8%)).

However, most of the students strongly disagree to the statement that, they were able to memorize and retrieve information as a result of the use of ICT in learning Kinematics graphs (30, (60%)), followed by the use of ICT has helped me increase my understanding and application levels in learning Kinematics graphs (28, (56%)), the use of ICT helps me to solve arithmetic and algebraic problems during Kinematics graphs (25, (50%)), the use of ICT offers me another way of interpreting data and developing concepts in learning Kinematics graphs (15, (30%)), my interest in obtaining knowledge is increased through the use ICT in physics (4, (8%)), and there is no difference in my academic performance in physics whether the physics teacher uses ICT in teaching or not and the use of ICT is highly effective in learning Kinematics graphs (3, (6)). This result suggest that the more physics teachers use ICT to teach Kinematic graphs, the more students would have a better understanding of this topic.

Moreover, items 8-14 on the questionnaire for teachers were used to answer research question two and the results after the analysis were presented in Table 4.

Table 4.4: Teachers' results on role ICT play in teaching and learning of Kinematics graphs

Item No.	Items	Strongly Disagree		Disagree		Agree		Strongly Agree	
		f	%	f	%	f	%	F	%
8.	Students' interest in obtaining knowledge is increased through the use ICT in physics lessons	2	50	2	50	0	0	0	0
9.	There is no difference in students' academic performance in physics whether I use ICT in teaching or not	4	100	0	0	0	0	0	0
10.	The use of ICT is highly effective in teaching Kinematics graphs	0	0	0	0	0	0	4	100
11.	The use of ICT has helped students increase their understanding and application levels in learning Kinematics graphs	0	0	0	0	1	25	3	75
12.	Students are able to memorize and retrieve information as a result of the use of ICT in	0	0	0	0	2	50	2	50

	learning Kinematics graphs								
13.	The use of ICT offers students another way of interpreting data and developing concepts in learning Kinematics graphs	0	0	0	0	2	50	2	50
14.	The use of ICT helps students to solve arithmetic and algebraic problems during Kinematics graphs	0	0	0	0	3	75	1	25

Source: Field data, 2016. Key: f=frequency, %= percent (Total number of teachers=4)

Results from Table 4.4 show that, most of the physics teachers strongly agree that the use of ICT is highly effective in teaching Kinematics graphs (4, (100%)), as compared to the use of ICT has helped students increase their understanding and application levels in learning Kinematics graphs (3, (75%)), students are able to memorize and retrieve information as a result of the use of ICT in learning Kinematics graphs and the use of ICT offers students another way of interpreting data and developing concepts in learning Kinematics graphs (2, (50%)), the use of ICT helps students to solve arithmetic and algebraic problems during Kinematics graphs (1, (25%)), students' interest in obtaining knowledge is increased through the use ICT in physics lessons and there is no difference in students' academic performance in physics whether I use ICT in teaching or not (0, (0%)). These results imply that the use of ICT in teaching Kinematics graphs helps physics students to improve upon their understanding of the topic. These results correspond with the results of the physics students. It was then concluded that, the use of ICT in teaching Kinematics

graphs' at St. Roses SHS, Akwatia enabled physics students to have a better understanding of the topic.

Findings of this study correspond with the findings of earlier studies. For example, in a study of 300 students (males and females), Al Essa, (1993) compared the use of ICT in teaching and learning, in science, to the use of traditional methods. The study sample was divided into two groups: the first group was experimental and consisted of 150 students who studied through the use of ICT, while the other was a control group consisting of 150 students who studied using traditional methods. The results indicated that statistically significant differences were shown in the immediate achievement using simulation strategy implemented by using ICT, with a greater impact for male students.

Again, findings of this study concur the findings of Scardamalia and Bereiter (2000) who investigated how to utilise ICT as a knowledge-supporting material in science lessons. The study involved 111 primary and secondary school students who were divided evenly into two groups according to their stages. The study was conducted in Seoul, South Korea. The effectiveness of using ICT as a knowledge-supporting material was evaluated. The experiment lasted three years, and the findings indicated that 76% of the students increased their interest in obtaining knowledge through using ICT. In addition, the primary school students showed dramatic improvements in terms of memorizing, retrieving information, and using computers, greater than the impact on their peers in high school.

More so, findings of this study harmonize the findings of Al Omar, (2001). Al Omar's, (2001) study in chemistry sought to identify the effect of ICT on direct and delayed achievement among the first-year secondary grade students, at scientific

branch, in chemistry. The study population consisted of all first-year secondary grade students enrolled in public schools located in First Irbid District in Jordan. The sample consisted of 114 students from two schools, one group for boys and the other for females. Two classes were selected by simple random method from each school. The researcher used computerized learning software that included unit 1 from chemistry textbook for first secondary grade, an achievement test, and pre-prepared notes related to the teaching of modern atomic theory and the periodic table.

The researcher found a statistically significant difference, at the significance level $\alpha \leq 0.05$, on the direct achievement in relation to the teaching method, in favor of the experimental group. Also there were statistically significant differences, at the significance level $\alpha \leq 0.05$, in relation to gender in favor of females. No significant differences were found, at the significance level $\alpha \leq 0.05$, in the direct achievement amongst students in relation to the interaction between teaching method and gender.

With respect to the delayed achievement, statistically significant differences were found in delayed achievement in relation to the teaching method in favor of the experimental group, while no significant differences were found in delayed achievement in relation to gender or the interaction between teaching method and gender.

But, findings of this study depart from the findings of Paddy, (2001). Thus, in a study related to chemistry, Paddy, (2001) indicated that there were no statistically significant differences in achievement among students who have learned through ICT and those who have learned through traditional methods. Furthermore, and unexpectedly, there were no statistically significant differences in achievement among students who studied through ICT and those who studied through traditional methods

regarding retaining information. Differences in the findings could be that, while Paddy's study was in Chemistry, the current study was in Physics.

Also, findings of this study do not run parallel with the findings of Al Hudhaifi and Al Doghaim, (2005). Their study findings revealed that there was no difference between the achievements of students studying through ICT and those not, according to the scientific thinking scale for the second secondary grade students in chemistry. Additionally, there were no statistically significant differences between an experimental and control group scores in the hypothesis testing skill and interpretation skill. There were, however, statistically significant differences in generalization skill according to scientific thinking.

4.1.3 Research Question Three

The third research question was: "What factors prevent physics teachers in using ICT to teach Kinematics graphs to SHS 2 science students of St. Roses SHS, Akwatia?"

Items 15-21 on both the questionnaire for physics students and teachers were used to answer this question. The results after the analysis were revealed in Tables 4.5 and 4.6.

Table 4. 5: Students' results on factors that prevent physics teachers in using ICT to teach Kinematics graphs

Item No.	Items	Strongly Disagree		Disagree		Agree		Strongly Agree	
		f	%	f	%	f	%	f	%
15.	My physics teacher is well advanced in age; therefore, do not use ICT in teaching Kinematics graphs	28	56	6	12	12	24	4	8
16.	My physics teacher has less knowledge in the use of ICT and this makes him/her feel anxious about using ICT to teach Kinematics graphs	3	6	2	4	14	28	29	58
17.	Lack of technological knowhow prevent my physics teacher from using ICT in teaching Kinematics graphs	7	14	2	4	11	22	30	60
18.	I perceive my physics teacher has negative attitude towards the use of ICT; hence, do not want to use ICT in teaching Kinematics graphs	5	10	14	28	3	6	28	56
19.	Lack of time available for	30	60	10	20	3	6	8	16

	classes, and in teachers' own schedules for planning is a major factor influencing the use of ICT in teaching Kinematics graphs								
20.	Inadequate computers and related hardware, lack of appropriate software and slow internet are some of the reasons why physics teachers don't use ICT in teaching Kinematics graphs	15	30	4	8	4	8	27	54
21.	Good technical support in the classroom and the whole school helps physics teachers to use ICT in teaching Kinematics graphs	36	72	8	16	1	2	5	10

Source: Field data, 2016. Key: f=frequency, %= percent (Total number of student=50)

Results from Table 4.5 show that, majority of the physics teachers strongly agree that lack of technological knowhow prevent my physics teacher from using ICT in teaching Kinematics graphs (30, (60%)), followed by my physics teacher has less knowledge in the use of ICT and this makes him/her feel anxious about using ICT to teach Kinematics graphs (29, (58%)), I perceive my physics teacher has negative attitude towards the use of ICT; hence, do not want to use ICT in teaching Kinematics graphs (28, (56%)), inadequate computers and related hardware, lack of appropriate

software and slow internet are some of the reasons why Physics teachers don't use ICT in teaching Kinematics graphs (27, (54%)), lack of time available for classes, and in teachers' own schedules for planning is a major factor influencing the use of ICT in teaching Kinematics graphs (8, (16%)), good technical support in the classroom and the whole school helps physics teachers to use ICT in teaching Kinematics graphs (5, (10%)), and my physics teacher is well advanced in age; therefore, do not use ICT in teaching Kinematics graphs (4, (8%)).

On the contrary, most of the students strongly disagree to the statement that, good technical support in the classroom and the whole school helps physics teachers to use ICT in teaching Kinematics graphs (36, (72%)), followed by lack of time available for classes, and in teachers' own schedules for planning is a major factor influencing the use of ICT in teaching Kinematics graphs (30, (60%)), my physics teacher is well advanced in age; therefore, do not use ICT in teaching Kinematics graphs (28, (56%)), inadequate computers and related hardware, lack of appropriate software and slow internet are some of the reasons why physics teachers don't use ICT in teaching Kinematics graphs (15, (30%)), lack of technological knowhow prevent my physics teacher from using ICT in teaching Kinematics graphs (7, (14%)), I perceive my physics teacher has negative attitude towards the use of ICT; hence, do not want to use ICT in teaching Kinematics graphs (5, 10%)), and my physics teacher has less knowledge in the use of ICT and this makes him/her feel anxious about using ICT to teach Kinematics graphs (3, (6%)). These results suggest that, though St. Roses SHS has ICT laboratory, it was likely that physics teachers in the school do not use them as a result of their inability to operate them.

Table 4.6: Teachers' results on factors that prevent Physics teachers in using ICT to teach Kinematics graphs

Item No.	Items	Strongly Disagree		Disagree		Agree		Strongly Agree	
		f	%	F	%	f	%	F	%
15.	I am well advanced in age; therefore, do not use ICT in teaching Kinematics graphs	2	50	2	50	0	0	0	0
16.	I have less knowledge in the use of ICT and this makes me feel anxious about using ICT to teach Kinematics graphs	4	100	0	0	0	0	0	0
17.	Lack of technological knowhow prevent me from using ICT in teaching Kinematics graphs	0	0	0	0	0	0	4	100
18.	I have negative attitude towards the use of ICT; hence, do not want to use ICT in teaching Kinematics graphs	0	0	0	0	1	25	3	75
19.	Lack of time available for classes, and in my own schedules for planning is a major factor influencing me in the use of ICT in teaching	0	0	0	0	2	50	2	50

	Kinematics graphs								
20.	Inadequate computers and related hardware, lack of appropriate software and slow internet are some of the reasons why I don't use ICT in teaching Kinematics graphs	1	25	1	25	1	25	1	25
21.	Good technical support in the classroom and the whole school helps me to use ICT in teaching Kinematics graphs	0	0	0	0	3	75	1	25

Source: Field data, 2016. Key: f=frequency, %= percent (Total number of teachers=4)

Results from Table6 indicate that, most of the teachers strongly agree to the statement that, lack of technological knowhow prevent them from using ICT in teaching Kinematics graphs (4, (100%)), followed by I have negative attitude towards the use of ICT; hence, do not want to use ICT in teaching Kinematics graphs (3, 75%)), lack of time available for classes, and in my own schedules for planning is a major factor influencing me in the use of ICT in teaching Kinematics graphs (2, (50%)), and inadequate computers and related hardware, lack of appropriate software and slow internet are some of the reasons why I don't use ICT in teaching Kinematics graphs and good technical support in the classroom and the whole school helps me to use ICT in teaching Kinematics graphs (1, (25%)).

On the other hand, majority of the students strongly disagree to the statement that, they have less knowledge in the use of ICT and this makes me feel anxious about

using ICT to teach Kinematics graphs (4, (100%)), as compared to I am well advanced in age; therefore, do not use ICT in teaching Kinematics graphs (2, (50%)), inadequate computers and related hardware, lack of appropriate software and slow internet are some of the reasons why I don't use ICT in teaching Kinematics graphs (1, (25%)), lack of technological knowhow prevent me from using ICT in teaching Kinematics graphs (0, (0%)), I have negative attitude towards the use of ICT; hence, do not want to use ICT in teaching Kinematics graphs (0, (0%)), lack of time available for classes, and in my own schedules for planning is a major factor influencing me in the use of ICT in teaching Kinematics graphs (0, (0%)), and good technical support in the classroom and the whole school helps me to use ICT in teaching Kinematics graphs (0, (0%)). These results suggest that, lack of knowledge on the part of the physics teachers obstruct them from using ICT in teaching and learning of Kinematics graphs. It was concluded based on these results that, physics teachers' lack of knowledge in the use of ICT prevents them from using it to teach Kinematics graphs.

Findings of this study were in agreement to the findings of earlier studies. For instance, Balanskat, Blamire and Kefala's (2006) study findings revealed that limitations in teacher's ICT knowledge makes them feel anxious about using ICT in the classroom and thus not confident in using it in their teaching. Findings of this study were in line with findings of a study by Becta (2004) who found that many teachers who do not consider themselves to be well skilled in using ICT feel anxious about using it in front of a class of children who perhaps know more than they do. Furthermore, research studies in Australia found that teachers who lacked knowledge and skills to use computers were not enthusiastic about integrating ICT in teaching and learning (Newhouse, 2002). Research done in developing countries further

revealed that lack of technological know how is the main obstacle to acceptance and adoption of new technology by teachers in classroom instruction (Pelgrum, 2001). Additionally, a study conducted in Bungoma by Wanjala, Khaemba and Mukwa, (2011), confirmed that indeed to adopt any educational technology effectively, teachers must feel confident in its operation and their own ability to use ICT it in classroom instruction.

4.1.4 Research Question Four

The fourth research question was: "What is the attitude of Physics teachers towards the use of ICT in teaching and learning of Kinematics graphs at St. Roses SHS, Akwatia?"

Items 22-26 on both the questionnaire for Physics students and teachers were used to answer this question. The results after the analysis were revealed in Tables 4.7 and 4.8.

Table 4.7: Students' results on attitude of physics teachers towards the use of ICT

Item No.	Items	Strongly Disagree		Disagree		Agree		Strongly Agree	
		F	%	F	%	f	%	f	%
22.	Most computer games are characterised by violence and this attract males than females	20	40	6	12	12	24	12	24
23.	Computers are connected with mathematics and sciences, which are domains dominated by males than females	3	6	2	4	14	28	29	58
24.	Family background sometimes compels females teachers not to use computers as compared to males	0	0	1	2	9	18	40	80
25.	The fear of damaging a computer sometimes makes teachers have negative attitude towards the use of ICT	5	10	14	28	3	6	28	56
26.	My physics teacher uses ICT in teaching because he/she is an expert in using computer	40	80	5	10	3	6	2	4

Source: Field data, 2016. Key: f=frequency, %= percent (Total number of student=50)

Results from Table 4.7 show that, most of the students strongly agree to the statement that, family background sometimes compels females teachers not to use computers as compared to males (40, (80%)), followed by computers are connected with mathematics and sciences, which are domains dominated by males than females (29, (58%)), the fear of damaging a computer sometimes makes teachers have negative attitude towards the use of ICT (28, (56%)), most computer games are characterised by violence and this attract males than females (12, (24%)), and my physics teacher uses ICT in teaching because he/she is an expert in using computer (2, (4%)).

However, most of the students strongly disagree to the statement that, their physics teacher uses ICT in teaching because he/she is an expert in using computer (40, (80%)), followed by most computer games are characterised by violence and this attract males than females (20, (40%)), the fear of damaging a computer sometimes makes teachers have negative attitude towards the use of ICT (5, (10%)) and computers are connected with mathematics and sciences, which are domains dominated by males than females (3, (6%)). These results suggest that the kind of training given to physics teachers could have negative impact on their use of ICT in teaching and learning of Kinematic graphs.

Similarly, items 22-26 on the questionnaire for Physics teachers were used to answer research question four and the results were presented in Table 4.8.

Table 4.8: Teachers' results on attitude of physics teachers towards the use of ICT

Item No.	Items	Strongly Disagree		Disagree		Agree		Strongly Agree	
		F	%	f	%	f	%	f	%
22.	Most computer games are characterised by violence and this attract males than females	2	50	0	0	0	0	2	50
24.	Computers are connected with mathematics and sciences, which are domains dominated by males than females	3	75	1	25	0	0	0	0
25.	Family background sometimes compels females teachers not to use computers as compared to males	3	75	0	0	0	0	1	25
26.	The fear of damaging a computer sometimes makes me to have negative attitude towards the use of ICT	4	100	0	0	0	0	0	0
27.	I use ICT in teaching because I am an expert in using computer	0	0	0	0	0	0	4	100

Source: Field data, 2016. Key: f=frequency, %= percent (Total number of teachers=4)

Results from Table 4.8 show that, most of the physics teachers strongly agree to the statement that, they use ICT in teaching because they were experts in using computer (4, (100%)), followed by most computer games are characterised by violence and this attract males than females (2, (50%)), family background sometimes compels females teachers not to use computers as compared to males (1, (25%)), computers are connected with mathematics and sciences, which are domains dominated by males than females (0, (0%)), and the fear of damaging a computer sometimes makes me to have negative attitude towards the use of ICT (0, (0%)).

On the contrary, most of the physics teachers strongly disagree that the fear of damaging a computer sometimes makes them to have negative attitude towards the use of ICT (4, (100%)), as compared to computers are connected with mathematics and sciences, which are domains dominated by males than females (3, (75%)), family background sometimes compels females teachers not to use computers as compared to males (3, (75%)), Most computer games are characterised by violence and this attract males than females (2, (25%)), and I use ICT in teaching because I am an expert in using computer (0, (0%)). These results suggest that, physics teachers in St. Roses SHS have adequate knowledge in the use of ICT; hence, they use it in the teaching and learning of Kinematic graphs. But, there results depart from the resulted from the students. The differences in the results could mean that there were other possible causes that negatively affected the attitude of physics teachers in their use of ICT which were hidden from the observations of the students. It was concluded based on these results that, physics teachers of St. Roses had positive attitude towards the use of ICT in teaching and learning of Kinematic graphs.

These findings do not depart from the findings of earlier studies. For example, the study of Al Khateeb, (2000) was conducted to identify the attitudes of teachers in

Irbid Governorate, in Jordan, towards instructional technology in relation to some independent variables such as gender, specialisation and years of experience. The study sample consisted of 139 teachers (male and female) in public schools located in Irbid Governorate. The researcher used a questionnaire comprising 40 items, allocated equally into positive and negative attitudes, during the academic year 1998/1999. The results indicated the presence of positive attitudes among teachers within the study population regarding instructional technology. The results also showed that there are significant differences between teachers' trends toward instructional technology and the scientific qualification, in favour of those who are holding an undergraduate degree (BA) over those holding a College diploma (two years of study). Furthermore, the results indicated that there are no significant differences regarding the attitudes of teachers towards instructional technology between gender, specialization and experience.

More so, Ng and Gunstone's (2003) study sought to identify the attitudes of science teachers within public secondary schools in Victoria State, Australia. Their investigation examined science teachers' attitudes towards the use of ICT in learning. In order to answer this question, the views and observations of science teachers regarding their teaching science in public schools in Victoria were collected. Within this study, the obstacles that restricted the implementation of these technologies in the classrooms were addressed and discussed. The results showed that a majority of the teachers participating were interested in using ICT in the teaching and learning process. The findings further showed that teachers had positive attitude towards the use on ICT in teaching and learning.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

The purpose of this study was to investigate the effects of ICT on the teaching and learning of Kinematics graphs among SHS 2 science students of Saint Roses Senior High School, Akwatia-Eastern Region. This chapter concentrated on the summary, conclusions and recommendations.

5.1 Summary

The purpose of this study was to investigate the effects of ICT on the teaching and learning of Kinematics graphs among SHS 2 science students of Saint Roses Senior High School, Akwatia-Eastern Region. Four research questions were formulated to guide the study. Literature relevant to this study was reviewed. A descriptive survey design using quantitative approach was employed in this study. A combination of purposive and simple random sampling techniques was used to fifty-four (54) participants. They comprised: 50 SHS 2 physics students and 4 physics teachers. Structured questionnaire was the instrument used to collect data in this study. Descriptive statistics tools (frequency and per cent) were used to analyze the data gathered and the findings were that;

- Physics teachers at St. Roses SHS used more of the lecture method of teaching as compared to the inquiry method.
- The use of ICT in teaching Kinematics graphs' at St. Roses SHS, Akwatia enabled Physics students to have a better understanding of the topic.
- Physics teachers' lack of knowledge in the use of ICT prevented them from using it to teach Kinematics graphs.

- Physics teachers of St. Roses had positive attitude towards the use of ICT in teaching and learning of Kinematic graphs.

5.2 Conclusions

Based on these findings, the following conclusions were made;

To commence with, teaching and learning of Kinematics graph by Physics teachers at St. Roses Senior High School was based mostly on the chalk-and-talk method of teaching. This means that, less chance was given to students in the teaching and learning process. This may cause them to forget concepts thought within the shortest possible time.

Also, the use of ICT in teaching Kinematics graphs enabled students to have a better understanding of the topic. Thus, students had the opportunity to manipulate the teaching and learning materials and were placed at the centre of the teaching and learning processes. Through this approach, students were likely to retain the knowledge gained for long.

Furthermore, most of the Physics teachers in St. Roses SHS, Akwatia lacked knowledge in the use of ICT and this prevented them from using it to teach Kinematics graphs. Thus, though Physics teachers in the school had access to the ICT laboratory, as a result of their lack of knowledge in the use of computer, most of them could not utilize this great opportunity.

More so, Physics teachers of St. Roses had positive attitude towards the use of ICT in teaching and learning of Kinematic graphs. Though most of them lacked the knowledge in the use of computers, they were also willing to learn and use ICT to improve their teaching and learning practices.

5.3 Recommendations

Based on these findings, the following recommendations were made;

Firstly, in-service training should be organized for physics teachers at St. Roses Senior High School. At this programme, they could be educated and encouraged to use more of the inquiry method as compared to the lecture method. This could help them improve upon their teaching practices which would have positive effects on their students.

Secondly, management of the school should ensure that the ICT laboratory is well equipped in order to encourage physics teachers to use it more in teaching and learning in St. Roses SHS. This could encourage other teachers in the school to do same

Thirdly, Physics teachers of St. Roses should be encouraged to maintain their positive attitude towards the use of ICT in teaching and learning. This could be achieved through guidance programmes organized in the school for them.

5.4 Suggestions for future studies

Future researchers could research into the following areas if deemed necessary;

1. The impact of ICT course at the university on the teaching and learning of science teachers at the SHS.
2. The role of socio-cultural background of science teachers on their use of ICT in the teaching and learning at the SHS.
3. Factors militating against the effective use of ICT by science teachers at the Senior High Schools in Ghana.

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APPENDICES

APPENDIX 'A'

QUESTIONNAIRE FOR PHYSICS STUDENTS

Dear Student,

This is an anonymous questionnaire. Do not write your name, or any other comments that could identify you so easily on this questionnaire. By completing this questionnaire you are consenting to take part in this research. Please, read the information below which explains the purpose of the research.

This questionnaire seeks your opinions and concerns about the effects of ICT on the teaching and learning of Kinematics graphs among SHS 2 science students of Akwatia. Please, feel free to respond to all the items on this questionnaire since there is no right or wrong answer. Please, information from this questionnaire will be used to improve the teaching and learning of physics in SHS in Ghana. The information gathered would be summarized for research reports and no person or school will be identified in the report.

Thank you for your participation in this study

Please, respond to all the items on this page by putting a **tick (√)** in the appropriate space provided using the following scale: 1=Strongly Disagree, 2= Disagree, 3= Agree and 4= Strongly agree.

S/No	Items	Strongly Disagree	Disagree	Agree	Strongly Agree
1.	My physics teacher leads the discussion throughout the lesson				
2.	My physics teacher does not involve us during teaching and learning				
3.	I become inactive student during teaching and learning				
4.	My contributions are regarded during teaching and learning				
5.	I play a key role during teaching and learning				
6.	I am engaged in practical activities during teaching and learning				
7.	My physics teacher allows me to have direct experience with materials, tools and processes during teaching and learning				
8.	My interest in obtaining knowledge is increased through				

	the use ICT in physics lessons				
9.	There is no difference in my academic performance in physics whether the physics teacher uses ICT in teaching or not				
10.	The use of ICT is highly effective in learning Kinematics graphs				
11.	The use of ICT has helped me increase my understanding and application levels in learning Kinematics graphs				
12.	I am able to memorize and retrieve information as a result of the use of ICT in learning Kinematics graphs				
13.	The use of ICT offers me another way of interpreting data and developing concepts in learning Kinematics graphs				
14.	The use of ICT helps me to solve arithmetic and algebraic problems during Kinematics graphs				
15.	My physics teacher is well advanced in age; therefore, do not use ICT in teaching Kinematics				

	graphs				
16.	My physics teacher has less knowledge in the use of ICT and this makes him/her feel anxious about using ICT to teach Kinematics graphs				
17.	Lack of technological knowhow prevent my physics teacher from using ICT in teaching Kinematics graphs				
18.	I perceive my physics teacher has negative attitude towards the use of ICT; hence, do not want to use ICT in teaching Kinematics graphs				
19.	Lack of time available for classes, and in teachers' own schedules for planning is a major factor influencing the use of ICT in teaching Kinematics graphs				
20.	Inadequate computers and related hardware, lack of appropriate software and slow internet are some of the reasons why physics teachers don't use ICT in teaching				

	Kinematics graphs				
21.	Good technical support in the classroom and the whole school helps physics teachers to use ICT in teaching Kinematics graphs				
22.	Most computer games are characterised by violence and this attract males than females				
23.	Computers are connected with mathematics and sciences, which are domains dominated by males than females				
24.	Family background sometimes compels females teachers not to use computers as compared to males				
25.	The fear of damaging a computer sometimes makes teachers have negative attitude towards the use of ICT				
26.	My physics teacher uses ICT in teaching because he/she is an expert in using computer				

THANK YOU

APPENDIX 'B'

QUESTIONNAIRE FOR PHYSICS TEACHERS

Dear Teacher,

This is an anonymous questionnaire. Do not write your name, or any other comments that could identify you so easily on this questionnaire. By completing this questionnaire you are consenting to take part in this research. Please, read the information below which explains the purpose of the research.

This questionnaire seeks your opinions and concerns about the effects of ICT on the teaching and learning of Kinematics graphs among SHS 2 science students of Akwastia. Please, feel free to respond to all the items on this questionnaire since there is no right or wrong answer. Please, information from this questionnaire will be used to improve the teaching and learning of physics in SHS in Ghana. The information gathered would be summarized for research reports and no person or school will be identified in the report.

Thank you for your participation in this study

Please, respond to all the items on this page by putting a **tick (√)** in the appropriate space provided using the following scale: 1=Strongly Disagree, 2= Disagree, 3= Agree and 4= Strongly agree.

S/No	Items	Strongly Disagree	Disagree	Agree	Strongly Agree
1.	I lead discussions throughout the lesson				
2.	I hardly involve students during teaching and learning				
3.	I make students inactive during teaching and learning				
4.	I regard student's contributions during teaching and learning				
5.	Students play a key role during teaching and learning				
6.	I engage students in activities during the lesson				
7.	I allow students to have direct experience with materials, tools and processes during teaching and learning				
8.	Students' interest in obtaining knowledge is increased through the use ICT in physics lessons				
9.	There is no difference in students'				

	academic performance in physics whether I use ICT in teaching or not				
10.	The use of ICT is highly effective in teaching Kinematics graphs				
11.	The use of ICT has helped students increase their understanding and application levels in learning Kinematics graphs				
12.	Students are able to memorize and retrieve information as a result of the use of ICT in learning Kinematics graphs				
13.	The use of ICT offers students another way of interpreting data and developing concepts in learning Kinematics graphs				
14.	The use of ICT helps students to solve arithmetic and algebraic problems during Kinematics graphs				
15.	I am well advanced in age; therefore, do not use ICT in teaching Kinematics graphs				

16.	I have less knowledge in the use of ICT and this makes me feel anxious about using ICT to teach Kinematics graphs				
17.	Lack of technological knowhow prevent me from using ICT in teaching Kinematics graphs				
18.	I have negative attitude towards the use of ICT; hence, do not want to use ICT in teaching Kinematics graphs				
19.	Lack of time available for classes, and in my own schedules for planning is a major factor influencing me in the use of ICT in teaching Kinematics graphs				
20.	Inadequate computers and related hardware, lack of appropriate software and slow internet are some of the reasons why I don't use ICT in teaching Kinematics graphs				
21.	Good technical support in the classroom and the whole school helps me to use ICT in teaching				

	Kinematics graphs				
22.	Most computer games are characterised by violence and this attract males than females				
23.	Computers are connected with mathematics and sciences, which are domains dominated by males than females				
24.	Family background sometimes compels females teachers not to use computers as compared to males				
25.	The fear of damaging a computer sometimes makes me to have negative attitude towards the use of ICT				
26.	I use ICT in teaching because I am an expert in using computer				

THANK YOU