UNIVERSITY OF EDUCATION, WINNEBA

EFFECT OF USE OF COMPUTER ANIMATIONS ON STUDENTS' PERFORMANCE IN SELECTED CONCEPTS IN PHYSICS

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DECLARATION

STUDENT'S DECLARATION

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

NAME OF CANDIDATE: KOFI AGYEMANG

SIGNATURE: …………………......

SUPERVISOR'S DECLARATION

I hereby declare that the preparation and presentation of this work was supervised in accordance with the guidelines for supervision of Thesis as laid down by the University of Education, Winneba.

NAME OF SUPERVISOR: PROF. VICTOR ANTWI

SIGNATURE ………………………..

DATE ………………………

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DEDICATION

This work is dedicated to Miss Miriam Anum. I really appreciate your support, encouragement and advice in the course of my study.

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ABSTRACT

The study examined the effect of computer animations on students' performance and conceptual understanding on Kinematics in one dimension and Projectile Motion in Uncle Rich SHS in the Central Region of Ghana. The research design employed in this study was the quasi – experimental using pretest and posttest equivalent control group design. Samples of ninety-three (93) SHS 2 students from two intact classes were used with Uncle Rich SHS 2 (Winneba) being the experimental group and Unique Academy SHS (Swedru) being the control group. An instrument known as Mechanics Conceptual Based Test (MCBT) was used to gather data for the study. Percentage, Frequency count, Mean, standard deviation, and mean gain were used to answer research questions, while independent sample t–test was used to test the hypotheses. The result shows that students taught using computer animations in an interactive learning setting performed better on the MCBT than those taught using the traditional lecture method. There was a remarkable improvement in the conceptual understanding of those exposed to the computer animation instructional approach than those exposed to the traditional method. This reflected in the performance of the experimental group. The treatment further improved the interest of students towards the teaching and learning of Kinematics in one dimension and Projectile motion. It is therefore recommended that computer animation instructional tool be incorporated in teaching and learning of Physics in Ghanaian S.H.S classroom.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter entails the background to the study, statement of the problem, purpose of the study, objectives of the study, research questions, null hypothesis, significance of the study, delimitation of the study, limitations of the study, definition of terms and organization of chapters.

1.1 Background to the study

Physics has been and will continue to be of tremendous importance to humanity for its ability to explain natural phenomena and everyday occurrences as well as its central role in the world's current technological development (Ikwa, 2000). Physics is viewed as the soul of science which plays a vital role in all human endeavours and serves as a pre-requisite subject for courses such as Medicine, Geology, Computer Engineering, Forestry, Space Navigation, Agricultural Science, Pharmacy, among others (Danjuma, 2008). Physics accords its respect from people for the fact that it contributes to the knowledge, growth and development of individuals in particular and the society in general (Atadoga, 2011). It is therefore more relevant for researchers of Physics education to find a better approach in improving the discipline as it has become the soul of the world we live in today. To achieve this goal, implementers of the Physics curriculum at all levels of our science educational institutions have to take a critical look at the learning and teaching materials used in delivery of Physics lessons and methods adopted by teachers in teaching of the subject (Physics). Also, the content knowledge of the learners of Physics, perception of learners towards the subject, attitudes of students towards Physics should all be investigated so as to improve the tremendous benefit of the subject to the learners of Physics and society (Ezeliora, 2005).

Teachers' use of a particular instructional method is influenced by their goals expected to be achieved regarding the course taught. In addition to this, the students, who are the audience, need to be taken into consideration since there exist individual differences. Teachers' ability to use the best instructive approach to teach students irrespective of their population, results in great academic achievements (Boumová, 2008).

Physics, like other disciplines, should have the ability to develop the creative thinking and critical analytical skills of students (Hussain, Azeem, & Shakoor, 2011). It should therefore not be out of the ordinary if Physics students have the proficiencies to solve problems both in the classroom and laboratory as well as practical ones related to industry, household and real life. The inadequate laboratories and other teaching and learning materials have resulted in the overemphasis on theory using the traditional lecture approach which limits students' understanding and academic achievement (Antwi, 2013).

Traditional lecture method of teaching is teacher centred which makes students passive listeners only, thus at the receiving end (Hake, 1998). Students gather facts and hold perceptions about phenomena in Physics. Krišťák, Němec and Danihelová (2014) assert that some of these perceptions students hold may be wrong and it is difficult to change as they progress in the educational system by the use of the traditional lecture method. Also, they attribute the acquisition of basic knowledge without deeper understanding of concepts for problem solving and exhibition of low conceptual understanding of Physics to the use of traditional lecture method. The dissatisfaction associated with the use of traditional method of instruction by Physics researchers has given way to the search into the use of other alternatives of teaching methods that would produce better results.

Antwi's (2013) research on Mechanics teaching at the Department of Physics Education, University of Education, Winneba (UEW) revealed that the dominant mode of instruction at UEW was the traditional lecture method. According to him, lecturers start their Physics (Mechanics) teaching by lecturing on general principles. They then use the principles to derive mathematical models, show illustrative applications of the models and give students some practice question(s) in similar derivations and finally test their ability to do the same during examination. Qualitative problems are mostly based on "define, state and list", which does not call for better understanding of concepts. Discussions, demonstrations, experiments and practical work, where students can interact among themselves, teachers and teaching assistants, to confirm and validate principles and results presented during lectures, and solidify, their understanding of fundamental Physics principles are rarely done in UEW. Usually due to a lack of equipment, an overload of course work and limited time at students' disposal, students in courses like Physics typically end up with limited conceptual understanding (Hestenes, Wells & Swackhamer, 1992), and a limited ability to transfer what they have learnt to new settings (Anyaehie, Nwobodo, & Njoku, 2007).

This practice is not different from what is deployed in the senior high school system in Ghana. Majority of the Physics teachers in Ghana resort to the traditional lecture method in teaching the course (Buabeng & Ntow, 2010).The abstract nature of the course poses danger to the interest of learners. Research has shown the immense contribution of animations to improving the understanding of Physics subject. With the numerous animation prepared by Physics Education Technology (PheT), teaching Mechanics would be more interesting. The researcher in respect of this aims to find out how the use of animations will affect the conceptual understanding of students and their achievement in kinematics in one dimension and projectile motion.

1.2 Statement of the Problem

In a research study conducted it was found that instructors of Physics presentation of the subject makes it difficult for its learners (Freedman, 1996; Antwi, 2013). Most of these instructors rely mostly on the traditional lecture approach in delivering the subject. In Ghana, the Chief Examiners for Physics in West African Examination Council (2008; 2010; 2012) has been reiterating that Physics instructors in the Senior High Schools (SHS) should use other approach of teaching the subject than the constant use of the traditional lecture approach. He recommended that instructional approaches that would make the students contribute more in the teaching and learning process in classroom should be used. Teachers should make teaching and learning more student-centred.

Despite the challenge of instructors in Physics using the traditional lecture method in class, Ghana Education Service over the years has been assisting in providing numerous instructional materials to be used in the teaching and learning of Physics to make students more active in class. However, the use of the traditional lecture method is still being used by majority of Physics instructors at the SHS due to the fact some instructors of the course were not exposed to other instructional approaches in teaching and learning of Physics (Boud & Feletti, 1999). Other approaches have been used in Ghanaian schools like interactive approach (Antwi, 2013), demonstrational approach (Chiappetta & Koballa, 2002), the use of instructional materials approach (Buseri & Dorgu, 2011) and discussion method (Damodharan & Rengarajan, 1999), yet there has not been a substantive increase by the majority of Physics instructors to defy the use of the traditional lecture approach; perhaps due to the strenuous effort that one has to put himself or herself through to become successful with the use of the alternative approaches in teaching. Buabeng and Ntow (2010) revealed in their study that the poor way Physics teachers relay content knowledge to learners seriously affect their interest and achievement in Physics.

One method that is quite inspiring in terms of helping SHS students in Ghana to hurdle over abstract concepts in Physics is the use of animations in the teaching and learning of Physics. It has proven well for some Physics teachers in the teaching of concepts in Physics (Onasanya, Daramola, & Asuquo, 2006). In Ghana, the use animations in the teaching of Physics concepts has not been extensively done at the SHS level to get its impact on students' conceptual understanding and interest.

It is due to this issue that renders this research pertinent, to determine the effect of computer animations on students' performance and conceptual understanding, and their interest in kinematics in one dimension and projectile motion.

1.3 Purpose of the study

The main purpose of the study was to investigate the effect of use of computer animations on Senior High School students' Performance in selected concepts in Physics.

1.4 Objectives of the study

The objectives of the study was to:

1. Investigate the use of computer animations on students' Performance in Kinematics in one dimension and Projectile motion.
2. Examine the use of computer animations on the conceptual understanding of students in Kinematics in one dimension and Projectile Motion.
3. Assess the use of computer animations on students' interest in teaching and learning of Kinematics in one dimension and Projectile Motion.

1.5 Research Questions

The study was guided by the following research questions:

1. What is the effect of the use of computer animations on students' performance on Kinematics in one dimension and Projectile Motion?
2. What is the effect of computer animations on students' conceptual understanding on Kinematics in one dimension and Projectile Motion?
3. What is the effect of computer animations on students' interest in teaching and learning of Kinematics in one dimension and Projectile Motion?

1.6 Null Hypothesis

The following research hypotheses guided the study:

H_{01}: There is no statistically significant difference in performance of students when exposed to the use of computer animations in their instruction and their counterparts exposed to the traditional lecture method in the teaching of Kinematics in one dimension and Projectile Motion.

H_{02}: There is no statistically significant difference in conceptual understanding of students exposed to computer animations' instructional approach and their counterparts exposed to the traditional lecture method in the teaching of Kinematics in one dimension and Projectile Motion.

1.7 Significance of the study

It is envisaged that when the findings of the research are made accessible, teachers, learners and curriculum developers would be the beneficiaries in that, the study would expose teachers to the benefit of using computer animations approach in teaching Kinematics in one dimension and Projectile Motion.

Moreover, this would help teachers improve on how to use the instructional approach in teaching and learning of Physics in Ghanaian educational system. Thus, it would help to improve teachers' effectiveness and confidence in the classroom during lessons, hence improving students' academic achievement and understanding. The students' learning rates and retention would also be enhanced.

Also, they would have better conceptual understanding in Kinematics in one dimension and Projectile Motion which would also improve their academic competence and their ability to succeed in school to achieve self-actualization.

More so, the findings of the research would bring to bear the relevance of the instructional approach to teaching and learning of Kinematics in one dimension and Projectile Motion, hence it would inform developers of the curriculum on including computer animations in the preparation of teaching and learning materials in the Senior High Schools. There are thousands of computer animations on the internet which could be put on a CD for effective teaching and learning in our Physics classrooms in Ghana. Furthermore, the findings of the research would enable administrators of SHS on how to provide in–service training for teachers on the best ways to integrate animations in the teaching and learning process of Physics. Fellow researchers would benefit from the research findings of the study. Thus, it would add to existing literature on the use of computer animations in the teaching and learning of Kinematics in one dimension and Projectile Motion and other researchers interested in these topics could refer to it.

1.8 Delimitations to the study

The study was restricted to Form two Science students because the selected concepts under consideration in this study is in the Senior High School Physics syllabus. The topics also under consideration are just topics under mechanics, an aspect of the entire topics at the Senior High level.

1.9 Limitations to the study

The main limitation of this study was that, there were possibilities of the students in the two groups interacting with each other outside the classroom which could affect the study. Other limitations of the study was absenteeism on the path of the students. Some research participants were sometimes absent from school due to truancy. Others were also driven from class for not being able to settle their school fees. All of these hindrances were beyond the reach of the researcher.

1.9.0 Definition of terms

Computer animations: Moving images via the use of computers.

Performance: Ability to perform tasks (quantitative and qualitative tasks) in Kinematics in one dimension and Projectile motion.

Conceptual understanding: Ability to make meaningful statements/explanations to problems (qualitative tasks) related to Kinematics in one dimension and Projectile motion.

Interactive setting: An atmosphere which allows students to share ideas with both instructor and peers.

Interest: A positive attitude towards lessons.

1.9.1 Organization of Chapters

The study is organized in five chapters. The first chapter looks at the background to the study, statement of the problem, purpose of the study, objectives and research questions of the study, significance of the study, delimitations, limitations and definition of terms.

Chapter two discusses review of relevant literature and related research. Chapter three is concerned with methodology and data collection. This includes the research design, study population, sampling and sampling procedures, instrumentations, and data collection procedure and data analysis.

Chapter four discusses the presentation and analysis of data collected. The final chapter looks at the summary of the research, findings, conclusions and suggestion for further research.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Overview

The review of literature focused on work done by researchers in related fields. The topical issues reviewed in the literature include the theoretical and conceptual frameworks of the study, which discuss among others the theories of Jean Piaget and Lev Vygotsky upon which the study was hinged. Empirical review on the use of computer animations on students' conceptual understanding and performance in Physics was discussed. : Theoretical Framework of the study; Conceptual Framework of the study; the mode of teaching method used in Ghanaian S.H.S Physics classroom; the Performance of students' with the traditional lecture approach in Physics classroom at the S.H.S level, the use of computer technology in the teaching of Physics at the S.H.S level and Related literature review on the use of computer animations on students' conceptual understanding and Performance were the issues under discussion.

2.1 Theoretical Framework of the study

The theoretical framework that underpinned the study was based on Jean Piaget's theory of cognitive development and Lev Vygotsky's social constructivism theory. Piaget (1954) opined that, the cognitive development of children towards formal thought could be facilitated through three cognitive processes: assimilation, accommodation and equilibration. To Piaget (1954), when children assimilate, they perceive new objects and events according to their existing schemata, mental models or cognitive structures.

The mental models of children, formed by their prior knowledge and experiences, control how they incorporate new experiences and new information into their minds. This may occur when the new experiences of children are aligned with their existing schemata (mental models or internal representations of the world) and as a result of their failure to change a faulty understanding (Piaget, 1954). Sometimes, when children's experiences contradict their existing knowledge, internal representations, or schemata, they may change their perceptions of the experiences to fit their internal representations.

Accommodation, however according to Piaget (1954) results as children reframe or modify their existing mental representations of the external world to fit their new experiences for learning to occur. Hence, as children exercise existing mental structures in particular environmental situations, accommodation– motivating disequilibrium results and the children construct new mental structures to resolve the disequilibrium (Piaget, 1954).

The state of disequilibrium and contradiction arising between the existing schemata and the more sophisticated mode of thought adopted by the new experience therefore, has to be resolved via equilibrium process.

Equilibration maintains the balance between always taking in new knowledge, and always assimilating knowledge with previously gained knowledge. Knowledge is therefore, not a mirror of the world but is created or 'constructed' from the individual's continuous revision and reorganization of cognitive structures in conjunction with experience (Piaget, 1954). Thus in the view of Piaget, students' are actively involved in the construction of their own knowledge.

It is argued that knowledge is constructed through action and that children must continually reconstruct their own understanding of phenomena through active reflections on objects and events till they achieve an adult's perspective. Piaget (1954) posited that, the process of intellectual and cognitive development is similar to a biological act, thus adaptation to environmental demands.

Vygotsky (1978) opined that social learning precedes development. According to Vygotsky (1978), every function in the child's cultural and development appears twice: first, on the social level and later, on the individual level; first, between people (inter - psychological) and inside the child (intra – psychological). To Vygotsky, children are capable of performing higher intellectual levels when asked to work in collaborative situations than when asked to work individually.

Vygotsky (1978) also believed that less skillful and individuals are better able to develop a more complex level of understanding and skill through collaboration, direction or assistance of an expert or a more capable peer than they could independently. Social interaction extends a child's zone of proximal development (ZPD), which is the difference between a child's understanding and potential to understand more difficult concepts (Vygotsky, 1978). In the view of Vygotsky, learning occurs in this zone. Thus with Vygotsky, children are capable of constructing their own knowledge through collaboration or assistance of an expert; children are socially engaged in constructing their own knowledge. This is what has been termed as 'social constructivism'.

Social constructivism not only acknowledges the uniqueness and complexity of the learner, but also actually encourages, utilizes and rewards it as an integral part of the learning process (Wertsch, 1997).

Vygotsky's ideas concerning the zone of proximal development provides a strong support for the inclusion of cooperative learning strategies in classroom instruction. Johnson and Johnson (1985) in their study have also clearly indicated the effectiveness of cooperative learning methods over either competitive or individual learning methods in the development of higher–order thinking skills as well as the achievement of greater learning outcomes. Stahl and Vansickel (1992) also opined that, every cooperative learning strategy, when used appropriately enables students to move beyond the text, memorization of basic facts, and learning lower level skills.

Ajaja and Eravwoke (2010) also argued that, cooperative–learning strategies result in cognitive restructuring, which leads to an increase in understanding of all students in a cooperative group.

Animations can be considered a variant of cognitive tools, that is, they allow students to test hypothesis and more generally "what–if" scenarios and enables learners to ground cognitive understanding of their action in a situation (Thomas & Milligan, 2004; Laurillard, 1993).

In Thomas and Milligan's view, animations in this respect are compatible with constructivist's view of learning. Light and Mevarech (1992) indicated out in the early 80's on the growing interest in the potentialities of both cooperative learning and of computer as facilitators of students learning. In the view of Newberry (1999), the claims made for each in some respects are rather similar, for both emphasize the roles of students' interactions in enhancing a wide range of school outcomes, including academic achievements, cognitive processes, meta–cognitive skills, motivation towards learning, self–esteem and social development. This seems to indicate that both computer animations and cooperative learning strategies have a positive influence on students' achievements.

2.2 Conceptual Framework of the Study

Based on the theories of Jean Piaget and Lev Vygotsky, a conceptual model was developed by the researcher for the study. When students are exposed to complex concepts, they are thrown into a state of disequilibrium. Computer animations instructional packages (administered in cooperative or individualized settings) however, seem to enable students to develop cognitive structures or mental models or reorganize their already existing schema to better understand concepts related to kinematics in one dimension and projectile motion. Some researchers (Glasersfeld, 1993; Gardner 1993; Pintrich, Marx, & Boyle, 1993) have noted that, the constructivists' position that students should have access to multiple viewpoints and representations for information is partially satisfied by well–constructed animations.

Ramasundarm, Grunwald, Mangeot, Comerford and Bliss (2005) and Cholmsky (2003) have also observed that, computer animations have the potential to make learning of complex and difficult concepts more interactive, authentic, and meaningful. Computer animations instructional packages seem to give students' experiences that facilitate conceptual development leading to increased understanding of difficult concepts.

Also with dynamic group support in cooperative learning environments, students' perform at higher intellectual levels, which enable them to better comprehend complex and difficult concepts in Kinematics in one dimension and Projectile Motion. Newberry

(1999) has opined that, the claims made for computer animations and cooperative learning strategies in some respects are rather similar.

According to Newberry (1999), they both emphasize the role of students' interaction in enhancing a wide range of school outcomes, including academic achievements, cognitive processes, meta–cognitive skills, motivation towards learning, self–esteem and social development. Computer animations instructional packages (either alone or in cooperative learning settings) therefore, seem to provide students with experiences that facilitate conceptual development, which leads to increased understanding of difficult concepts.

Evaluation of the instructional processes however, reveals learning outcomes, which could serve as an evidence of the attainment of the curriculum objectives.

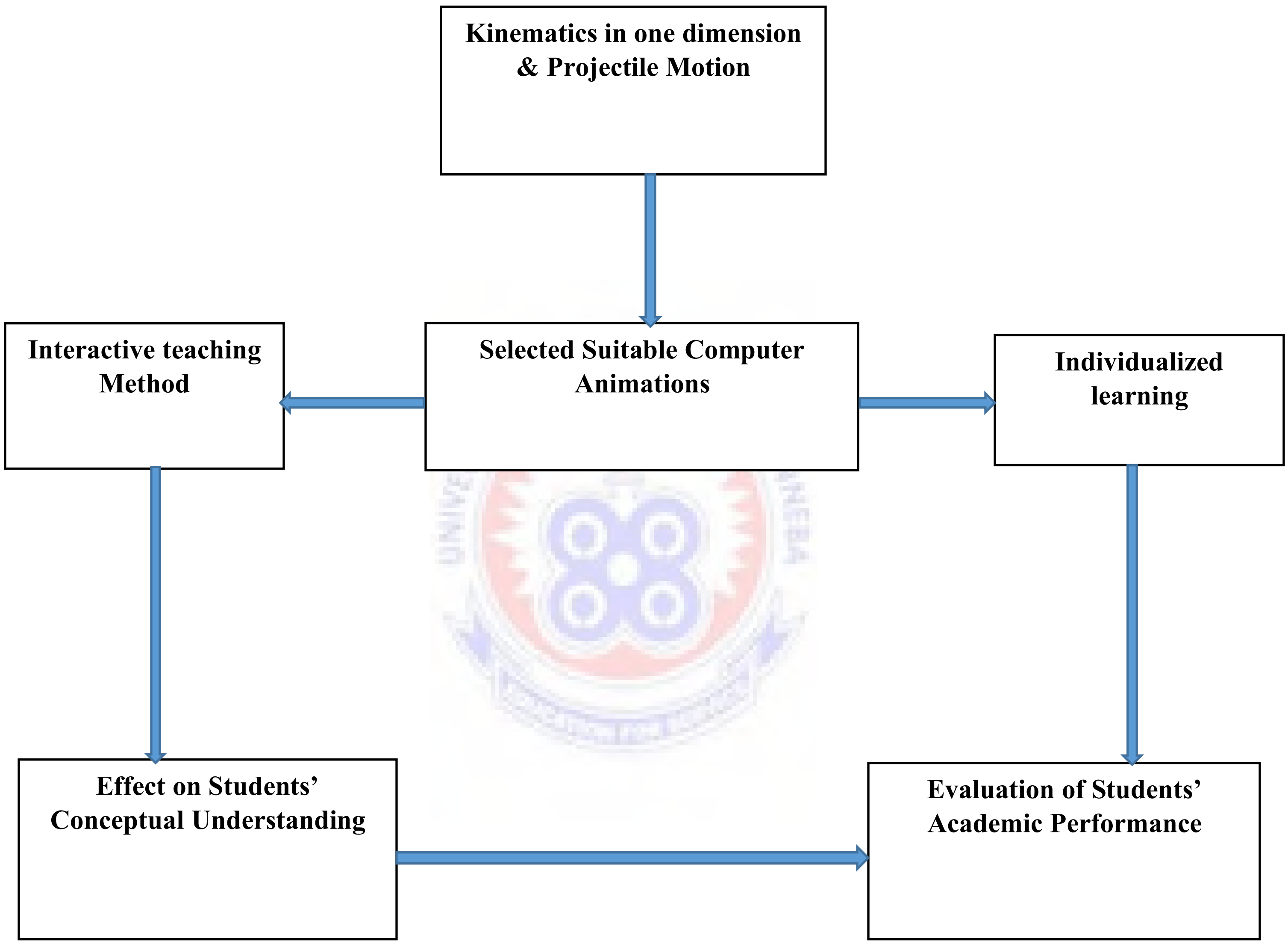


Fig 2.1: Conceptual framework of the study

2.3 Mode of teaching method used in Ghanaian S.H.S Physics classroom

The primary purpose of teaching at any level of education is to bring a fundamental change in the learner (Tebabal & Kahssay, 2011). To facilitate the process of knowledge transmission, teachers should apply appropriate teaching methods that best suit specific objectives. In the traditional epoch, many teaching practitioners widely applied teacher-centred methods to impart knowledge to learners comparative to student-centred methods. Until today, questions about the effectiveness of teaching methods on student learning have consistently raised considerable interest in the thematic field of educational research (Hightower, 2011). Moreover, research on teaching and learning constantly endeavour to examine the extent to which different teaching methods enhance growth in student learning.

Quite remarkably, regular poor academic performance by the majority of students is fundamentally linked to application of ineffective teaching methods by teachers to impact knowledge to learners (Adunola, 2011). Substantial research on the effectiveness of teaching methods indicates that the quality of teaching is often reflected by the achievements of learners. According to Ayeni (2011), teaching is a process that involves bringing about desirable changes in learners so as to achieve specific outcomes. In order for the method used for teaching to be effective, Adunola (2011) maintains that teachers need to be conversant with numerous teaching strategies that take recognition of the magnitude of complexity of the concepts to be covered.

In Ghanaian Senior High Schools, every General Science, Technical and Agricultural student take the Physics subject over a period of three years. The Ghanaian Physics syllabus has been structured to cover three years of SHS programme. Each year's work consists of a number of sections with each section comprising a number of units. There are six main sections. Section one consists of concepts such as motion, forces and energy. Different types of motion, effect of force on motion and nature of energy are to be discussed. Topics such as thermal Physics where heat and temperature are to be discussed are in section two. Section three treats the concept of waves under which characteristics of wave motion including that of light are to be discussed. Electric and magnetic fields are treated in section four. Under this section, the major role of magnet in instrumentation and machinery especially, in utilization of electromagnetic fields in the generation and storage of electricity are emphasized. Section five provides a guide to teaching atomic and nuclear Physics where characteristics of atom, the concept of photoelectric effect and its applications, x – rays and the peaceful uses of nuclear energy are to be discussed. Guidance in teaching electronics, where characteristics and the application of semi – conductor diodes and transistors in voltage stabilization, amplification of signals and electric switching is provided in the last section (CRDD, 2008). At the end of the school year, students write a national examination. Students write two separate papers in all. Paper three is a practical paper which requires students to experiment with instruments given to obtain results following instructions given is paramount. Paper two and one are theory papers which measure student's ability to recall simple laws, apply them and also exhibit good computational skills in formula work. It is therefore important for students reading Physics to have a great command on the subject matter.

Buabeng and Ntow (2010) in a study have revealed some contributing factors to students' poor achievement in Physics. The factors outlined included, methods of teaching adopted by teachers in the classroom, qualification of teachers, and availability of teaching and learning materials. The study revealed that as a result of the inadequate teaching and learning aids, teachers are forced to use the traditional–lecture method in teaching the subject. This affected the students' conceptual understanding and performance in Physics. The study also reveals students disinterest in the subject as a result of how the subject was presented, and the unknown career opportunities available. It is very clear that, low level of understanding of concepts affects students' achievement.

The University of Education, Winneba is one of the renowned universities in Ghana responsible for training of teachers into schools in Ghana. Antwi (2013) conducted a research on Mechanics teaching at University of Education, Winneba (UEW) at the Department of Physics Education. According to the study, the dominant mode of instruction in Science at UEW is the lecture approach. He was of the view that lecturers start their Physics (Mechanics) teaching by lecturing on general principles. They then use the principles to derive mathematical models, show illustrative applications of the models and give students some practice question(s) in similar derivations and finally test their ability to do the same during examination. Qualitative problems are mostly based on "*define*, *state* and *list*", which does not call for better understanding of concepts. Discussions, demonstrations, experiments and practical work, where students can interact among themselves, teachers and teaching assistants, to confirm and validate principles and results presented during lectures, and solidify their understanding of fundamental Physics principles are rarely done in UEW. Usually due to a lack of equipment, an overload of course work and limited time at students' disposal. Students in courses like this typically end up with limited conceptual understanding (Hestenes, Wells, & Swackhamer, 1992), and a limited ability to transfer what they have learnt to new settings (Anyaehie, Nwobodo, & Njoku, 2007). Several difficulties were revealed as the instructor adopts the teacher centred approach. Learners were only spectators during the lesson delivery. Students show low conceptual understanding in Newtonian Mechanics, like graphs, momentum and impulse, and circular motion. Students also lacked the ability to transfer knowledge to solve problems as well.

This practice is not different from what is practiced in the senior high school system. Physics teachers, majority in Ghana, resort to the traditional method in teaching the course (Antwi, 2013). Mechanics, an interactive course which requires a real view of how objects move and the effect of forces are subjected to lecture method. The abstract nature of the course poses danger to the interest of learners.

The value attached to students' time makes it vital for teachers to make maximum use of it through adopting methods that serve as source of motivation and promote effective learning (Boumová, 2008). Teachers' use of a particular instructional method is influenced by their goals expected to be achieved regarding the course taught.

In addition to this, the students, who are the audience, need to be taken into consideration. Since there exist individual differences, teachers' ability to use the most instructive approach to teach students irrespective of their population, results in great academic achievements.

Physics, like other disciplines, should have the ability to develop the creative thinking and critical analytical skills of students (Hussain, Azeem, & Shakoor, 2011). It should therefore not be out of the ordinary if Physics students have the proficiencies to solve problems both in the classroom and laboratory as well as practical ones related to industry, household and real life. The inadequate laboratories and other teaching and learning materials have resulted in the overemphasis on theory (usually traditional) which limits students understanding and academic achievement.

In spite of the demerits associated with the traditional method of teaching, Hussain, Azeem and Shakoor (2011) admire its use due to its perception of possessing the ability to establish and maintain order in class as well as serving as a safety net for new teachers who may be unfamiliar with other methods. Also, it is more preferred when a large quantity of information is to be disseminated effectively. These notwithstanding, the traditional method is generally less preferred to other methods such as scientific enquiry due to how best and with ease students are able to apply Physics concepts to real life situations when taught with the latter (Hussain, Azeem, & Shakoor, 2011).

From their research results, Krišťák, Němec and Danihelová, (2014) highlighted how the traditional method hampers increase in students' knowledge, irrespective of the facilitator teaching the subject. This suggests how inevitable it is to replace the traditional methods with new, interactive ones if better student achievement and conceptual understanding is expected. However, its negative effects cannot be exchanged with the merits outlined by researchers.

According to Boud and Feletti (1999), teacher–centred approach simply means students obtain information from the teacher without building their engagement level with the subject being taught. Teo and Wong (2000) opined that the approach is least practical, more theoretical and memorizing. It does not apply activity based learning to encourage students to learn real life problems based on applied knowledge. Since the teacher controls the transmission and sharing of knowledge, the lecturer may attempt to maximize the delivery of information while minimizing time and effort. As a result, both interest and understanding of students may get lost. To address such shortfalls, Zakaria, Chin and Daud (2010) specified that teaching should not merely focus on dispensing rules, definitions and procedures for students to memorize, but should also actively engage students as primary participants.

With the advent of the concept of discovery learning, many scholars today widely adopt more supple student-centred methods to enhance active learning (Greitzer, 2002). Most teachers today apply the student-centred approach to promote interest, analytical research, critical thinking and enjoyment among students (Hesson & Shad, 2007). The teaching method is regarded more effective since it does not centralize the flow of knowledge from the lecturer to the student (Lindquist, 1995). The approach also motivates goal-orientated behaviour among students, hence the method is very effective in improving student achievement (Slavin, 1996). Physics teachers and learners' are more likely to benefit from the significance this method accord it users.

2.4 Performance of students' with the traditional lecture approach in Physics classroom at the S.H.S level

The most widely used method of teaching in Ghanaian Physics classrooms has been the traditional lecture method (Buabeng & Ntow, 2010). In their study, it was also clear that, the traditional lecture instructional approach negatively affect the performance of students.

Performance of students in Physics in Ghana has been very alarming over the years. These low conceptual understanding of students goes a long way to affect their performance at the end of the examination. Data reveals that SHS students' performance from 2003 to 2009 showed an abysmal performance. Performance statistics by West African Examinations Council (WAEC) from 2003 to 2009 reveals that the majority of the Physics candidates did not obtain the pass grade (A–D or A1–C6) to qualify for admission to tertiary education. The trend in performance indicates that from 2003 – 2005, out of 33,043 candidates who sat for SSCE Physics exams, 13, 067(39.5%) obtained grade A – D. From 2006 – 2008, candidates who sat for the WASSCE Physics exams were 88, 294 out of which 41,973 (47.5%) candidates obtained A1 – C6 (WAEC, 2010). The West African Chief Examiners report (2008; 2010, 2012) reveals that students demonstrate low conceptual understanding in explaining concepts related to Mechanics, thermal energy and electricity and magnetism. In 2012 for example, majority of student's responses to questions under Mechanics exposed their low conceptual understanding on motion under gravity. Students could not explain why a body moving under free fall has its horizontal velocity to be constant throughout its motion. A basic understanding of motion under gravity reveals that it is only the vertical velocity of the body that is affected in such motion hence the horizontal velocity remains constant throughout. Critically examining the possible factors contributing to the abysmal performance one of such is the instructional approach practiced in the Ghanaian Physics classroom. The way the subject has been presented to learners has not been interesting and motivating (Buabeng & Ntow, 2010).

This actually contributed to students' poor performance over the years. A more interesting approach as suggested by modern day research can be adopted to address the challenge.

2.5 The use of computer technology in the teaching of Physics at the S.H.S level

Technology, since its introduction has benefited its users in numerous ways, differing from one sector to another (Akour, 2006). Its ability to increase productivity has made it one of the most sought after promoters of development more especially in the outcome of students' performance and conceptual understanding. The various sectors of the economy, from agriculture to health, industry and tourism among others rely on technological advancement to partake in the benefits that come along with it. The education sector has certainly not been left out of this. It is therefore not surprising when Çankaya and Karamete (2007) and Hancer and Tüzemen (2008) posited that problem solving in education has been almost always impossible without the use of new technologies, especially in this fast growing technological world.

The rising concerns about how ineffective traditional lecture methods of teaching has been in recent times and the disinterest students show in learning Physics has resulted in the global call for change in the development of courses and curricula as well as pedagogy (Tambade & Wagh, 2011). The gradual shift from traditional lecture method to technology–based methods has also been influenced by what Karamustafaoğlu (2010) believes is the need to focus on student–centered learning rather than the teacher–centred approach.

The use of computer technology such as Computer Assisted Instruction (CAI) is an effective tool that fosters this as it challenges students to be creative thinkers, intelligent as well as develop their individual skills.

Teacher–centred approach such as explaining, question–to–answer and demonstration have until now been predominantly used for teaching. Studies have revealed that students both successful and unsuccessful ones have been encountering challenges in gaining conceptual understanding in science due to how frightening it appears to be (Hançer & Tüzemen, 2008). There is therefore the need to use other alternatives of instruction to overcome this challenge towards enhancing their understanding and academic achievement.

According to Hançer and Tüzemen (2008), CAI is defined as using computers as the learning environment, which makes the education period strong and gets students motivated. It is done by the combination of computer technology and learning principles by a facilitator. Karamustafaoğlu (2010) also suggests the presentation of subjects of a course, going over what has been previously taught, solving problems and carrying out researches in class using computers as aid with the purpose of boosting student motivation as CAI. Thus, in simple terms, it is the use of computer to provide instruction.

The advancement in technology has opened a window of opportunities in the teaching and learning of Physics. It has resulted in the discovery methods of teaching among which includes visualization of abstract concepts (Meltzer & Manivannan, 2002; Tambade & Wagh, 2011).

Students face difficulty in grasping what they are taught in the classroom regarding the concepts in Physics. The use of computer technology (CAI) as opined by Karamustafaoğlu (2010) encourages students to get more engaged and interactive in the learning process. Computer technology has the ability to overcome the difficulty in understanding Physics concepts by students and their achievement is improved in the Physics classroom when implemented. In addition, computer technology has the potential to present a safe approach to experiments since students do not come into direct contact with equipment. Due to the ease in understanding and committing to memory information through various senses, computer technology enhances the learning process considering how the computer can exercise various senses in the delivery of the subject.

Experiments carried out by various researchers have brought to bear significant differences between the academic achievements of students who are taught by traditional methods and those by computer technology, and have all been in favour of the latter. This suggests how successful and effective computer technology is in teaching and fostering students' conceptual understanding and academic achievement in Physics than the traditional lecture methods.

Building up points from the numerous advantages computer technology has on teaching and learning, it is imperative that computer technology is incorporated in the Physics classroom. The Ghanaian SHS Physics is more intensive and practical oriented which requires much time and work. The current challenge facing the teaching and learning of Physics in this country could be attributed to inadequacy of equipment.

Teaching and learning aids has a gross effect on students' conceptual understanding and achievements. Buabeng and Ntow (2010) in their study attributed poor performance of students in Physics to the unavailability of equipment to enhance effective teaching and learning in the Physics classroom, which is obviously true.

2.6 The use of computer animations on students' conceptual understanding and Performance

For the past two decades, the most prominent feature of the technology-based learning environment has become animation (Dunbar, 1993). Mayer and Moreno (2002) stated that animation is a form of pictorial presentation, a definition which also refers to computer-generated motion pictures showing associations between drawn figures. Things which correspond to this idea are: motion, picture and animation. As far as videos and illustrations are concerned, these are motion pictures depicting movement of real objects.

The birth of pictorial forms of teaching has been observed to have developed as a counterpart to verbal forms of teaching (Lowe, 2004; Pailliotet & Mosenthal, 2000). Although verbal ways of presentation have long dominated education, the addition of visual forms of presentation has enhanced students' understanding (Mayer, 1999; Sweller, 1999). In fact, some disciplines are taught in universities which deal with dynamic subject matter, and animation or graphic illustration is more favoured as a way of addressing the difficulties which arise when presenting such matters verbally or numerically (Lowe, 2004).

Even though such multimedia instructional environments hold potential for enhancing people's way of learning (Lowe, 2004) there is still much debate surrounding this area; indeed animation presentations are less useful for the purposes of education and training than was expected. Moreover, little is known about the way animation needs to be designed in order to aid learning (Plötzner & Lowe, 2004) and not to act solely as a way to gain aesthetic attraction. For instance, some animators who work in the entertainment industry create animations for the sake of entertainment and they are therefore unlikely to be interested in helping to build coherent understanding using their work (Lowe, 2004).

The current mode of learning in Ghana is structured on traditional chalk-and-talk methods. Learning process has been highly dependent on time, place and teacher-oriented. One way to bring about a change of emphasis in teaching, from the teacher directed approach to a facilitated approach, is to change the medium of instruction (Kearsley, 2000; Kiili, 2005).

Multimedia offers an alternative medium of instruction to the current learning process. The nature of interactivity and discovery in multimedia learning bears a beneficial boost to the monotony of passive learning (Mayer & Sims, 1994; Mayer, 2000). Both teachers and students may control their own paced of lesson according to his or her own ability.

Multimedia can give low ability students extensive learning time before moving forward.

Alternatively, high ability students can branch out to random sequencing through the module and not be confined by linearity or a much slower pace (Mayer, 2001; Mayer & Moreno, 2003). This aspect of multimedia learning supports student-centred strategy whereby learners take responsibility in their own learning process (Clark & Mayer, 2003). The liberty to proceed or recede allows self-pacing, an important facet to enable learners to learn according to their individual pace and that will insure both groups of students may perceive information equally (Moreno & Mayer, 2000).

According to Kommers, Grabinger and Dunlap (1996), multimedia refers to computer-based applications where users are provided with information through different types of media. Mayer (2000) defines multimedia as the presentation of the learning material using both pictorial form and verbal form such as spoken and printed text. Through it, instruction may include motion, voice, text, graphics and still images (Moore, Burton, & Myers, 1996). One important combination of media is animation that has been defined as images in motion (Dwyer & Dwyer, 2003). Animation capable features are innovations which can enliven the learning experience. The flexibility of learning through animation will allow a wider range of stimuli and thus increase the student engagement in learning. Kearsley (2002) shows that students, who learn from animation have greater self-esteem and motivation. According to Reeves (1998), animation learning can stimulate more than one sense at a time and that may be more attention-getting and attention-holding.

Information processing theories described human brain as similar to a computer and human learning as similar to how computer processes information (Chandler & Sweeler, 1991). There are three main storage structures in the memory system (1) sensory register, which registers stimuli in the memory system; (2) short-term memory (STM), which serves as temporary storage; and (3) long-term memory (LTM) where information is permanently stored. Short-term memory can only hold five to nine chunks of information (Miller, 1956) before it is processed in LTM. Not all the information stored in the LTM can be retrieved. Retrieval is more likely when appropriate cues are provided in the encoding process (Driscoll, 1994). Pavio's (1986) dual coding theory further stated there are two separate information processing systems which is a visual system which processes visual knowledge and a verbal system for processing verbal knowledge. According to Rieber (1994) animation that combines visual and verbal knowledge may store information into long-term memory thus facilitates encoding and retrieval process. Dual coding theory also suggests there are three distinctive levels of processing that can occur between the verbal and visual system: representational, associative and referential (Rieber, 1996). Representational processing connects the incoming stimuli from the environment to either the verbal or visual system. Associative processing constructs connections within either of the verbal or visual systems, and referential processing builds connections between the verbal and visual systems (Rieber, 1994).

Previous studies revealed that animation had facilitated the learner encoding process than Static visuals (Lin, 2001). Rieber, Boyce and Assad (1990) suggested that animation helped decrease the time to retrieve information from long-term memory and then subsequently reconstruct it in short-term memory. Reiber (1990) further explained that animations facilitate the reconstructing process during retrieval by encouraging organization. Mayer (1996) in his study showed that computer based animations can be used to promote scientific understanding. The findings of the research revealed that students performed better on recall and problem solving test when both the verbal and visual systems were utilized. Animation with a support of text had reduced cognitive load of students (Mayer, 1996). His research found that animation complemented with a textual explanation enabled students to take greater advantage of their capability to process information on two levels, by stimulating the visual system and by reducing the load placed on the verbal processing system. This reshuffling of information in working memory increased their ability to make meaning out of the information in preparation for storage in long-term memory. The placement of the supporting textual explanation next to the animation further reduced cognitive load and enhanced performance (Mann, 1995; Moreno, 1999). Students will be guided to learn by sifting the relevant from the irrelevant information and can relate new information to real world situations (Stoney & Oliver, 1999).

Prior knowledge has been considered the most important factor that influences learning (Ausubel, 1968; Bloom, 1994). Jonassen and Grabowski (1993) defined prior knowledge and achievement as the knowledge, skills or abilities that the learners brings to the learning environment before the instruction. Dwyer (1994) further classified students' prior knowledge into high and low level. Hannafin (1997) suggested that compared to individuals who have lower prior knowledge, individuals who have higher prior knowledge can quickly determine their own learning needs, generate their own learning strategies and assimilate new information to their existing knowledge structure. Rieber (2000) also stated that related prior knowledge provides the learners unique relevant elaboration that is unavailable to learners with limited prior knowledge. It is suggested that knowledge will be encoded more meaningfully and retrieved more easily by learners with high prior knowledge. Mayer and Anderson (1992) found that learning significantly improved for students who possess low prior knowledge when verbal and visual information are presented simultaneously.

They suggested that experienced students might be able to build referential connections between verbal and visual information and their existing knowledge on their own. The computer-based instruction utilized in this study presented verbal (the text) and visual (the graphic illustration or animation) information simultaneously. One of the purposes of this study is to investigate if varied animation strategies will improve the performance of the students identified as possessing low levels of prior knowledge.

The potential benefits of Computer Animation (CAI) cannot be underestimated in the contemporary world. There is a plethora of established findings on the instructional value of computer, particularly in advanced countries.

There are now several CAI packages on different subjects. It is obvious that the current trend in research all over the world is the use of computer facilities and resources to enhance students' learning. Handelsman, Ebert-May, Beichner, Bruns, Chang, DeHaan, Gentile, Stewart, Tilghman and Wood (2004) opined that many exercises that depart from traditional methods are now readily accessible on the web, even though teachers do not use these facilities. In a review of empirical studies on CAI, Cotton (1997) concluded, among others, that the use of CAI as a supplement to conventional instruction produces higher achievement than the use of conventional instruction alone, research is inconclusive regarding the comparative effectiveness of conventional instruction alone and CAI alone, and that computer-based education (CAI and other computer applications) produce higher achievement than conventional instruction alone. In addition, students learn instructional contents faster with CAI than with conventional instruction alone, they retain what they have learned better with CAI than with conventional instruction alone, and CAI activities appear to be at least as cost effective as and sometimes more cost-effective than other instructional methods, such as teacher-directed instruction and tutoring. Furthermore, computer assisted instruction has been found to enhance students' performance than the conventional instructional method in counselor education (Karper, Robinson, & Casado-Kehoe, 2005).

However, Mills' (2001) findings revealed that CAI was found to be as effective as classroom for fact based learning, but not as effective for topics requiring critical thinking or mathematical problem solving.

In addition, the time required for learners to use CAI was higher overall than conventional classroom instruction. Students taught using traditional instruction combined with the use of computer performed significantly better than students taught using traditional instruction in a college setting (Akour, 2006).

Similarly, college students taught statistics using lecture-plus-CAI obtained higher averages on midterm and final exams than students taught using lecture method only (Basturk, 2005). Based on a review of several studies and shortcoming on studies comparing CAI with conventional instruction, CAI can be considered as effective as traditional instruction. Furthermore, how CAI is delivered can affect its effectiveness, and that new studies are needed to clarify the effect of CAI in contemporary student environment (Jenks & Springer, 2002). Thus, empirical findings on the use of CAI have been mixed.

Students receiving CAI based instruction also enjoyed their classes more and had better attitudes towards computer. Studies have shown that students who went through active-engagement computer-based activities did better than students who went through traditional instruction (Steinberg, 2000). Venkataiah (2004) observed that Computer-Assisted Instruction (CAI) is an interaction between a student, a computer and a software programme guided by the teacher for the purpose of enhancing learning outcomes. Even though CAI was expensive and mechanical, it was considered to be a better teaching machine because of its flexibility and versatility. Furthermore, it provided integrated experiences which varied from abstract to concrete; helped the teacher to reduce repetition of words; improved students manipulative skills; improved visual perceptions and retention of information by the learner.

Gender issues too have been linked with performance of students in academic tasks in several studies but without any definite conclusion. But there is a general conclusion that general imbalance exists in computer use, access, career and attitude. Some studies revealed that male students perform better than the females in Physics, Chemistry, and Biology (Danmole, 1998; Novak & Mosunda, 1991; Okeke & Ochuba, 1986) while others revealed that female students are better off than males (Kelly, 1978: Wonzencreft, 1963). Some studies such as those of Bello (1990) did not find any form of influence being exerted by gender on students' academic performance in the sciences.

Gender factor on the use of CAI has also been of interest to researchers. Collazos, Guerrero, Llana and Oetzel (n.d.) examined gender influence on collaborative use of computer based communication. They found that group with minority women had low index of collaboration compared to homogenous group and group with majority women.

Spencer (2004) found no significant influence of gender on the achievement of college students in mathematics when they were exposed to mathematics courseware in online and traditional learning environment.

However, female online learners were significantly less likely to complete the course compared to their traditional female counterparts or male online counterparts. In a review of studies on access, use, attitude, and achievement with computer, Kirkpatrick and Cuban (1998) concluded that when female and male students at all levels of education had the same amount and types of experiences on computers, female achievement scores and attitudes are similar in computer classes and classes using computer with that of their male counterpart.

The close affinity and links between technology and cooperative learning had been noted by Millis and Cottell (1998) in their assertion that cooperative learning and technology are natural partners. This is because the use of technology involves human dimensions of caring, community, and commitment. Furthermore, using technology in ways that promote sequenced learning within groups can lead to more in-depth processing of course content and, hence, more retention of information (Newberry, 1999).

CHAPTER THREE

METHODOLOGY

3.0 Overview

This chapter discusses the research design which was adopted by the researcher to effectively address the problem under investigation. It also delved into the population of the study, sample and sampling procedure adopted in carrying out the research. The chapter also outlined the instrument used in the study and the validity and reliability of the instruments used were discussed in this chapter. How data was collected and analyzed are also found in this chapter. Thus Diagnosis stage, Treatment design, Implementation of the Treatment and Post - Treatment.

3.1 Research Design

The study is a quasi-experimental research, designed to investigate the effect of computer animations on students' conceptual understanding and performance, and interest on Kinematics in one dimension and Projectile Motion (Kinematics and Projectiles). Quasi experimental research was chosen because it would better investigate the effect of computer animations on students' conceptual understanding and achievement, and interest in Kinematics on one dimension and Projectile Motion.

The research consisted of two main groups; a control group and experimental group. The traditional lecture method of instruction was used as a mode of instruction in teaching the Kinematics in one dimension and Projectile motion whereas computer animation was used as the mode of instruction in teaching the experimental group.

3.2 Population

The population for the study comprised all students of Uncle Rich SHS and Unique Academy SHS (Effutu Municipality and Agona Swedru Municipality respectively).Both schools have a population of three hundred and fifty (Uncle Rich SHS = 180, Unique Academy = 170).The target population for the study included all Science students in Uncle Rich SHS (Winneba) and Unique Academy SHS (Swedru). Winneba and Swedru are two different municipalities of about 24 km apart. Hence what one group learns or studies may not influence the other group. The accessible population for the study however, comprised SHS Two General Science students of both schools. The two schools included in the study were chosen based on their performance in the WASSCE; the willingness of the heads of the schools and elective Physics teachers to participate in the study; the proximity of the schools to the Researcher and the fact that the students of the two schools had a fair idea of the concept on the kinematics and projectile motion prior to the study.

3.3 Sampling and Sampling Technique

A total of Ninety three (93) students were used for the study. Forty-eight (48) students from the Uncle Rich SHS were used as the experimental group, while forty-five students from Unique Academy SHS were used as the control group. Participants in the study were all of similar educational background as they had all passed the Basic Education Certificate Examination (B.E.C.E) at the Junior High School (JHS) level. Also, they had some basic knowledge of the concepts related to the Kinematics in one dimension and Projectile Motion as they had already been introduced to it at SHS one.

The study employed purposive sampling for the selection of the classes for the study. The samples for the study were second year students of Unique Academy SHS (Control group) and Uncle Rich SHS (experimental group), all in the Central Region of Ghana. Second year students were purposively selected for the study because kinematics in one dimension and pr1ojectile motion are taught during the first year of the SHS science programme, and these are the topics that most of the students have difficulties with regard to the understanding of concepts. Out of the forty – eight (48) participants of the experimental group, thirty – six (36) were boys and the remaining twelve (12) were girls. The control group consisted of thirty - five (35) boys and ten (10) girls.

3.4 Research Instrumentations

Test and questionnaires were used to collect the data for the study. The test was a diagnostic test (Pre – treatment test) designed to measure their performance and level of conceptual understanding and a similar test was designed consisting of twenty (20) test items each (Both qualitative and quantitative items) to evaluate the extent to which the treatment had improved their performance and conceptual understanding of students on kinematics in one dimension and projectile motion.

Treatment procedure was designed for implementation. After the implementation of the treatment the post – treatment test (conceptual - based test) consisting of twenty (20) test items (Appendix 2) similar to the diagnostic test was administered to the same students' in the experimental and control group to ascertain the effect of the treatment.

A close - ended questionnaire was used in the study. According to Wilson and McLean (1994), closed ended questions in general are quick to complete and straight forward to code especially for computer analysis. Questionnaire was administered to both groups at the end of the treatment stage. This was done with the view that, students already were not exposed to any other mode of instruction than the traditional lecture method hence would rate the traditional lecture approach higher (Antwi, 2013). The researcher believed that after the treatment stage, students' will be able to clearly distinguish the effect of the two approaches used in the teaching of kinematics in one dimension and projectile motion and the one that helped in improving their conceptual understanding highly.

3.5 Validity and Reliability of Instruments

The test was given at two different times; at the early stage (Pre - treatment stage) and at the end of the Treatment (Post – treatment stage). The test was labeled Mechanics Conceptual Based Test (MCBT).

For the purpose of content validation and reduction of errors, the test was presented to two Senior lecturers in the Physics Department of University of Education, Winneba (UEW) and one Senior High School Physics teacher with a ten (10) - year experience from a school around Winneba for comments on the appropriateness of the test based on the SHS Physics syllabus content. After this, the self–designed test items were pilot-tested at Apam Senior High School located in the same area with eighteen (18) students. The test was administered twice (thus the second test was administered one week after administering the first test). The reliability analysis of the instruments was performed statistically and Cronbach alpha coefficient of 0.75 was obtained. The Cronbach alpha of 0.75 was higher than the 0.70 that is generally accepted in Science research. This means that the coefficient level was higher for the instrument to be used. For that reason internal consistency of the instruments was thus reliable. The reliability co–efficient was calculated using the SPSS version 16**.**

3.6 Data Collection Procedure

Copies of letters asking for permission to conduct research were taken from the Head of Department of Science Education, University of Education, Winneba and given to the Directors of Education in the Winneba and Swedru Municipalities, and the Headmasters of Uncle Rich SHS and Unique Academy SHS. The questionnaire was administered to the students of Uncle Rich SHS and Unique Academy SHS the next day after the Treatment Phase. Students of Uncle Rich SHS were supervised by the researcher and that of Unique Academy SHS was supervised by a colleague teacher in the school. The questionnaire items were five (5). Ninety - three (93) students answered the questionnaire. Students who needed help in terms of further explanation were given. The respondents were assured of the anonymity and confidentiality of their responses. They were asked not to write their names on the sheet.

The twenty (20) concept based test was administered in both schools, Uncle Rich SHS, Winneba and Unique Academy, Swedru at the same time in the next day after the treatment phase. The researcher supervised the students at Uncle Rich SHS, Winneba and the colleague teacher who taught the students using the Traditional Lecture Approach, supervised the students at Unique Academy, Swedru. They used 45 minutes in answering the concept-based tests in both cases (Pre-Treatment Test and Post-Treatment Test).

3.7 Data Analysis

The responses and scores obtained from questionnaire items and post – test respectively was coded and analyzed through the use of Statistical Package for Social Science (SPSS) version 16.0 and Excel. The SPSS is a software that is quite user – friendly and does most analysis of data one needs as far as quantitative analysis is concerned. It is also by far the most common statistical data analysis used in educational research (Muijs, 2004).

Descriptive statistics and Inferential statistics function of the SPSS was used to analyse the data.

3.8 Pre–Treatment Phase

The researcher and his supervisor held a meeting in planning the strategies that will improve students' conceptual understanding and performance in Kinematics and Projectile Motion.

The Pre – treatment test was actually designed by the researcher and the Principal supervisor to clearly reveal the level of conceptual understanding of students. Responses from students were carefully analyzed to inform the researcher on strategies to employ at the treatment stage.

3.9 Treatment Design

The treatment design was done after the analysis of the diagnostic stage (Pre-Treatment stage). The diagnostic test exposed the level of conceptual understanding and achievements of students in Kinematics in one dimension and projectile motion. Upon the analysis of the students' performance, the following activities were designed for implementation on the experimental group:

- Pre–class Reading assignment on kinematics in one dimension and projectile motion.
- Incorporating relevant computer animations in power point presentation during the teaching of kinematics in one dimension and projectile motion.

Students are not 'tabula rasa'. In most science courses, students' contributions are mostly not considered. This really affects the interest of students' towards science courses. Pre-reading is an important aspect of teaching and learning. For effective teaching and learning, it is more appropriate that learners are given the opportunity to prepare themselves before class.

Integrating technology in teaching and learning is fast growing in the world (Duffy, & Jonassen, 1992). Research has proven the positive effect that instructional tool has on it users. Computer animation, an instructional tool which is widely used in most developed countries has been found to eliminate alternative conception of students' hence improving their performance.

Power point presentation is one of the computer applications which facilitate teaching and learning. Its merit in the classroom cannot be underestimated. However some school of thought suggests it is time consuming, especially during the preparation of the slides to use in the teaching process (Raver & Maydosz, 2010). Though researcher may agree to this school of thought, the effect it has on learners cannot be exchanged with the time it takes one to prepare the power point.

The Ghanaian SHS Physics subject is designed to cover three years of teaching and learning. Kinematics in one dimension and Projectile motion are some of the topics that are taught at the early stages in the first year. Table 3.0 shows how the Kinematics and Projectile Motions are structured in the syllabus:

Table 3.0: The Structure of Kinematics and Projectile Motions in the SHS syllabus

Topic	Specific objectives	Content
	The students will be able to:	
Kinematics in one dimension	Distinguish between the concepts of distance and displacement, speed and velocity, average velocity and instantaneous velocity and acceleration.	Distance, displacement, speed, velocity, acceleration, uniform velocity, instantaneous velocity and average velocity.
Motion of free fall	Explain free fall motion	Free falling Bodies
Projectile motion	Projectile motion horizontal range maximum height	Discuss the motion of a projectile.

3.9.0 Treatment Phase

Pre – Reading Assignment

In many introductory science courses, students tend to start studying the textbook only after the lecture. To achieve productive student involvement, it was essential that students come prepared. Their ideas and contributions played a vital role in the teaching process. For instance, if the students are well-prepared, their responses to conceptual reasoning questions will give the instructor insight into what students find difficult, complementing the instructor's ideas on what materials need most emphasis (Crouch & Mazur, 2001). This is unlike the traditional lecture approach where most students can come to class unprepared because their ideas will not be needed. According to cognitive scientists, educational researchers and contemporary psychologists, a brief preview of text in books will improve students' ability to follow the class, for they have seen the new terminology and will recognize signposts that will help integrate the classes into an overall picture (Hubin & Ridell, 1977). In a study conducted by Cummings, Laws, Redish and Cooney

(2004), a Physics major student remarked that after struggling through the first half of his junior level Mechanics course, he felt that the course was now going much better. What had changed? Did he have a better background in the material they were covering now? “No”, he responded, “I started reading the book before every class. That helps me a lot. I wish I had done it in Physics One and Two”. As the authors conclude, this student had learned something very important.

The researcher in view of this designed a manual which served as a guide for the students to come prepared before every lesson (Table 3.1). This was done with the view of giving the learner a fair idea of what was going to be taught in class. Also the researcher adopted this technique to serve as a measure to involve a strong students’ participation during the teaching and learning period. It gave students’ the privilege to make meaningful contributions during lessons.

Table 3.1: A manual for students to come to class prepared

Week	Topic	Reading Assignment(s)	Reference Book
1	Distance, Displacement, Speed and Average Speed	Definition of Distance, Displacement, Speed and Average Speed. Distinguish between Distance & Displacement	Physics GAST Pg. 59, & 60.
2	Velocity, Average Velocity, Acceleration and Instantaneous Velocity. Problem related Questions	Meaning of Velocity, average velocity, acceleration, & instantaneous velocity. Self-check: Q1, Q2, Q3, Q4 & Q5	Physics GAST, Pg 60, 61 & 62 Physics GAST, Pg 65
3	Motion of free fall	Meaning of Motion of free fall. Solve example 1 under motion under free fall	Advance Level Physics, Pg 8.
4	Projectile Motion	Meaning of a projectile, Range, Time of flight, Maximum height attainable Solve related Questions (Q5, 6, 9, & 10a, 10b)	Advance Level Physics, Pg13

Incorporating relevant computer animations in power point presentation

Computer technology is vast growing over the years in every sector (Olugbenga & Adebayo, 2010). In most advanced countries, it has been of very great benefits to its users. Africa, specifically West African sub–region is now showing more interest in the use of computer technology in teaching and learning in the classroom (Danjuma, 2008). This is as a result of the numerous researches conducted by researchers of different disciplines on the relevance of the tool in teaching and learning across the world. Although some disadvantages exist in the use of the tool yet not comparable to its merits on its users (Danjuma, 2008).

Power point is a computer application normally used in presentations at seminars, conferences and other meetings. Research conducted on the use of the computer application has revealed students' interest of the application. Drouin, Hile, Vartanian and Webb (2013) in their study revealed that most of the Science students preferred Power point lectures. Students rated lectures with power point higher than those without slides. However, some researchers are of the view that, preparing a power point note on topics is not enough to produce a positive effect on teaching and learning

The researcher then incorporated relevant computer animations on concepts to be taught. This was to allow students to think critically and have open mindedness in the classroom. The following was how Kinematics in one dimension and Projectile motion were taught in the classroom:

Week 1, Lesson 1

Title: Motion in one direction

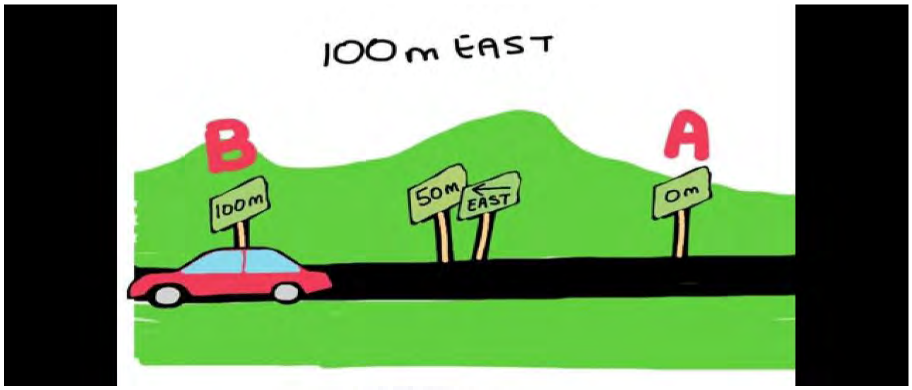
Materials: Textbooks, Computer and Projector

Mode of Teaching: Classroom discussion, Demonstration and Power Point Presentation

Students' Misconception: Students believe that total distance covered by a body is the same as the total displacement of a body in motion. Speed and average speed are sometimes confused by students. Average speed looks at the total distance covered per the time elapsed to complete the journey.

Introduction and Activity: A student is called to walk back and forth for a particular number of steps, say five steps forward and four steps back. Researcher asked students to find the distance and displacement covered by their colleague (considering forth as positive and back as negative). Students were asked to defend their answer in each case. Researcher introduced the lesson by evaluating their answers to explain the concept of distance and displacement. Teacher explained to students' the necessity to consider the signs in solving problems related to displacement. Motion to the left (East) was considered as positive, to the right (West) negative, upwards (North) positive and downwards (South) as negative. Students were made to understand that, distance is regardless of the direction of the motion.

Researcher displayed an animation on the screen showing the motion of a car moving along a path back and forth (A to B). Researcher used the animation to explain the concept.



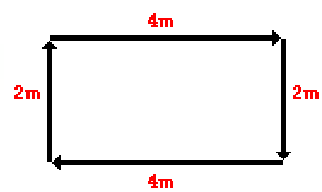
Considering the direction of the car as it moves from A to B and B to A, the total distance covered by the car was 200m whereas the displacement of the car was ZERO. This was because the car moved +100 m East (B to A) and returned at a distance of 100 m West (A to B).

The researcher in an attempt to evaluate their understanding asked one of the students to move 10 steps North and 5 steps back and 4 steps to the right and 2 steps to the left. Researcher sketched the motion of the students on the whiteboard and asked students to determine the distance and displacement covered stating their reasons.

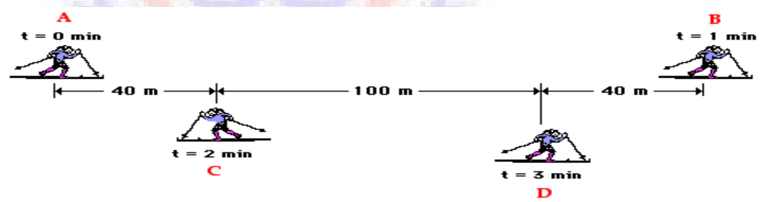
Four students were asked to present their answers on the board for further discussion. The researcher allowed the class to evaluate the answers on the board. This was to determine the extent to which the learners had grasped the concept.

The researcher displayed two separate animations showing the motion of a teacher and skier respectively. Students were asked to use the idea of distance and displacement to determine the distance and displacements.

1. A Physics teacher walks 4 meters East, 2 metres South, 4 metres West, and finally 2 metres North.



2. Use the diagram to determine the resulting displacement and the distance travelled by the skier during these three minutes.



Summary:

In conclusion, we can say that distance is "*how much ground an object has covered*" during its motion. It is regardless of the direction along which the object moves. Displacement on the other hand refers to "*how far out of place an object is*". It is the objects overall change in position.

Week 1, Lesson 2

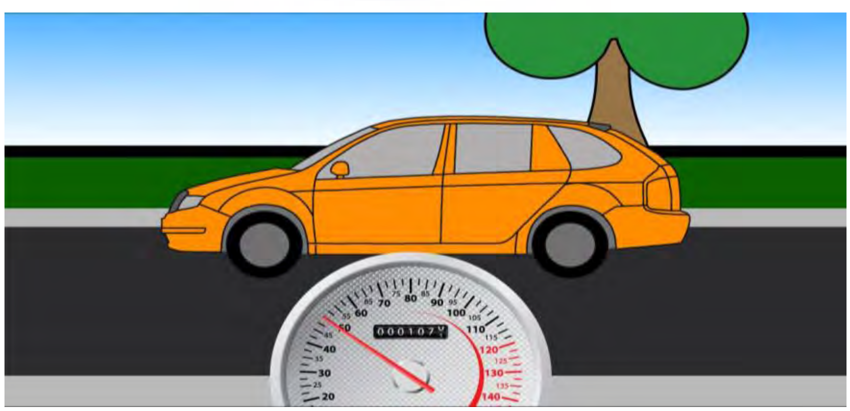
Title: Speed, Average Speed, Velocity, and Average Velocity

Materials: Textbook, Computer, Projector, White marker board.

Mode of Teaching: Discussion, Demonstration, and Power point presentation

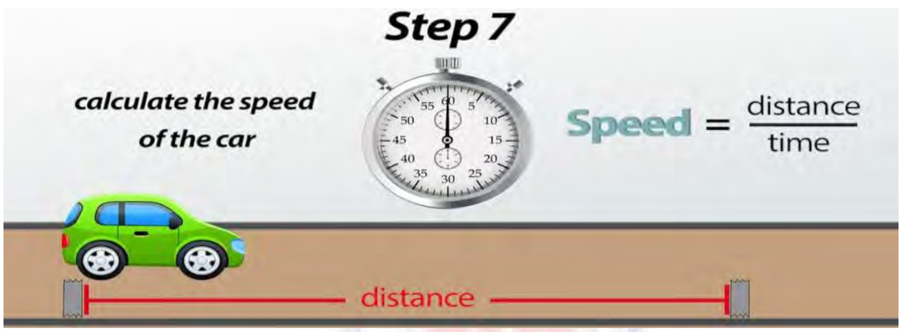
Students' misconception: Some science students think that speed and velocity are the 'same' quantity. Students perceive that if the velocity is constant then acceleration is also constant.

Introduction and Activity: The researcher introduces the lesson by displaying a car moving with it speedometer moving. The researcher asked the students what the speedometer represented.

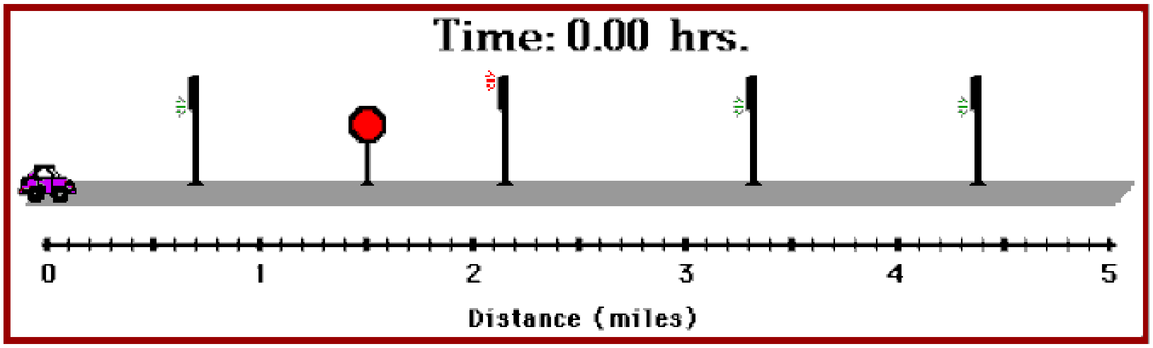


The researcher based on the answers given by the students introduced the lesson. Some answers given by some of the science students were not quite clear. Researcher in view of this based his explanation on the concept of speed from the animation displayed.

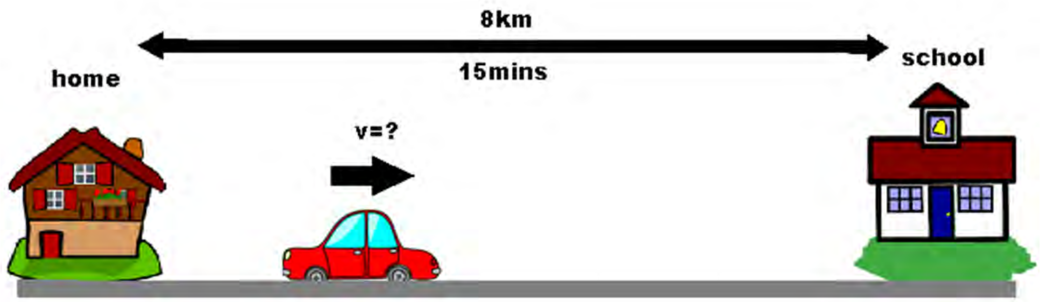
The researcher displayed another animation showing a car moving at a particular distance with a particular time. This was used to explain the concept. Speed was referred to as how much distance covered by an object within a certain period of time, regardless of the direction.



The concept of average speed was introduced by displaying an animation showing a car moving a distance. At each distance, the velocity of the moving car was determined. The average velocity of the car was determined finally. This allowed the researcher to explain to the students that, the average speed of the car refers to the distance covered by the car per the time elapsed for the journey. In the animation, the speed of the car at each distance could be summed up and divided by the number of laps. But to make it easier it was advisable to determine the average speed of the car by determining the total distance covered per time elapsed for the entire journey. Below was the animation used to explain the concept:



The idea of Velocity and average velocity was introduced by the researcher. An animation showing the motion of a car in a straight path was used. The idea of displacement was adopted in explaining the concept. The researcher echoed the idea of considering the direction of the object is it moved. The animation gave a clear understanding on the fact that, a body may be moving with a zero velocity but with a speed of 32km/h. Students observed that as the car moved back and forth (from home to school and vice versa), its displacement was found to be zero within 0.5 hours whereas distance covered by the car was 16km within 0.5 hours hence the velocity was zero. The researcher explained that velocity may be referred to as the change in position of an object per the allowed period to change its position. Below was the animation used to explain the concept:



The concept of average displacement was introduced by displaying an animation showing a Skier back and forth within a time frame. The velocity at each point was considered and finally the average velocity was determined. Using the animation, students were made to understand the fact that the direction of the motion was paramount in understanding the concept. In the determination of the average velocity of the car the direction was considered. The total change in position of the car per the time elapsed was considered as its average velocity.

Summary: Speed refers to "*how much distance covered per time elapsed, regardless of the direction of motion*". Average speed refers to "*how much total distance covered per time elapsed*". Velocity refers to '*the change in position of an object per the time elapsed, considering the direction of the motion*". Average velocity refers to "*the total displacement per the time taken with respect to the direction of the motion*". To distinguish speed from velocity, the researcher explained that, "*Speed had only magnitude (scalar) whereas Velocity had both magnitude and direction (vector)*".

Week 2

Title: Instantaneous velocity, Acceleration.

Materials: Textbook, Computer, Projector, White board.

Mode of Teaching: Demonstration, Discussion and Power Point Presentation

Students' misconception: Students believe that a car moving with a constant velocity is accelerating.

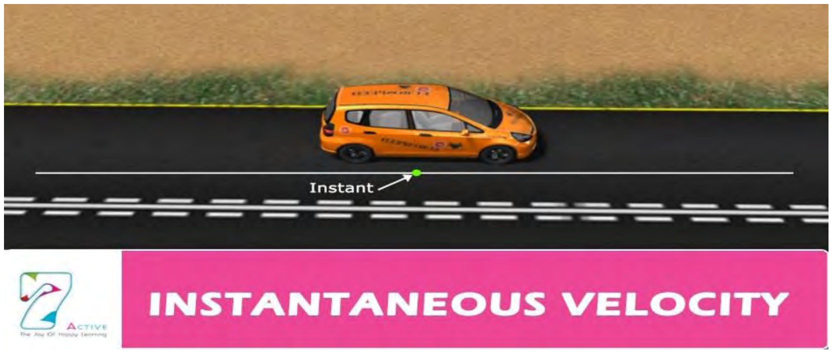
Introduction and Activity: The researcher introduced the lesson by displaying two separate cars, one moving with a constant velocity and the other moving with a changing velocity. Researcher enquired from students whether the two cars were accelerating.

Based on the response of the students, the researcher revisited the animation displayed and explained the concept of acceleration. The time rate of the change in the velocity of an object is acceleration. Thus as the velocity of the body changes within a time frame it is considered to be accelerating. A car in motion whose velocity remains the same cannot be considered to be accelerating. This is because its velocity is constant (not changing).

Below was the animation used to explain the concept of acceleration:

A (Changing velocity) B (constant velocity)

Instantaneous velocity was introduced by displaying an animation showing the velocity of a car at a particular distance at a particular time. Students were asked to be observe the velocity of the car at each instance.



The researcher used the motion of the car to explain the concept of instantaneous velocity. The velocity of a moving object at a particular time is referred to as instantaneous velocity.

Summary:

Acceleration of a moving object refers to "*change in the velocity of the moving object within an elapsed time*". The *velocity of a moving object at a specific point in time* is referred as Instantaneous velocity.

Week 3

Title: Motion of free fall.

Materials: Textbook, Computer, Projector, White board.

Mode of Teaching: Discussion, Demonstration and a Power Point Presentation

Students Misconception: Science students do not believe that two objects of different masses fall on the ground at the same time when released from the same height (in a free fall motion).

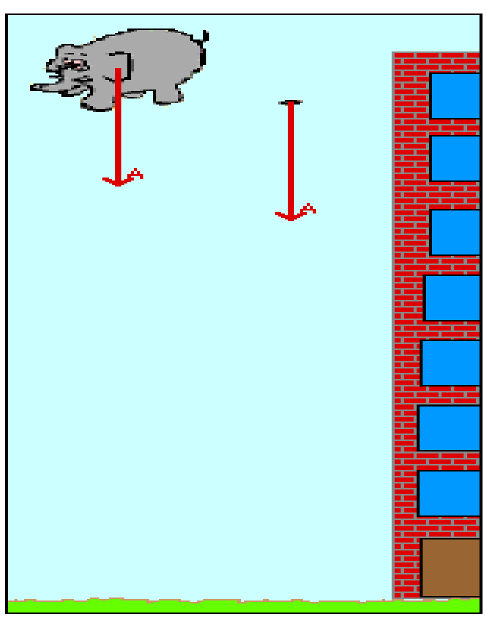
Introduction and Activity: The researcher introduced the lesson by displaying a conceptual reasoning question on the concept of motion of free fall.

Question:

Does a ball dropped out of the window of a moving car take longer to reach the ground than one dropped at the same height from a car at rest (air resistance is neglected)?

The researcher introduced the lesson by displaying an animation showing two objects of different masses being dropped from the same height. Students were made to observe the motion of the two objects as they fell. Students were made to reflect on their answers earlier on. The researcher discussed free-fall motion with students.

That the free-fall motion is a type of motion where objects or bodies fall under the sole influence of gravity. Thus Gravity is the sole force that acts on objects that fall freely.



Summary:

Free fall is any motion of a body where gravity is the only force acting upon it. All objects that falls freely from a height moves under the sole influence of gravity. The mass of the object has no impact on the fall of the body.

Week 4

Title: Projectile Motion

Materials: Textbooks, Computer, Projector, White board.

Mode of Teaching: Discussion, Demonstration and Power Point Presentation

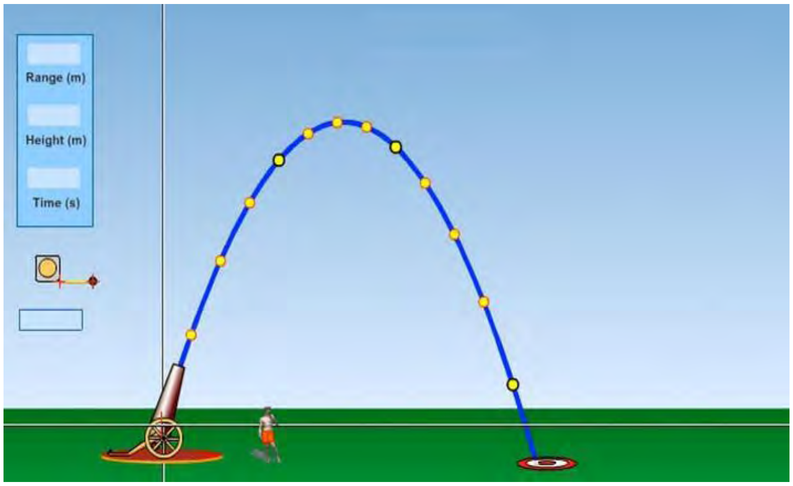
Students' challenge: Some science students find it very difficult to understand why the horizontal velocity of a projectile remains constant throughout whiles the vertical velocity changes with time.

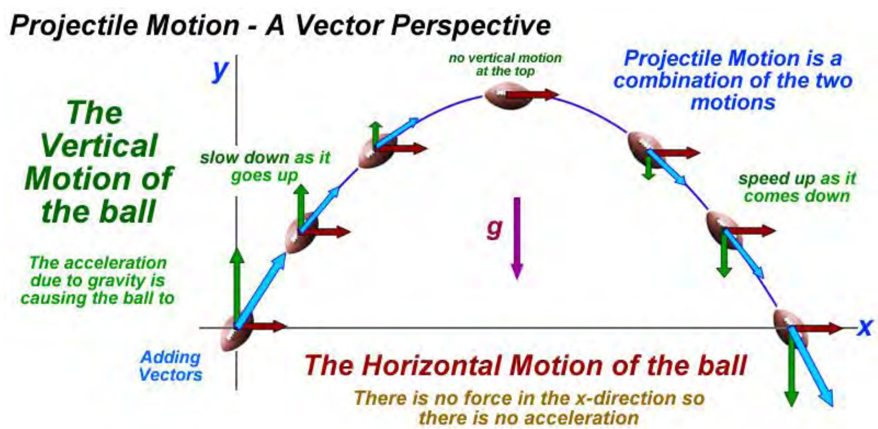
Introduction and Activity: The researcher introduced the lesson by throwing an object (marker) up and asked students to observe its motion. The researcher enquired from the students the force that acts on the body as it moves up and come down.

An animation was displayed on an object which was shot at an angle to the horizontal with an initial velocity and moves freely under gravity. Students were asked to observe the vertical velocity and horizontal velocity of the particle as it moved up and went down.

From the animation it was observed that the vertical velocity decreased as it moved up and increased as it moved downwards. The explanation was that the horizontal velocity was not seen to be changing in the process (remains constant) because acceleration due to gravity acts vertically but not horizontally. At the peak the object moves only in horizontal direction, hence the vertical velocity is zero. It is at this point that the object attained its maximum height.

Furthermore, the time of flight, which is the time taken to complete the motion (thus as the projectile moves up and down) is twice the time taken to reach the maximum height (only in situations where the point of projection is in the same level with the point where the object drops. This is because, the time taken to reach the maximum is half cycle of the motion. The researcher also explained that the horizontal distance covered by the particle is its range.





Summary:

Projectile is a particle when given an initial velocity moves freely under the influence of gravity. No force acts in the x – direction as the particle moves and fall. The horizontal velocity of the particle remains constant throughout its motion because gravity, *g,* acts vertically and not horizontally. At a certain point, the particle is seen to have only a horizontal motion (no vertical motion), hence the maximum height if the particle is attained at this point. The vertical velocity of the projectile decreases as it moves up and increases as it falls. The horizontal distance covered by the particle is referred to as its range. The time taken by the particle to complete its motion is the time of flight.

3.9.1 Post – Treatment Phase

At the end of the implementation of the treatment, a well-designed conceptual based test (twenty test items) on the Kinematics in one dimension and Projectile Motion was administered by the researcher and his colleague to students at Winneba and Swedru respectively. This test was similar to the one administered at the pre – treatment stage. This was done to measure the effect of computer animation on students' conceptual understanding and academic performance. A set of questionnaire was also administered by the researcher to evaluate students' interest before and after the implementation of the treatment. The results of the Pre Treatment test, Post-Treatment test and questionnaire was analysed and presented in the next chapter.

CHAPTER FOUR

ANALYSIS OF DATA AND DISCUSSION OF FINDINGS

4.0 Overview

This chapter presents the demographic characteristics of the respondents, results and findings of the study. The results are presented based on the research questions and research hypotheses. The information collected during the research has been analyzed in terms of descriptive and inferential statistics. Statistical analyses were carried out using SPSS version 16 for Windows and also Microsoft Excel. A number of tables have been constructed for easy presentation of data. T – test assuming equal variances was used for testing the hypothesis at 0.05% level of significance. The results are presented based on the following research questions:

1. What are the effects of the use of computer animations on students' conceptual understanding on Kinematics in one dimension and Projectile Motion?
2. What are the effects of computer animations on students' Performance on Kinematics in one dimension and Projectile Motion?
3. What are the effects of computer animations on students' interest in teaching Kinematics in one dimension and projectile motion?

4.1 Demographic Characteristics of Students

This section discussed the demographic characteristics of the respondents. The parameters discussed included group equivalence analysis before the study, age and gender of students.

4.2 Groups Entry Characteristic Analysis

The experimental group (n = 48) and control group (n= 45) were constituted from two different schools within the same Region. Unpaired sample t – test was used to determine whether there is a significant difference between the experimental and control groups prior to the introduction of the treatment phase. The results of the entry characteristics test of the groups are presented in Table 4.0.

Table 4.0: Entry Characteristics on Performance for the Groups

Groups	N	Mean	SD	t - value	p – value
Experimental	48	22.97	6.66	0.22	0.82*
Control	45	22.87	6.75		

*not significant, p > 0.05

In the Table 4.0, the mean and standard deviation scores of the experimental group were determined as 22.97 and 6.66 respectively in entry characteristics test conducted before the treatment. In the control group, the mean and standard deviation scores were determined as 22.87 and 6.75 respectively in the same entry characteristics test conducted before the treatment phase. No statistically significant difference [t (91) = 0.22, p = 0.82, p >0.05] was observed in the unpaired– sample t – test conducted on performance in the baseline test conducted for the two groups before the treatment phase.

According to this result, the mean score of the experimental group is almost within the same standard deviation range as the mean score of the control group. This indicates that both the experimental and control groups were equivalent in performance standard before the treatment. Hence any change in groups performance in MCBT after the treatment may be attributed to the new strategies used in the teaching process.

Results

As already indicated, the results and analysis of the data collected were done along the research questions.

4.3 Analysis of Data

Analysis with Respect to Research Question One

RQ 1: What is the effect of computer animations on students' Performance on Kinematics in one dimension and Projectile Motion?

The effect of computer animations on students' performance on Kinematics in one dimension and Projectile Motion was determined using descriptive statistics of the pre – test and post test scores of the experimental and control groups' performance in the MCBT. Table 4.3 shows the mean, standard deviation and mean gain for experimental group in MCBT conducted before and after the implementation of the treatment.

Table 4.3: Pre-Treatment and Post-Treatment Mean Scores for the Experimental Group and Control Group

Group	N	Pre-Treatment Mean	Post-Treatment Mean	Mean gain
Experimental	48	22.97 (6.66)	30.17 (6.81)	7.20
Control	45	22.87 (6.75)	26.84 (5.59)	3.97

*standard deviation in parenthesis

Table 4.3 shows that experimental group had pre-treatment and post-treatment mean scores of 22.97 (SD = 6.66) and 30.17 (SD = 6.81) respectively. Table 4.3 also shows performance mean gain of 7.20 after using the computer animations in an interactive learning setting to teach the experimental group. . Achieving a group average of 30.17 in the post-treatment test compared with 22.97 in the pre – treatment test confirms a clear improvement in the experimental group performance after using computer animations in an interactive learning setting. However, relative bigger standard deviation (SD = 6.81) in the pre-treatment test compared with standard deviation (SD = 6.66) shows relatively bigger variability in the scores of the individual students in the experimental group performance in the MCBT after using computer animations instructional approach in an interactive learning setting.

Again Table 4.3 shows that the control group had pretest and posttest mean scores of 22.87 (SD = 6.75) and 26.84 (SD = 5.59) respectively after being exposed to the traditional lecture method only and also shows the performance mean gain of 3.97. Achieving a group average of 26.84 in the post - treatment test compared with 22.78 in the pre – treatment test confirms an improvement in the control group. However, the improvement is not as large as students who were taught with computer animations in the Experimental Group. Also smaller standard deviation (SD = 5.59) in the post – treatment test compared with a standard deviation (SD = 6.75) pre – treatment test shows smaller variability in the scores of the individual students in the control group performance in the MCBT. Therefore by these results computer animations only had a real positive effect on the students' performance in kinematics in one direction and projectile motion.

Analysis with respect to Research Question 2

RQ 2: What is the effect of the use of computer animations on students' conceptual understanding on Kinematics in one dimension and Projectile Motion?

The effect of computer animations on students' conceptual understanding on Kinematics in one dimension and Projectile Motion were determined using descriptive statistics of the pre-treatment and post-treatment responses of the experimental group's to determine their level of conceptual understanding in the MCBT. Table 4.4 shows frequency and percentages on their conceptual understanding in MCBT for both control and experimental group conducted before and after implementation of the Treatment.

Table 4.4: Comparing Students' Conceptual understanding on Pre and Post – Treatment test Scores for Both Groups

Group		N	NU	PU	U
Experimental	Pre – treatment	48	35 (72.91)	10 (20.83)	3 (6.25)
	Post- treatment	48	5 (10.42)	14 (29.17)	29 (60.41)
Control	Pre – treatment	45	39 (86.67)	6 (13.33)	0 (0.00)
	Post – treatment	45	21 (46.7)	19 (42.22)	5 (11.11)

*NU: No understanding, PU: Partial Understanding, U: Complete Understanding, Percentages in parenthesis

Table 4.4 shows that 35 participants in the experimental group representing (72.91%) demonstrated no understanding in the pre–treatment test administered, 10 participants representing 20.83% showed partial understanding in the pre–treatment test and 3 participants representing 6.25% showed a complete understanding in the pre–treatment test administered. The table also shows that 5 participants representing 10.42% demonstrated no understanding in the post treatment test administered after the implementation of the treatment. The table also shows that 14 participants in the experimental group representing 29.17% demonstrated partial understanding in the post –treatment test administered. Furthermore, the table shows that 29 participants in the experimental group representing 60.41% demonstrated a good understanding in the post –treatment test administered.

Table 4.4 shows that 39 participants in the control group representing 86.67% demonstrated no understanding in the pre–treatment test administered, 6 participants demonstrated partial understanding representing 13.33%, none of the participants demonstrated a complete understanding in the pre–treatment test administered. The table also shows that 21 participants in the control group representing 46.7% demonstrated no understanding in the post–treatment test administered, 19 participant representing 42.22% demonstrated partial understanding and 5 participants representing 11.11% demonstrated complete understanding in the post–treatment test administered.

Comparing the data above, there is a great improvement in the conceptual understanding of the participants on Kinematics in one dimension and Projectile Motion after the implementation of computer animations in an interactive learning setting. Considering the percentage score for participants in the experimental group who had attained complete understanding (60.41%) after the implementation of the post–treatment test as compared to their pre-treatment score of complete understanding of 6.25% clearly shows a positive effect of the implementation of the treatment by the use of computer animations on Kinematics in one dimension and Projectile Motion. Also, there was a little improvement in the conceptual understanding of participants in the control group; 39 participants representing 86.67% demonstrating no understanding in the pre–treatment test administered compared to 21 participants representing 46.7 % demonstrated no understanding in the post–treatment test. However, the table also shows 6 participants representing 13.33% who demonstrated partial understanding in the pre–treatment test administered as compared to 19 participants representing 42.22% demonstrating partial understanding in the post–treatment test administered. Also none of the participants demonstrated a complete understanding in the pre–treatment test comparable to 5 participants representing 11.11% demonstrating complete understanding in the post – treatment. The above data reveals that there is a quite remarkable improvement in the conceptual understanding of participants in the experimental group on kinematics in one direction and projectile motion.

Analysis with Respect to Research Question Three

RQ 3: What is the effect of computer animations on student's interest in teaching and learning Kinematics in one dimension and Projectile Motion?

To find out the effect of computer animations on student's interest in teaching and learning of Kinematics in one dimension and Projectile Motion responses from questionnaire administered at the end of the treatment phase were computed and used to determine its effect on student's interest in teaching and learning Kinematics in one dimension and Projectile Motion. Tables 4.5 and 4.6, shows frequency count and percentages of students responses on questionnaires related to interest of students towards teaching and learning of Kinematics in one dimension and Projectile Motion before and after the treatment stage.

Table 4.5: Response of Students' on their Interest towards Physics Teaching (Experimental Group)

Before Treatment						After Treatment				
SA (5)	A (4)	NS (3)	D(2)	SD (1)	Interest towards Physics Teaching	SD (1)	D(2)	NS (3)	A(4)	SA (5)
0 (0.00)	0 (0.00)	1 (2.08)	11 (22.91)	36 (75.00)	1. I look forward to eagerly participate in physics lessons.	0 (0.00)	0 (0.00)	1 (2.08)	43 (89.58)	4 (8.33)
0 (0.00)	0 (0.00)	2 (4.17)	18 (37.5)	28 (58.33)	2. Lessons in the class were fun.	0 (0.00)	0 (0.00)	0 (0.00)	45 (93.75	3 (6.25)
12 (25.0)	33 (68.75)	0 (0.00)	1 (2.08)	2 (4.17)	3. I disliked lessons in the class.	34 (70.08)	13 (27.08)	1 (2.08)	0 (0.00)	0 (0.00)
18 (37.5)	22 (45.83)	4 (8.33)	3 (6.25)	1 (2.08)	4. Lessons in the class bored me.	37 (77.08)	9 (18.75)	2 (4.17)	0 (0.00)	0 (0.00)
0 (0.0)	0 (0.0)	1 (2.0)	10 (20.83)	37 (77.08)	5. The class was one of the most interesting classes	0 (0.00)	0 (0.00)	2 (4.17)	44 (91.67)	2 (4.17)

In Table 4.5, it was evident from the responses from the questionnaire that 75% of experimental group (36) strongly disagreed to eagerly participate in Physics lessons and 22.92% disagreed on the same question before the implementation of the treatment. Also, 58.33% of experimental group strongly disagreed that Kinematics in one dimension and Projectile Motion were fun and 37.5% disagreed on the same question. This shows students' disinterest in teaching and learning of Kinematics in one dimension and Projectile Motion before implementation. The data also revealed that 68.75 % of experimental group agreed that they disliked lessons in class and 25.00% strongly agreed on the same note. The table shows that 45.83% and 37.50% of experimental group agreed and strongly agreed respectively that lessons were boring to them before the implementation of the treatment. The data also shows that 77.08% of the experimental group strongly disagreed that Physics class was one of the most interesting class whereas 20.83% of experimental group also disagreed that the Physics lesson was more interesting.

After the treatment stage, 89.58% of experimental group agreed they looked forward to eagerly participate in Physics lessons after the implementation of the treatment and 8.33% also agreed on the same note. Also 93.75% of the experimental group agreed that lessons in Physics class were fun after the implementation of the treatment and 6.25% strongly agreed on the same note. However, 70.83% of experimental group strongly disagreed they disliked lessons in class after the implementation of the treatment and 27.08% disagreed they disliked lesson in class after the treatment stage. The table also shows that 77.08% of experimental group strongly disagreed lessons in the class bored them after the implementation of the treatment and 18.75% disagreed on the same note. Finally, 91.67% of experimental group agreed the class was one of the most interesting classes and 4.17% strongly agreed on the same question after the implementation of the treatment.

Comparing the responses of experimental group on interest of students towards teaching and learning of Kinematics in one dimension and Projectile Motion before and after implementation of treatment showed an improvement of students' interest.

Table 4.6: Response of Students' on their Interest towards Physics Teaching (Control Group)

Before Treatment						After Treatment				
SA (5)	A (4)	NS (3)	D(2)	SD (1)	Interest towards Physics Teaching	SD (1)	D(2)	NS (3)	A(4)	SA (5)
0 (0.00)	0 (0.00)	2 (4.44)	10 (22.22)	33 (73.33)	1. I look forward to eagerly participate in physics lessons.	5 (11.11)	6 (13.33)	1 (2.22)	23 (51.11)	10 (22.22)
0 (0.00)	0 (0.00)	0 (0.00)	18 (40.00)	27 (60.00)	2. Lessons in the class were fun.	7 (15.56)	7 (15.56)	0 (0.00)	21 (46.67)	10 (22.22)
15 (33.33)	30 (66.67)	0 (0.00)	0 (0.00)	0 (0.00)	3. I disliked lessons in the class.	22 (45.83)	10 (22.22)	1 (2.22)	7 (15.56)	5 (11.11)
23 (51.11)	22 (48.89)	0 (0.00)	0 (0.00)	0 (0.00)	4. Lessons in the class bored me.	22 (45.83)	9 (20.00)	2 (4.44)	7 (15.56)	5 (11.11)
0 (0.0)	0 (0.0)	0 (0.00)	8 (17.78)	37 (82.22)	5. The class was one of the most interesting classes	8 (17.78)	7 (15.56)	2 (4.44)	10 (22.22)	18 (40.00)

In Table 4.6, it was evident from the responses from the questionnaire that 73.33% of control group strongly disagreed to eagerly participate in Physics lessons and 22.22% disagreed on the same question before the implementation of the treatment. Also, 60.00% of control group strongly disagreed that Kinematics in one dimension and Projectile Motion were fun and 40.00% disagreed on the same question. This showed students disinterest in teaching and learning of Kinematics in one dimension and Projectile Motion before implementation. The data also revealed that 33.33% of control group strongly agreed that they disliked lessons in class and 66.67% agreed on the same note. The table showed that 51.11 and 48.89% of control group strongly agreed and agreed respectively that lessons were boring to them before the implementation of the treatment. The data showed that 82.22% of the control group strongly disagreed that Physics class was one of the most interesting class whereas 17.78% of control group also disagreed that the Physics lesson was more interesting.

The table also shows that 51.11% of control group agreed they looked forward to eagerly participate in Physics lessons after the implementation of the treatment whereas 22.22% strongly agree on the same note. Also, 46.67% of control group agreed that lessons in Physics class were fun after the implementation of the treatment whereas 22.22% strongly agree on the same note. However, 45.83% of control group strongly disagreed they disliked lessons in class after the implementation of the treatment and 22.22% also disagreed on the same note. The table also shows that 45.83% of control group strongly disagreed lessons in the class bored them after the implementation of the treatment and 20.00 disagreed on the same note. Finally, the table shows that, 40.00% of control group strongly agreed the class was one of the most interesting classes after the implementation of the treatment and 22.22% agreed on the same note.

Comparing the responses of control group on interest of students towards teaching and learning of Kinematics in one dimension and Projectile Motion before and after implementation of intervention showed a slight improvement of students' interest.

Testing of Hypothesis with respect to Research Question One

To determine whether the difference in performance between the experimental group and control group were statistically significant, research question one was formulated into a null hypothesis and tested. It was hypothesized that:

> H_{01}: There is no significant difference in performance of students exposed to computer animations instructional approach and their counterparts exposed to the traditional lecture method in teaching Kinematics in one dimension and Projectile Motion.

To test this hypothesis, an unpaired sample t – test was performed and results were presented in Table 4.7.

Table 4.7: Inferential Statistics for Groups' Mean Score Difference for the Post – treatment test

Groups	N	Mean	SD	t - value	p - value
Experimental	48	30.17	6.81	2.54	0.012*
Control	45	26.84	5.59		

*significant, $p < 0.05$

The results in Table 4.7 showed that there was a significant difference between the post–treatment test scores of students exposed to computer animations instructional approach (M = 30.17, SD = 6.81) and those exposed to the traditional lecture method (M = 26.84, SD = 5.59), [t = (91) 2.54, p = 0.012]. Hence the null hypothesis was rejected.

Testing of Hypothesis with respect to Research Question Two

To determine whether the difference in conceptual understanding of the experimental group and control group were statistically significant, research question two was formulated into a null hypothesis and tested. It was hypothesized that:

> H_{02}: There is no significant difference in conceptual understanding of students exposed to computer animations instructional approach and their counterparts exposed to the traditional lecture method in teaching Kinematics in one dimension and Projectile Motion.

Table 4.8: Inferential Statistics for Groups' Mean Score Difference for the Post treatment test

Groups	N	Mean	SD	t - value	p - value
Experimental	48	18.08	3.66	2.71	0.0188*
Control	45	15.86	3.33		

*significant, $p < 0.05$

The results showed that there is significant difference between the conceptual understanding of students exposed to computer animations instructional approach (M = 18.08, SD = 3.66) and those exposed to the traditional lectured method only (M = 15.86, SD = 3.33), [t = (91) 2.71, p = 0.0188]. Hence the null hypothesis was rejected.

4.5 Discussion of Findings

Research Question 1

What is the effect of the use of computer animations on students' performance on Kinematics in one dimension and Projectile Motion?

The study set out to find the effect of computer animations' instructional approach on the performance of SHS 2 students on Kinematics in one dimension and Projectile Motion. It yielded some information about the effect of computer animations' instructional package on Kinematics in one dimension and Projectile Motion on students' performance. In the earlier part of this chapter, findings were mainly presented and analysed based on the specific research questions with only brief comments on them. In this part however, the findings have been discussed in detail under the research questions set to guide the study.

Findings with respect to research question one were positive in that, the performance of SHS 2 students exposed to the computer animations instructional tool was better that their counterparts exposed to the traditional lecture method approach to the teaching and learning of Kinematics in one dimension and Projectile Motion. The findings of the study thus supported the research hypothesis that there is a statistically significant difference in performance between students exposed to computer animations' instructional approach and their counterparts exposed to traditional instructional approach for teaching and learning of Kinematics in one dimension and Projectile Motion. The independent measures t – test analysis have been presented in Table 4.7.

These findings reaffirm the previous studies of Kara and Kahraman (2008), Yeşilyurt (2007), Kiboss, Wekesa and Ndirangu (2006); Akour (2006) and Akpan and Andre (2000) conducted in Biology, which indicated that the achievement scores of students exposed to computer animations were higher than those students exposed to traditional, conventional or regular methods of instruction.

The findings are also in congruence with those of Mwei, Too and Wando (2011), Udousoro (2000) in Mathematics, Baryak (2008), Karamustafaoğlu, Aydin and Özmen (2005), Kiboss and Ogunniyi (2003) in Physics, and Okoro and Etukudo (2001) in Chemistry. These studies confirmed that computer animations' instructional tool has been effective in enhancing students' performance than the traditional lecture approach in subjects Physics, Chemistry, Biology and Mathematics. For example, in a study to investigate the effects of computer animations on university students' achievements in Physics, Baryak (2008) affirmed that students in the experimental group who were exposed to computer assisted instruction were more successful than students in the control group who were exposed to face –to–face instruction.

However, the findings of the study contradict that of Owusu, Monney, Appiah and Wilmot (2009), Strauss and Kinzie (1994), and Duhrkopf and Kramer (1991). These studies indicated that students' achievement in Biology was not improved significantly by means of computer animations instruction. Owusu, Monney, Appiah and Wilmot (2009) for instance, investigated the effects of computer assisted instruction (CAI) on performance of SHS Biology students in Ghana. The findings indicated that, students instructed with the traditional approach performed better on the posttest than those instructed with the CAI.

Hence the effect of computer animations' instructions on students' performance seems to be mixed. However, based on the findings of the study a strong case can be made in favour of incorporating computer animations' instructional tool in Physics teaching and learning at the SHS level in Ghana.

Research Question 2

What is the effect of computer animations on students' conceptual understanding on Kinematics in one dimension and Projectile Motion?

Findings with respect to research question two were positive in that, the conceptual understanding of students in the experimental group exposed to computer animations' instructional approach did improve significantly than those exposed to the traditional lecture approach. This also, positively affected the performance of the experimental group as the quantitative questions in the post test were conceptually based. One needed to have conceptual understanding before he/she could solve.

Analysis of the research literature (Cummings, Laws, Redish & Conney, 2004) suggested that computer animations help students to have a better understanding of related concepts in Physics to improve their performance in understanding. Also, studies of Feurzeig and Roberts (1999) revealed that most students in the experimental group who were exposed to computer modelling and animation in science education were able to grasp concept taught in Mechanics than those exposed to the traditional lecture method.

The findings are in congruence to studies conducted by Concari, Giorgi, Camara and Giacosa (2006), and Joolingen, Jong, Lazonder, Savelsbergh and Manlove (2005). Their studies indicated that animations used in Physics teaching allow the students to explore and to visualize graphic representations. The studies also suggested that learning with computer animations is closely related to a specific form of constructivist learning, namely scientific discovery learning. This allows students to create their own knowledge hence improve on their conceptual understanding. Students can interact with the system by changing the parameters to the desired ones and observe the effect of those changes.

Based on the findings of the study, a strong case can be made on the positive or improved effect of computer animations on the conceptual understanding of students in Kinematics in one dimension and Projectile Motion.

Research Question 3

What is the effect of computer animations on students' interest in teaching and learning Kinematics in one dimension and Projectile Motion?

Findings with respect to research question three showed that there was a significant improvement in the interest of students towards the teaching and learning of Kinematics in one dimension and Projectile Motion after the implementation of the treatment.

Analysis of the research literature (Buabeng & Ntow, 2010) suggested that, there were wide range of reasons for which students' showed negative response in Physics. Among the reasons included perceived difficulty of Physics and mode of instruction in teaching Physics, hence suggested a modern approach in making the subject more interesting.

The findings corresponds to studies conducted by Demirci (2003) and Antwi, Anderson and Hagan-Sakyi (2015) that tested the effect of computer animations on students' interest towards teaching and learning of Kinematics in one dimension and Projectile Motion. For example, in the study of Antwi, Anderson, and Hagan-Sakyi (2015), a students' observation checklist was developed, and this was used to record students' behaviour (concepts, skills, processes, interest and attitudes). The method employed was computer assisted instruction. It was interactive and learner centred. In effect students' interest and attitude towards physics teaching and learning improved.

The findings have equally added weight to the campaign of shifting from traditional ways of teaching and learning Physics (Kinematics in one dimension and Projectile Motion) and embrace computer animations' instructional approach in an interactive learning setting. Importance of this is that students' become active in teaching and learning processes; with its associated benefits as highlighted by the results of the study.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

In this chapter, the summary of findings of the study have been documented. There were three major findings that emerged out of the treatment used. Conclusions, recommendations and suggestions were made based on the findings for further research work.

5.1 Summary

The study investigated the effect of the use of computer animations on SHS 2 Science students in Uncle Rich Senior High School in the Effutu Municipality. Students' performance, conceptual understanding and interest by the use of computer animations on Kinematics in one dimension and Projectile Motion were determined. Population of 93 students, constituted from two equivalent classes was used for the study. The duration for treatment activities with the students was five (5) weeks.

The main focus of the study was to measure control group's performance in MCBT and experimental group's performance in the same test before and after the treatments were administered. The control group was taught using traditional lecture method while the experimental group was taught using computer animations instructional tool in an interacting learning setting. Two research instruments were used to collect data for the study. Data collected from the MCBT were quantitatively analyzed and the main findings were as follows:

Effects of the use of computer animations on students' performance on selected topic in Mechanics.

The study revealed that computer animations instructional tool in an interactive learning setting had positive effect on the students' performance in Kinematics in one dimension and Projectile Motion. The results showed that using traditional lecture method on the participants, the mean score of the control group rose from 22.87 to 26.84, and also the mean score of the experimental group rose from 22.97 to 30.17. This indicates that computer animations instructional tool in an interactive learning setting had a positive effect on the students' performance in the Kinematics in one dimension and Projectile Motion. There was a slight improvement in the performance of participants in the control group.

However, post hoc analyses revealed that the performance of the experimental group exceeded their counterpart in the control group where students were instructed using traditional lecture method.

Effects of the use of computer animations on students' conceptual understanding on Kinematics in one dimension and Projectile Motion

The study revealed that computer animations instructional tool in an interactive learning setting had positive effect on the students' conceptual understanding in Kinematics in one dimension and Projectile Motion. The results showed that using traditional lecture method on the participants, the mean score of the control group was 15.86, and also the mean score of the experimental group was 18.08. This indicates that computer animations instructional tool in an interactive learning setting had a positive effect on the students' conceptual understanding in Kinematics in one dimension and Projectile Motion.

However, post hoc analyses revealed that the conceptual understanding of the experimental group exceeded their counterpart in the control group where students were instructed using traditional lecture method.

Descriptive statistics result from the MCBT (qualitative questions) conducted on the experimental group before and after the implementation of the treatment showed that participant in the experimental group had improved tremendously compared to their pre–stage of MCBT (See Table 4.4)

Effects of computer animations on student's interest in teaching and learning Kinematics in one dimension and Projectile Motion

Responses on questionnaire administered computed into frequency and percentages after the treatment clearly exposed the interest level of students in the experimental group. The result showed that majority of the students had negative interest towards the teaching and learning of Kinematics in one dimension and Projectile Motion before the implementation of the treatment. Responses on questionnaire by the control group also revealed that the interest level was negative before implementation. After the treatment stage, responses on questionnaire reveals that there was a slight improvement in the interest towards teaching and learning of Kinematics in one direction and projectile motion.

5.2 Conclusion

Computer animations' instructional approach in an interactive learning setting used had proven to be an effective approach to teaching and learning of Kinematics in one dimension and Projectile Motion at SHS 2. Within the limitations of the study, the instruments designed to improve upon students' abysmal performance in Kinematics in one dimension and Projectile Motion yielded positive results. The study showed that students learn better in an interactive learning environment; more students are motivated to learn more to make meaningful contributions in Physics classrooms. Also students develop more interest in Physics studies when they interact with each other that when they work alone.

Moreover, per the analyses of the posttest results of the two groups, it is right to conclude that, computer animations' instructional tool in an interactive learning setting had positive effect than traditional lecture strategy only.

Also, it is right to conclude from the findings of the study that, in enhancing the performance of students in Kinematics in one dimension and Projectile Motion, both the teacher and the students have unique roles to play. Teachers should be seen as facilitators, and coaches; people who assist students to learn for themselves. However teachers should not assume that students' mind is *"tabula rasa"* or empty slate that should be filled with teacher's information. Hence students must be fully involved in the teaching and learning process from the beginning to the end of the lesson.

Finally, the effect of computer animations on students' conceptual understanding was a great subject under study. The treatment clearly had a positive effect on the conceptual understanding of the students' on kinematics in one dimension and projectile motion. It is therefore more appropriate to conclude from the findings of the study that, in teaching Kinematics in one dimension and Projectile Motion, computer animation instructional tool must be deployed in the teaching and learning process. Also, the use of computer animations from the findings of the study had a positive effect on the interest level of the students towards teaching and learning of Kinematics in one dimension and Projectile Motion.

5.3 Recommendations

Based on the major findings of the study and conclusions drawn, some recommendations are made for consideration.

1. Teachers should be encouraged to use computer animations' instructional tool in an interactive learning setting to improve students' level of conceptual understanding in Physics, especially Kinematics in one dimension and Projectile motion.
2. Physics teachers should develop interest in the use of computer animations' instructional approach in an interactive learning environment in order to enhance students' performance kinematics in one dimension and projectile motion and break from the old traditional belief underlying teaching and learning of Physics.
3. Teachers should be encouraged to use computer animations' instructional tool in an interactive learning setting to teach other science related subjects since it has the potential to improve upon students' performance at Senior High School level.

4. In service training in the form of workshops, conferences, seminars should be organized by governments to prepare teachers to incorporate computer animations in their teaching at Senior High School level.
5. Science educators and curriculum planners should integrate innovative pedagogical strategies like computer animation instructional tool in an interactive learning setting into their various science teacher education programmes.

5.4 Suggestions for further research

Based on the findings of this study, the following suggestions for further research are made:

1. It is suggested that the study (computer animation instructional tool) should be replicated in other Physics concepts. This would also provide a basis for greater generalization of the conclusion drawn from the analysis.
2. Also, the study should be replicated using large sample size to provide a basis for more generalization of the conclusion drawn from the findings of the study about the effectiveness of computer animations' instructional approach in an interactive learning setting use in the teaching of Physics.

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APPENDIX 1

UNIVERSITY OF EDUCATION, WINNEBA

PRE – TREATMENT TEST

MECHANICS CONCEPTUAL BASED TEST

SCHOOL:

AGE:

CLASS:

GENDER:

DURATION: 45 minutes

INSTRUCTION: There are twenty conceptual based questions in all. Supply the correct answer that best fits each question. Now answer the following:

1. Does a car speedometer measure speed, velocity, or both? Explain your answer in each case.
2. Can an object have varying speed if its velocity is constant? If yes, give examples.
3. When an object moves with constant velocity, does its average velocity during any time interval differ from its instantaneous velocity at any instant?
4. In drag racing, is it possible for the car with the greatest speed crossing the finish line to lose the race? Explain.
5. If on object has a greater speed than a second object, does the first necessarily have a greater acceleration? Explain using examples.
6. Compare the acceleration of a motorcycle that accelerates from 80 km/hr to 90 km/hr with the acceleration of a bicycle that accelerates from rest to 10 km/hr in the same time.
7. A person standing at the edge of a cliff throws one ball straight up and another ball straight down, each at the same initial speed. Neglecting air resistance, which ball hits the ground below the cliff with the greater speed?

   a. ball initially thrown upward;
   b. ball initially thrown downward;
   c. neither; they both hit at the same speed.
8. Can an object be increasing in speed as its acceleration decreases? If so, give an example. If not, explain.

9. As a freely falling object speeds up, what is happening to its acceleration due to gravity –does it increase, decrease, or stay the same?

10. How would you estimate the maximum height you could throw a ball vertically upward? How would you estimate the maximum speed you could give it?

True or False questions on concepts and equations of a projectile

A projectile is launched. Assuming that air resistance is negligible, which of the following are true?

11. Any object upon which the only acting force is the force of gravity is called a projectile.

12. The projectile problem involves constant velocity along the horizontal direction and constant acceleration in the vertical direction.

13. The vertical component of the velocity of the projectile is constant.

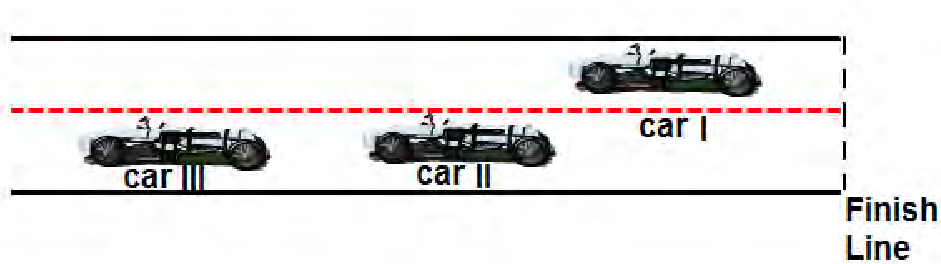
14. The horizontal component of the velocity of the projectile is constant.

15. The acceleration is constant.

Supply the answer that best fit

16. Does a ball dropped out of the window of a moving car take longer to reach the ground than one dropped at the same height from a car at rest?

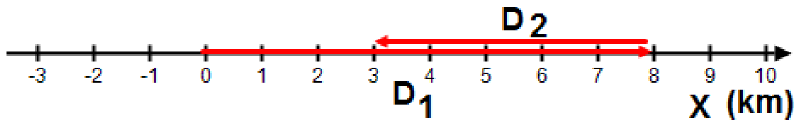
17.



A snapshot of three racing cars is shown on the diagram. All three cars start the race at the same time, at the same place and move along a straight track. As they approach the finish line, which car has the lowest average speed?

A. Car I
B. Car II
C. Car III
D. All three cars have the same average speed
E. More information is required.

18.



The diagram above illustrates a person who, starting from the origin, walks 8 km east during first day, and 5 km west the next day. Use it to answer questions 18 and 19.

What is the net displacement of the person from the initial point in two days?
A. 6 km, east
B. 3 km, east
C. 10 km, west
D. 5 km, west
E. 9 km, east

20. What is the traveled distance of the person from the initial point in two days?

A. 13 km
B. 3 km
C. 10 km
D. 5 km
E. 9 km

APPENDIX 2

UNIVERSITY OF EDUCATION, WINNEBA

POST – TREATMENT TEST

MECHANICS CONCEPTUAL BASED TEST

SCHOOL:

AGE:

CLASS:

GENDER:

DURATION: 45 minutes

INSTRUCTION: There are twenty conceptual base questions in all. Supply the correct that fits each question. Now answer the following.

1. Two sets of coffee filters are dropped on earth. One set of coffee filters is <u>heavier</u> than the other, but they both have the same size and shape. Will the filters land at the same time? Why or why not?

2. A train covers 60 miles between 2 p.m. and 4 p.m. How fast was it going at 3 p.m.?

3. Is it possible that the car could have accelerated to 55mph within 268 meters if the car can only accelerate from 0 to 60 mph in 15 seconds? Explain your answer.

4. Mr. Letourneau is flying his broom stick parallel to the ground. He undergoes two consecutive displacements. The first is 100 km 10 degrees west of north, and the second is 120 km 50 degrees east of north. What is the magnitude of the broom stick's displacement?

5. A rock is dropped from the top of a sailboat's mast while at rest and hits the deck below. Now the boat is moving at a constant speed and the rock is dropped from

the same point. Will it hit the deck at the same point or a different point it hit when the boat was at rest? Comment on your answer.

6. Can an object have an eastward velocity and a westward acceleration? Explain.

7. Can the displacement be greater than the distance travelled by an object? Give reasons.

8. Can the speed of a body be negative? Give your reason.

9. Can a body have a constant velocity and still have varying speed? Comment on your answer.

10. Can a body have zero velocity and still be acceleration? Comment on your answer.

11. Can an object have eastward velocity while experiencing a westward acceleration? Comment on your answer.

12. Is it possible for a body to be accelerated without speeding up or slowing down? If so give example.

13. Under what condition is the average velocity equal to the instantaneous velocity?

14. Why is the speed, in general, greater than the magnitude of the velocity?

15. Is the direction of acceleration same as the direction of velocity? Explain

16. Two balls of different masses (one lighter and other heavier) are thrown with same initial speed. Which one will rise to the greatest height? Give reasons to your answer.

17. Two balls of different masses (one lighter and other heavier) are thrown vertically upwards with the same speed. Which one will pass through the point of projection in their downward direction with greater speed? Explain your comment.

18. Is it possible to have a constant rate of change of velocity when velocity changes both in magnitude and direction? If yes, give one example.

19. If the displacement of a body is zero, is the distance covered by it necessarily zero? Comment with suitable illustration.

20. Can the direction of motion of a body change if its velocity is changing at uniform rate? Explain your comment.

APPENDIX 3

UNIVERSITY OF EDUCATION, WINNEBA

DEPARTEMENT OF SCIENCE EDUCATION

QUESTIONNAIRE

These are questions designed by the researcher to seek the opinion of the respondents on their interest towards teaching and learning of Physics in the Ghanaian SHS classroom. Respondents are hereby assured of anonymity and confidentiality. Respondents are highly requested to be truthful enough to assist the researcher.

Instructions: You are requested to provide the following information.

Please tick (√) your response to each questionnaire.

SCHOOL: ………………………………………………………………………….

DATE OF BIRTH (dd/mm/yy): ………………………………………………….

CLASS: ……………………………………………………………………………..

GENDER: **MALE** ☐

FEMALE ☐

Before Treatment					Interest towards Physics Teaching	After Treatment				
SA (5)	**A (4)**	**NS (3)**	**D (2)**	**SD (1)**		**SD (1)**	**D (2)**	**NS (3)**	**A (4)**	**SA(5)**
					1. I look forward to eagerly participate in physics lessons.					
					2. Lessons in the class were fun.					
					3. I disliked lessons in the class.					
					4. Lessons in the class bored me.					
					5. The class was one of the most interesting classes					