UNIVERSITY OF EDUCATION, WINNEBA

USING ANIMATIONS AND MODELS TO ENHANCE THE PERFORMINCE OF STUDENTS IN BIOLOGY AT THE ST. MARY'S BOYS SENIOR HIGH SCHOOL

EVELYN BUATSI

2013

UNIVERSITY OF EDUCATION, WINNEBA

USING ANIMATIONS AND MODELS TO ENHANCE THE PERFORMINCE OF STUDENTS IN BIOLOGY AT THE ST. MARY'S BOYS SENIOR HIGH SCHOOL

EVELYN BUATSI

(7110130005)

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

OCTOBER, 2013

DECLARATION

Student's Declaration

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

....

EVELYN BUATSI DATE

Supervisor's Declaration

I hereby declare that the preparation and presentation of this dissertation were supervised in accordance with the guidelines on supervision of dissertations laid down by the University of Education, Winneba.

....

DR. YAW AMEYAW DATE

ACKNOWLEDGEMENT

Thanks, glory and adoration be unto the most-high God for making this dissertation a success. I would also wish to express my profound gratitude to my principal supervisor, Dr. Yaw Ameyaw, a Senior lecturer in the Department of Science Education, University of Education, Winneba, for his immense contribution towards the completion of this work.

I also wish to express my sincerest appreciation to Dr. J. Nana Annan in the Department of Science Education, University of Education, Winneba, who taught me Principles of Research Methods, Statistical Analysis and Evaluation. I am seriously indebted to Mr. Cosmos Eminah, a chemistry tutor at Winneba Secondary School, It was his advice, guidance, encouragement and suggestions that made this work see the light of the day. God richly bless him.

Last but not the least, I would like to say a big thank you to my lovely husband, for his understanding and support, both spiritually and financially. I am also grateful to all my course mates, especially Alexander Hero Asare.

DEDICATION

I dedicate this work to my beloved children Elikem Kudjawu, Hannah Edith Cromwell and Charles Chris Cromwell, as well as my husband, Albert Samuel Cromwell

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

This study investigated the use of animations and models to enhance the teaching and learning of biology at St Mary‟s Boys Senior High School, Takoradi in the Western Region of Ghana. It explored the views of students on biology as a subject as well as the views of students on the role of animations in learning. The population consisted of 60 students from two intact classes of Saint Mary‟s Boys Senior High School in the Western Region of Ghana. Based on the results of the pre-test, one of the classes was assigned to the control group, and the other to the experimental group. Interviews, questionnaires and test were used as the main instruments to collect data for the study. These instruments were examined and modified by lecturers in the Department of Science Education, University of Education, Winneba. The Cronbach Alpha reliability of the questionnaires, pre-test and post-test used were determined to have values ranging between 0.75 and 0.81. An animation-oriented instructional approach was applied in teaching the experimental group whereas the control group was taught without the use of models or animations. Analysis of the data gathered with the various instruments was conducted using the Statistical Package for The Social Sciences (SPSS) version 16. The results showed that, there was a statistically significant difference in performance between the experimental and control group. The experimental group performed better in the post-test than the control group. It was recommended that biology teachers should employ an animation-oriented instructional approach in teaching biology to enhance students‟ understanding and performance in the subject.

CHAPTER ONE

INTRODUCTION

1.2 Overview

This chapter provides an introduction to the study. It focuses on the use of biological animations and models to enhance students" performance in biology. The statement of the problem gives an insight into how most of the teaching approaches are not able to give students firsthand information as well as sustaining their interest. In addition, this study was purposed to find out the effect of the intervention on students" performance. Furthermore, the research questions based on the objectives of the study were addressed as well as the significance, limitations and delimitation.

1.2 Background to the Study

Education may be seen as a process by which individuals acquire knowledge, skills and attitudes, which enables them to develop their faculties in full. One of the benefits of good education is that it enables individuals to contribute to the development in the quality of life for themselves, their communities and the nation as a whole. According to Anderson (2006), when the objectives of education are achieved, learning becomes meaningful and fulfilling to the learner.

Science education has been recognized worldwide as being vital for a nation's overall economic development. When used effectively science and technology are able to improve productivity and meet the needs of society. This has been demonstrated in most developed countries, and more recently in the newly industrializing countries, where science and technology have been responsible for more than half of the increase in productivity (Anderson, 2006). Science education should therefore appeal to all learners, regardless of their backgrounds. The fact however remains that pupils are likely to learn better when the appropriate methods are adopted in teaching the subject. Therefore, it becomes important to know the methods to adopt, and how student interests are sustained.

Teaching students what they have to know is the responsibility of the teacher who is supposed to combine the appropriate methods and curriculum to achieve the set objectives. There are a number of different methods of teaching and learning activities. All the methods serve various educational purposes and have different capacities of motivating pupils and developing their interests. One such method that is increasingly being adopted in other jurisdictions is the use of educational software programmes. An example of such an educational software is the „Sunflower‟ programme which is designed to help teachers tackle tricky topics in secondary Biology, Chemistry and Physics.‟ Sunflower‟ Science features a large collection of animations, models and simulations to help teachers tackle abstract ideas and give students a solid understanding that will serve them well through their education. In this study, the focus is to bring to bear the significance of using „Sunflower‟ to enhance the teaching and learning of Biology in the Senior High School.

The relevance of this study is captured in the context that Ghana, like many of the African Countries is still faced with challenges of underdevelopment. As appropriately stated by Aikenhead (2005), the environmental preservation, the combating and control of diseases, lack of culture of self-employment after leaving school, population control, food production, health and sanitation are some of the challenges that confront most of the developing countries in Africa. When one considers the key role science and technology continue to play in societies, especially in the developed countries, then Ghana, as a developing country, cannot afford to follow recent trends in highly developed countries, where according to Schreiner and Sjøberg (2004) young people seem to lose their interest for science and technology in schools and further studies.

Many underlying reasons have been advanced for the difficulty in sustaining such interests in science and technology studies. Although significant emphasis is placed on poor resourcing among others, teaching methods can be another critical reason for the above scenario. It is in this regard that this study examines the option of using Sunflower to enhance teaching and learning of Biology in the Senior High School, using St. Mary‟s Boys Secondary School as a case study.

1.3 Statement of the Problem

Research into students‟ understanding in science related topics indicates that ineffective methods of teaching promote misconception leading to poor performance as well as loss of interest in science (Knight, 2002). Biology like all the other sciences is faced with a number of problems at the Senior High School. Despite the growing importance of Biology in our today‟s world, many students are losing interest in it. As suggested by Schriener and Sjerberg (2004), most of the students have developed ambivalent attitudes and perception toward science and technology. Ghana sought to increase and sustain students‟ interest in science and technology and science related programmes at the Senior

High School and tertiary levels of education. Though some progress has been made in this direction, the current rate of which students enter science related programmes may not lead to the attainment of the projections made in the vision 2020 document.

1.4 Purpose of the Study

The purpose of the study was to use biological animations and models to enhance the study of biology at St Mary"s Senior High School in Takoradi.

1.5 Objectives of the Study

The following are the objectives of the study:

1. Find out the views of students on biology
2. Determine the perceptions of students about the use of biological animations in lessons.
3. Determine the effect of the use of biological animations on students" performance in biology.
4. Find-out the benefit of the use of animations over the traditional method of teaching biology.

1.6 Research Questions

The study was guided by the following research questions:

1. What are the views of students on biology as a subject of study?
2. What are the student"s perceptions about the lessons during the interventions?
3. What is the effect of the interventions on student"s performance in biology?

4. To what extent is the new approach better than the traditional approach of teaching?

1.7 Significance of the Study

The study is important due to the significant of science education to Ghana‟s development.

As modern methods evolve, it is important that our old methods are synchronized with global methods. Accordingly this sought to bring to bear the strength of biological animations and models to improve the study of biology. The study also sought to increase and contribute to academia by serving as a reference for further related studies.

1.8 Delimitations

The study focuses on the adopting of biological animations and models in teaching and learning biology. The study was restricted to students of St. Mary‟s Boys Secondary School. Accordingly, only respondents from the school were used. The study was confined to only two classes since it was an experimental research. The study was not extended to other areas of science education but limited to biology. Again, the study focused on just one topic in the Senior High School biology syllabus.

1.9 Limitation

The researcher is a class teacher, and therefore personal biases and enthusiasm may have influenced the results of the study. Therefore, there may be a bias favoring the implementation of the intervention.

1.10 Organization of the Study

The study is organized into five chapters. Chapter one (1) presents the background and the objectives of the study. Other areas covered in the chapter are the research questions, Significance of the study, delimitations and limitations of the study. Chapter Two (2) reviews relevant literature covering the subject and gives detailed definitions and analysis of key terms and concepts. Chapter Three (3) delves into the analysis of the methodology employed for the study and outlines the data collection tools and procedure to selecting sample frame. Chapter three also covers the profile of the case institution. Chapter Four (4) focuses on the findings and discussion of findings. Lastly, Chapter Five (5) deals with relevant recommendations and provides a general conclusion to the study.

CHAPTER TWO

LITERATURE REVIEW

2.1 Overview

This chapter is a review of literature that guides the data collection and analysis of empirical findings. The chapter puts into perspective the theories relevant to the current focus such as the purpose of science education, student‟s interest in Biology as a subject, science education in Ghana and students‟ preference for teaching methods. These are all discussed in the context of the formal education environment, with specific reference to the secondary education.

2.2 The Purpose of Science Education

Researchers and science educators have over a decade presented several conflicting perspectives on the purpose and goals of science education (Bajah, 1998; Cobern, 1994; National Research Council, 1996; Oversby, 1998; UNESCO, 1994). Their views about the purpose and goals of science education include developing creativity in learners; improving scientific literacy and technological literacy of citizens; preparing citizens for an active contribution towards their own culture; and, inculcate the spirit of scientific thinking in learner.

Lederman (2003) suggested that an adequate understanding of the nature of science and scientific inquiry is the main instructional purpose of science education. Again, Lederman points out that science is part of the human quest for understanding and wisdom and reflects human wonder about the world. The study of science as a „way of knowing," and a „way of doing" can help students reach deeper understandings of the world" (Shamos, 1995). Shamos (1995) claims that the knowledge of science is important in making crucial decisions on everyday issues and problems, and in the production of informed citizens who are capable of taking personal actions to find solutions to any identified issues and problems.

The American Association for the Advancement of Science (AAAS, 1989) argues that an understanding of science concepts and principles is crucial to developing scientific literacy and also for meaningful and productive careers in science and asserts thus, "more and more jobs today require people who have the ability to learn, reason, think, make decisions, and solve problems and as well engage in scientific discourse" (p. 89).

This assertion supports the goals for science education as enumerated in the report of the National Science Education Standards (National Research Council, 1996) which stated that the knowledge of science concepts and principles would help students to be able to: experience the richness and excitement of knowing about and understanding the natural world; use appropriate scientific processes and principles in making personal decisions; engage intelligently in public discourse and debate about matters of scientific and technological concern; and increase their economic productivity through the use of the knowledge, understanding, and skills of the scientifically literate person in their careers.

According to Craven and Penick (2001) scientifically literate persons are those who can think, ask questions, and provide logical and coherent answers to any situations and everyday experiences. Thus, a scientifically literate student develops higher order cognitive thinking to identify and evaluate ill-defined problems, to make informed decisions, and also to provide a variety of solutions to any particular problem (Craven & Penick, 2001; Hurd, 1993). Therefore, understanding the nature of science and scientific inquiry to foster learners‟ ability to develop scientific literacy is a purpose and goals for science education.

2.3 The Role of Students' Interest in Science Education

Positive relationships have been reported between interest and a wide range of learning indicators (Pintrich & Schunk, 2002). When allowed to pursue their own interests, students participate more, stay involved for longer periods, and exhibit creative practices in doing science (Seiler, 2006). Interest has also been found to influence future educational training (Krapp, 2000) and career choices (Kahle, Parker, Rennie, & Riley, 1993).

Beyond being a useful and pragmatic practice, involving students in decisions about their lives in school is an important moral and educational principle (Davie & Galloway, 1996). Jenkins (1999) examined the implications of “citizen science”, i.e. science which relates in reflexive ways to the concerns, interests and activities of citizens as they go about their everyday lives, for the form and content of school science education. He suggested constructing science curricula that enable young people to engage in science-related issues that are likely to be of interest and concern to them (Jenkins, 1999).

This idea also appears in the recommendations of several organizations, including the National Research Council (1996) and the American Association for the Advancement of

Science (1993), which have proposed that science curricula provide a common basis of knowledge while addressing the particular needs and interests of students. Listening to the students is still a frequently overlooked approach to improving academic success (Conboy & Fonseca, 2009).

Many scholars have pointed to the importance of relevance to curriculum development (Edelson & Joseph, 2004; Kember, Ho, & Hong, 2008) and science teaching (e.g. Darby, 2009). However, when aiming at creating relevant learning materials, developers frequently rely on an adult notion of what should be relevant and interesting to students (e.g. Bulte, Westbroek, de Jong, & Pilot, 2006; Chamany, Allen, & Tanner, 2008; Edelson & Joseph, 2004). However, for science to be relevant to its practitioners, the origin of the questions which are being investigated are of great importance (Tippins & Ritchie, 2006). Therefore, the ability to identify students‟ own interests in biology may be used to contextualize and personalize some of the formal biology curriculum.

2.4 Students' Interest in Biology

According to Baram-Tsabari, Sethi, Bry, and Yarden (2006), research has provided some insight into students' interest in biology. It is the most popular science subject among students and adults (Dawson, 2000; Falchetti, Caravita, & Sperduti, 2003; Osborne & Collins, 2000), and especially among females (Murray & Reiss, 2005). Ayalon (1995) describes biology as an emerging "feminine niche" in science. It is the only science subject that has escaped a masculine image.

Differences exist between the topics that males and females find interesting within biology. According to results from the international project 'Relevance of Science Education' (ROSE) in Denmark (Busch, 2005), England (Jenkins & Nelson, 2005), and Norway (Schreiner, 2006), girls are most interested in biological topics dealing with health, mind and well-being. Moreover, interest in biology is not a constant trait: interest in zoology, for example, decreases with age, while interest in human biology increases.

This trend has been identified among young (under 14-year-old) Israeli children (Baram-Tsabari & Yarden, 2005) as well as adolescents from various countries (Baram-Tsabari, Sethi, Bry, & Yarden, 2006), and it continues among adults (Baram-Tsabari & Yarden, 2007). The increased interest in human biology among adolescents is probably due to the approach of puberty and the related increasing interest in one"s body. Adults seem to be more interested in human biology because they are more concerned with health issues. Older pupils" interest in human biology is well attested to by a number of other studies, including some conducted in England (Osborne & Collins, 2000), Israel (Tamir & Gardner, 1989), and Poland (Stawinski, 1984).

2.5 Science Education in Ghana

Any country striving to develop in order to raise the standard of living of its population and maintain a balanced economy must as a matter of necessity adopt science and technology as the basis for achieving sustainable development. This is the role that science and technology has played in transforming traditional European economies to the present high income levels. Ghana, as nation recognizes the importance of science and technology in national development. Hence, since the attainment of independence, successive governments have endeavoured to make science and technology a basis for the country‟s development (Anderson, 2006).

Ghana had its independence from Britain in 1957 and became republic in 1960. It was the first African country in sub-Sahara to get independence. But Ghana, like most of post independent countries, especially in Africa, was faced with the problems of malnutrition, poverty, disease, illiteracy, low life expectancy and low industrialization. Science and technology education was accepted by the nation as the engine that could drive the move to overcome these problems associated with underdevelopment.

The government, in early 1960s, established economic and educational policies, which resulted in an increased access to education (Anamuah-Mensah, 1994). The emphasis was on science teaching and the establishment of industries in both urban and rural communities. The University of Science and Technology in Kumasi, was also borne out of the policy to train engineers, architects and scientists to operate these industries. This together with the University of Ghana in Accra, the University of Cape Coast in Cape Coast and in addition, polytechnics, Diploma certificate awarding institutions, teacher training colleges and technical schools instituted admission policy that favoured the admission of more pupils into sciences and science education (Anderson, 2006).
According to Anderson (2006) the quota allocation was hardly filled. The government had to institute some incentive package to move human resource development in the direction of science and technology. There was an easy access to scholarships for science courses. Science and mathematics students in the universities as well as science and mathematics teachers in secondary schools were offered inducement allowances. This

period also witnessed massive inflows of voluntary service corps and a number of financial aids from the international developed communities both in the former Eastern and Western blocks. These services went mostly into improving on science teaching and learning.

As the local industries saw expansions in their activities and increase in profits, many of the industries established scholarship schemes to provide assistance to the needy but brilliant pupils at both secondary and tertiary levels of education. Some of the industries also offered opportunities to students, especially students of the University of Science and Technology and the polytechnics whose areas of studies have direct bearing on the activities of those industries, to have technical training during the long vacations. This was meant to raise their competences in the use of scientific and technological skills prior to their engagements with the industrial activities (Anderson, 2006).

The foreign exchange earnings from the cocoa industry, which was one of the major backbone on which the nation rely on to boost the economy, provided some science students and other students at the secondary schools with bursaries. Most of the students were either the wards of cocoa farmers or located in rural communities in the cocoa farming areas. This was to reduce the burden of financial commitments of the rural farmer.

During this period a closer relationship was sought between the culture practices of the people, their environment and workplace and the science subject taught in the schools (Anamuah-Mensah, 1998). Science as a unit (physics, chemistry, biology and agriculture were combined) was made compulsory at all levels of pre-tertiary education. Some training colleges were designated as science colleges to train science teachers for the basic level of education in order to increase access to science learning at that level. Many other initiatives have been instituted to boost the teaching and learning of science (Anderson, 2006).

After many years of independence and despite the various actions, such as policies and initiatives by successive governments, not very much has been achieved in our effort at developing the nation through science and technology education. According to Fredua-Kwateng and Ahia (2005), Ghana still faces the problems of underdevelopment. The status of science education and application of modern technology for industrial and agricultural purposes have increased, but not to the expected levels when compared to some Asian countries, like Malaysia, who had independence around the same time as that of Ghana; though, they may be other contextual factors that might have contributed in propelling Malaysia into an emerging industrial country. Incidence of diseases, unsanitary conditions, and environmental degradation are common occurrences (Fredua-Kwateng & Ahia, 2005).

It is clear to deduce that the introduction of science and technology education as a vehicle to facilitate Ghana‟s .development has not been very much successful. Many Ghanaian science education researchers have elaborated on the causes for the present state of science education (Anamuah-Mensah, 1994; 1998; 2004, Fredua-Kwateng & Ahia, 2005). Prominent among the causes are the neglect of the indigenous culture in the development of science curriculum and in instruction.

In the past, Aikenhead (1997), for example, had argued for a cross-cultural science curriculum that permits pupils to move between various cultures and subcultures (e.g. the culture of the nation, the subcultures of science and school science) and those teachers who hold beliefs enabling them to take a cross-cultural perspective towards the curricular and instructional environment will ultimately be able to assist pupils as they encounter different cultures and subcultures.

Another area of concern has always been the teaching methodology. According to Anderson (2006), the teaching methodology in Ghana appears to consist more of direct-teaching, which requires the pupils to listen attentively throughout the duration of the instruction.

In the opinion of Anderson, it is likely that the pupils‟ interest might not be stimulated enough to enjoy science as a form of knowledge construction but function more as a validation of a given knowledge (Fredua-Kwateng & Ahia, 2005). The result is that science learning is reduced to rote learning and memorization. This form of science education in Ghana only reproduces and reinforces our economic and technological underdevelopment.

Looking at the range of problems that confront Ghana, the most appropriate science pedagogy must be knowledge construction for problem-solving and problem-posing. Another area which has affected the country‟s science and technology efforts, relates to coordination of these activities. Essentially, there was no coordination mechanism to make it possible for activities to be integrated to reduce duplication of efforts and to promote synergy (Anderson, 2006).

2.6 Use of Modern Technology in Science Education in Ghana

Ghana, in 1995, became one of the countries in sub-Saharan Africa to have access to Internet (Sulberger cited in Intsiful, 2003). However, Ghana continues to grapple with the provision of infrastructure facilities; such as science laboratories, books and equipment. But Ghana as a nation within the global village also sees it as equally important to position the educational system in such a way that it can empower the country to be part of the mainstream technological advancement in the world.

As a consequence, the government of Ghana has initiated a number of programmes to develop the ICT infrastructure so as to put Ghana in the mainstream of ICT. One of such programmes is the development of a national fibre optic network by the nation"s electricity provider, the Volta River Authority (VRA) (Intsiful, Okyere, & Osae, 2003). Yet ICT development is still in its infancy in Ghana. The costs of subscription and infrastructure are high, coupled with the poor quality of service by internet service providers (Sulberger, 2001). These are some of the major barriers to the use of ICT in science education and education in general.

Information on classroom characteristics in the TIMSS 2003 indicates that in Ghana, though the national curriculum contains policy statements about the use of computers in teaching, on the average, computers were not accessible to a large number of pupils in schools who participated in TIMSS (Anamuah-Mensah, 2004). In addition, most of the remote rural schools are not connected with the national electricity grid.

The infrastructural barrier may be seen in a way to translate into the national level of or status in digital literacy; low level of computer literacy, limited access to Internet and computers. As described by Anderson (2006), these challenges which appear to be common in most developing countries may widen the gap between the developed and the developing countries in ICT literacy.

The young learner may have high interest or fascination for the use of ICT in learning school science, the practical situation in the face of our economy may lower enthusiasm. Educational policy makers need to rethink how to make ICT more accessible within science education in this era of science for all, in order to produce skilled work-force that can compete effectively in a globalized knowledge-based economy.

2.7 Teaching Methods and Teacher Effectiveness

2.7.1 Teaching Method

As stated by Lieberman (2004), a teaching method comprises the principles and methods used for instruction. Commonly used teaching methods may include class participation, demonstration, recitation, memorization, or combinations of these. The choice of teaching method or methods to be used depends largely on the information or skill that is being taught, and it may also be influenced by the aptitude and enthusiasm of the students (Lieberman, 2004).

Lieberman (2004) and Franklin (2001) identified the following as common teaching methods which run across all level of education:

Lecturing: As suggested by Lieberman (2004), lecturing is the process of teaching by giving spoken explanations of the subject that is to be learnt. Lecturing is often accompanied by visual aids to help students visualize an object or problem.

Demonstrating: Franklin (2001) describes demonstrating as the process of teaching through examples or experiments. For example, a science teacher may teach an idea by performing an experiment for students. A demonstration may be used to prove a fact through a combination of visual evidence and associated reasoning. Demonstrations are similar to written storytelling and examples in that they allow students to personally relate to the presented information. Memorization of a list of facts is a detached and impersonal experience, whereas the same information, conveyed through demonstration, becomes personally relatable (Lieberman, 2004). According to Lieberman, demonstrations help to raise student interest and reinforce memory retention because they provide connections between facts and real-world applications of those facts. Lectures, on the other hand, are often geared more towards factual presentation than connective learning.

Collaborating: Collaboration allows students to actively participate in the learning process by talking with each other and listening to other points of view. Collaboration establishes a personal connection between students and the topic of study and it helps students think in a less personally biased way (Lieberman, 2004). Group projects and discussions are examples of this teaching method. As suggested by Franklin (2001), teachers may employ collaboration to assess student's abilities to work as a team, leadership skills, or presentation abilities. Collaborative discussions can take a variety of forms, such as fishbowl discussions. After some preparation and with clearly defined roles, a discussion may constitute most of a lesson, with the teacher only giving short feedback at the end or in the following lesson.

Learning by teaching: In this teaching method, students assume the role of teacher and teach their peers. Students who teach others as a group or as individuals must study and understand a topic well enough to teach it to their peers. By having students participate in the teaching process, they gain self-confidence and strengthen their speaking and communication skills (Lieberman, 2004).

2.7.2 Teacher Effectiveness

Teaching and learning are the two sides of a coin. The most accepted criterion for measuring good teaching is the amount of student learning that occurs. There are consistently high correlations between students" ratings of the “amount learned” in the course and their overall ratings of the teacher and the course. Those who learned more gave their teachers higher ratings (Cohen, 1981; Theall & Franklin, 2001). This same criterion was also put forth by Thomas Angelo, when he stressed that teaching in the absence of learning is just talking Doyle. T. (n.d). A teacher"s effectiveness is again about student learning.

The literature on teaching is crammed full of well researched ways that teachers can present content and skills that will enhance the opportunities for students to learn. It is equally filled with suggestions of what not to do in the classroom. However, there is no rule book on which teaching methods match up best to which skills and/or content that is being taught. Students often have little expertise in knowing if the method selected by an individual instructor was the best teaching method or just "a method" or simply the method with which the teacher was most comfortable (Theall & Franklin, 2001).

Doyle. (n.d). "*Research indicates that students are the most qualified sources to report on the extent to which the learning experience was productive, informative, satisfying, or worthwhile. While opinions on these matters are not direct measures of instructor or course effectiveness, they are legitimate indicators of student satisfaction, and there is substantial research linking student satisfaction to effective teaching (Theall & Franklin, 2001).*"

A meta-analysis of 41 research studies provides the strongest evidence for the validity of student ratings since these studies investigated the relationship between student ratings and student learning. Doyle (n.d.) quoted Ory (1994) "The use of students" ratings for evaluating teacher effectiveness is the single most researched issue in all of higher education. Over 2000 articles and books have been written on this topic over the past 70 years" (p. 144). Research on student evaluation of teaching generally concludes that student ratings tend to be reliable, valid, relatively unbiased and useful (Murray, 1994).

There is much debate within the higher education community on how teaching or teaching effectiveness may be defined (Braskamp & Ory; 1994). For instance, Centra

(1993), defines effective teaching as "that which produces beneficial and purposeful student learning through the use of appropriate procedures" (p. 42).

Braskamp and Ory, (1994) include both teaching and learning in their definition, defining effective teaching as the "creation of situations in which appropriate learning occurs; shaping those situations is what successful teachers have learned to do effectively" (p. 40).

Many researchers have focused on whether or not students are legitimate judges of teaching effectiveness. Though caveats abound, the general sense is that students are both rational and reliable sources of evidence (Arreola, 1995; Braskamp & Ory, 1994; Pratt, 1997), While in class, students are exposed to all sorts of instructional experiences (lectures, instructional materials and aids, readings, exams). They are in effect experimental consumers able to discern quality, relevance, usefulness, and instructor interaction with students (Montgomery, n.d.**)**.

As consumers, Cuseo (n.d.) claims that students can judge what is taught and how it is taught, yet Braskamp & Ory (1994) claim that students can only provide information with respect to teaching. However, Ory (2001) sums it up best by stating that "unless they haven‟t been to class, as consumers they have a legitimate voice" (p. 32)**.** Theall (2001) mentioned that the students can answer questions about the quality of lectures, the value of readings and assignments, the clarity of the instructor's explanations. Students are certainly qualified to express their satisfaction or dissatisfaction with the experience. They have a right to express their opinions in any case, and no one else can report the extent to which the experience was useful, productive, informative, satisfying, or worthwhile.

2.8 New Educational Concepts and Approaches to Biology Education

The goals, scope and content of biological education vary greatly with its target populations and the groups and parties involved in its implementation. Biological education means different things to different people. For biology researchers, education means the acquisition of the scientific knowledge, data and techniques that are necessary to perform research projects. For developers, professionals and engineers in a large variety of domains such as agriculture, health, industry, biotechnology and environment, education must provide the biological foundations underlying their respective domains of expertise. And for the general public, the principal aim of biological education, whether at schools (primary and secondary) or through the media, must be to develop citizens' biological literacy, i.e., provide them with the core biological knowledge, the ability to formulate questions, and an idea of how and where to look for answers, in order to help them to participate responsibly in the life of the society.

The diversity of the objectives assigned to biological education reflects its social function which is to re/produce knowledge, apply it and adapt to its impact on society. Therefore, addressing the challenges of biological education for the next century requires taking into consideration not only the new problematique and new scientific knowledge, but also to address the ethical dimension of biological sciences as well as the new findings of research on education processes and learning theory.

Biology, psychology and cognitive sciences are generating knowledge about how the human brain learns; and have shown us that we can use this knowledge to intervene effectively in the learning process of virtually any and all humans beings. In a comprehensive study of the theory of learning, Giordan (1998), explains that learning is better achieved through a process of deconstruction. Concepts have evolved from the old passive process, whereby teachers passed or communicated their knowledge to students considered as empty containers; to the behaviourist and constructivist approach by which the teachers help the learners to construct knowledge, moving from the simple to the complex and from the specific to the general; and finally the development of a more active approach, whereby the re-construction of knowledge follows a necessary phase of deconstruction, i.e. a process by which the knowledge is generated (appropriated) by the learners themselves.

The adoption of this new learning concept has important consequences for the organization and functioning of educational institutions and curricula, the definition and practice of the respective roles of teachers versus learners, and the relationship between knowledge acquisition and learners' attitudes, behaviour and ability to adapt to complex and ever-changing environments.

The development of the deconstructivist concept and the reconstructivist approach have led to more educational institutions adopting a new method of "learning science as scientists do." Students are invited to participate in research projects designed for them and the results of which are presented at major scientific congresses and published. At the AAAS Congress in 1998, held in Anaheim, USA, there were two major poster sessions with hundreds of 'young' scientists (students at secondary schools) presenting their research results (Theall, 2001).

Another important consequence of adopting the re-constructivist approach consists in its great potential to reinforce the societal relevance of biological education, i.e., the link between science education and the needs of society, which, in turn, calls for the development of ethical dimensions of science education.

Today, the statement "If only biologists knew what biology knows "is more true than ever (Schreiner, 2006).

The explosion of scientific knowledge and the rapid production and accumulation of staggering amounts of scientific data and information are creating the need for knowledge management, i.e., knowledge about knowledge. Actually, knowledge management is about learning. It is impossible for educational systems to cover all domains of knowledge, there is a need for school science curricula to provide citizens with basic scientific literacy, i.e., a common core of understanding, a knowledge basis and the intellectual ability to formulate questions and find answers. At the same time, the explosion of scientific and technological knowledge is introducing new concepts and tools for distance learning, new access to the world storehouse of knowledge, and new interpersonal and group communication capabilities.

Two subsequent approaches will also be needed: (1) to develop mechanisms for "learning on demand" within, and (2) a framework for continuous, life-long education. The success of such an endeavour will mark the passage of education to the society.

Biological training and education will be more and more about knowledge management than the simple traditional teaching of scientific data. Increasingly, modern Information and Communication Technology (ICT) is being developed and used for education in-school and out-of-school situations. In the developed countries, more and more ICT educational material, CD-ROMs and/or online education tools are becoming more available for learners. Modelling and simulation games are being developed. Benefits of introducing ICT are numerous, to mention but a few: increasing interactivity, availability of immediate links with almost an infinite world library, encouraging group work, and providing good tools for auto-evaluation.

However the development of ICT in education, and in particular in biological education is still is in its infancy. There is here a large domain for development and research towards reconsidering the learners and teachers' functions and role and rethinking the structure of the school, college and university.

Parallel to the explosion of scientific knowledge, the emergence of a new problematique, and the development of new concepts, approaches and tools, there also are a host of new parties with huge stakes and interest in biological education. Among these parties, there are natural partners wishing to strengthen their role in biological education, such as botanical gardens, national parks and nature reserves, and natural history museums, and science centers. In addition, a large number of organizations, foundations, and agricultural and industrial corporations (pharmaceutical industries and biotechnology) are concerned with and, to a certain extent, involved in the development of biological education programmes.

2.9 Effectiveness of Teaching Methods

The traditional passive view of learning involves situations where material is delivered to students using a lecture-based format. In contrast, a more modern view of learning is constructivism, where students are expected to be active in the learning process by participating in discussion and/or collaborative activities (Fosnot, 1989). Overall, the results of recent studies concerning the effectiveness of teaching methods favor constructivist, active learning methods.

The findings of a study by de Caprariis, Barman and Magee (2001) suggest that lecture leads to the ability to recall facts, but discussion produces higher level comprehension. Further, research on group-oriented discussion methods has shown that team learning and student-led discussions not only produce favorable student performance outcomes, but also foster greater participation, self-confidence and leadership ability (Perkins & Saris, 2001; Yoder & Hochevar, 2005).

Hunt, Haidet, Coverdale, and Richards (2003) examined student performance in team learning methods, finding positive learning outcomes as compared to traditional lecture-based methods. In contrast to these findings, a study by Barnes and Blevins (2003) suggests that active, discussion-based methods are inferior to the traditional lecture-based method. A comparison of lecture combined with discussion versus active, cooperative learning methods by Morgan, Whorton and Gunsalus (2000) demonstrated that the use of the lecture combined with discussion resulted in superior retention of material among students.

2.10 Students' Preferences for Teaching Methods

In terms of students" preferences for teaching methods, a study by Qualters (2001) suggests that students do not favour active learning methods because of the in-class time taken by the activities, fear of not covering all of the material in the course, and anxiety about changing from traditional classroom expectations to the active structure. In contrast, research by Casado (2000) examined perceptions across six teaching methods: lecture/discussion, lab work, in-class exercises, guest speakers, applied projects, and oral presentations. Students most preferred the lecture/discussion method. Lab work, oral presentation, and applied projects were also favorably regarded. Hunt *et al* (2003) also noted favorable student attitudes towards active learning method.

CHAPTER THREE

METHODOLOGY

3.1 Overview

This chapter describes the research design used for the study. It also describes the population, the sampling procedures used in the study. Other issues such as validity and reliability and the tools used to analyze the data were discussed.

3.2 Research Design

The research design that was used in the study was Action research. Action research is categorised as one of the qualitative research design. According to Sagor (2000), action research focuses on the development, implementation, and testing of a programme, product or procedure. Action research has grown in popularity throughout the past two decades (Fleming, 2000). It is becoming a more accepted tool for teachers to assess their own teaching strategies and reflect upon their effectiveness.

Mcniff (1999) defined action research as the name given to an increasingly popular movement in educational research that encourages teachers to be reflective of their own practices in order to enhance the quality of education for themselves and their students. The significance of using this methodology is to concentrate on some occurrence or entity. Also this approach seeks to uncover the interaction of major factors characteristic of the observable facts (Merriam, 1998) and also help provide a means to understand the essence of the school-based research experience.

As a philosophy, action research focuses on inquiries into aspects of human life and activities (Marshall, 1999). Action research was chosen for this study because the circumstances of this study required flexibility, the involvement of students and changes in learning behaviour must be seen within the period of the intervention. Another equally important aspect of this research is the use of different methods for data collection so as to determine student acquisition of knowledge through varied teaching methods (Burns, 2000; Cohen & Manion, 1994).

3.3 Research Population

A research population is a large well-defined collection of individuals or objects having similar characteristics (Castillo, 2009). The accessible population for this study was first year science students at St. Mary"s Boys Senior High school, in the Sekondi-Takoradi Metropolis of the Western Region.

3.4 Sample and Sampling Procedures

Sampling is a procedure whereby element or people are chosen from a population to represent the characteristics of that population. The sample was made up of sixty students of which all of them were males. The age range of students was from fourteen to seventeen years. A sample is a finite part of a statistical population whose attributes are studied to gain information about the larger population. According to Castillo (2009), sampling procedures are the strategies applied by researchers during the sampling process.

3.5 Research Instrument

A research instrument is a device used to collect data to answer the research question. Data collection is an essential component of a research work. According to O"Leary (2004), collecting credible data is a tough task and it is worth remembering that one method of data collection is not inherently better than another. Three main instruments were used to collect data; questionnaires, interviews and achievement test. The interview was conducted with students in the intervention group.

3.6 Test Items (Pre and Post tests)

The two (2) tests used in the collection of quantitative data from all participants were similar in number and structure. The tests were administered to two groups. The intervention group was taught using biological animations while the non-intervention group was taught using the traditional method. The pre-test was used to assess participants" knowledge on the concepts in diversity of living organisms after the revision exercise in the pre-intervention stage. The post-test, however, was used to assess their achievement or performance in the concepts in diversity of living organisms after the intervention has been implemented. Both tests were constructed with reference to the objectives of the SHS curriculum. Each test was made up of a compulsory 12-item multiple choice and short answer essay-type test.

3.7 Interviews

This study used both structured and unstructured interviews as a method for data collection. Two types of interviews were conducted for twelve students to ascertain their opinions and experiences about Biology as a subject, and the treatment/intervention activities. There were two types of interviews: Pre-intervention interview and Post-intervention interview. The Pre-intervention interview was made up of only part one, whilst the Post-intervention interview had part one and two. A sample of the interview schedule is presented in Appendix C.

The respondent answered oral question in their own words and their responses were recorded by the interviewer (Borg, Gall & Gall, 1996). The part one of the interviews solicited for students‟ general perceptions and feelings about the Biology subject and the part two enquired on students‟ preference for the mode of representation used in the intervention. The interviews for the pre- intervention and post- intervention lasted for 10 and 15 minutes respectively.

3.8 Content Analysis

Content Analysis is a research method for subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns (Hsieh & Shannon, 2005).

A content analysis of students‟ scores and responses to the tests, were carried out using students T- test analysis for any significant difference in their mean scores in both the pre-test and the post-test (in order to examine how students actually comprehend and interpret the Biological concepts and the relationships among the interventions used). Students‟ perceptions on the intervention as well as their attitude towards Biology after the intervention were also analyzed based on their responses to the items on perception and attitude. The students‟ exercises in the intervention stage were regularly compared with students" output in the pre-interventions exercise; this is referred to as constant comparative method (Denzin & Lincoln, 2005; Glaser & Strauss, 1967).

3.9 Validity of the Instruments

The primary objective of a research is to provide valid information that could be used in describing, predicting, and explaining phenomenon. Moreover, research data is considered valid if they provide a measure of what is intended to be measured (Cohen, Manion & Morrison, 2000).

According to Golafshani (2003), validity describes whether the means of measurements are accurate and are actually measuring what they intend to measure. A test is deemed valid if its results are appropriate and useful for making decisions and judgment about an aspect of students" achievement (Gronlund & Linn, 1990).

Face validity of the test items for both pre-test and post-test were enhanced by two experienced Biology teachers in the School, some senior Biology Lecturers and Supervisors. The items were examined based on the cognitive level of the students and the instructional objectives stipulated in the Biology Syllabus for Senior High Schools in Ghana (MOE, 2010). Also, the face validity of the Observation instruments was improved through assessment by Lecturers, peers and a PhD student who were familiar with the purpose of observation.

3.10 Reliability of the Instruments

The researcher calculated the reliability coefficient of the test as proposed after a pilot test of both pre-test and post-test instruments were conducted with science students who had passed the Biology course to SHS one in the same school. That class was chosen because the unit „Diversity of living things" had been treated. The internal consistence analysis (ICA) was carried out according to Cronbach (1951). The ICA calculation of the Cronbach"s alpha coefficient result is presented in Table 3.1. In both cases the coefficients were higher than 0.7, showing the capacity of the test to discriminate students with scientific understanding from those with no understanding of the topic.

Table 1: Reliability values of research instruments

Instrument	N	Items	Cronbach Alpha Coefficient
Pre-test	60	20	0.75
Post-test	60	20	0.85
Questionnaire on Students" views of Biology	60	11	0.81
Questionnaire on Students" views of Biological Animations	30	11	0.77

3.12 Treatment of the Groups

All of the 60 students involved in the study received instructions on diversity of matter over a period of two weeks. After the two week period, the students in both groups were then assessed using the pre-test. The class with the low average score were designated the experimental group and the class with the higher average score labeled the control group. After that the students in the experimental group were taught in the ICT laboratory using computer animations depicting the physical features as well as characteristics of organisms in different kingdoms, phyla and classes. The animations also stressed on the differences in the morphology and other key features of organisms in different kingdoms. Each animation video was followed by a summary of the core points/ characteristics. Within the same time period, the researcher taught students in the control group using the lecture method. After two weeks of instruction, the students in both groups were assessed using the post-test.

3.12 Data Collection Procedure

The researcher obtained an introductory letter from the head of Science Education Department of the University of Education, Winneba which was used to obtain permission from the school authorities to undertake the study and administer the instruments in the selected school.

The researcher sought for permission from the Head teachers to undertake the study. Permission was also sought from the teachers of the selected classes. The first visit was used to establish rapport with the students and to solicit their participation in the study and to select a date for the administering of the instrument.

In the first week, the questionnaire and the pre-test were administered to the students in their respective groups by the researcher. This was done during their biology periods and the responses were collected immediately to ensure 100% collection. After the treatment, the post-test was conducted for the students and the scripts of students were collected were immediately collected and marked.

After the administration of the post-test in the last week, all the students in the treatment group were provided a questionnaire on the use of biological animations in order to find out their views about the relevance of the use of animations during biology lessons.

Finally, 20-minute interview was also conducted for about ten students from the treatment group to find out their views and perceptions about the use of computer animations in biology lessons. The interviewees were assured of confidentiality and also given code names in order to prevent the exposure of their identities. Prior to each interview session, the interviewees and the researcher agreed on time and venue of interview which would be convenient for the interviewee. The permission of each interviewee was also sought before the interview sessions were recorded.

3.13 Data Analysis

Both qualitative and quantitative methods of data analysis were employed by the researcher for the analysis of the data collected. Data from the interview sessions were analyzed qualitatively while the data from the student questionnaire and the test were analyzed quantitatively. Analyses of the results obtained from the study were carried out in three (3) phases. The researcher made use of both descriptive and inferential statistics in data analysis.

Firstly, frequencies and percentages of the responses provided by the students to the various questionnaire items were taken.

The statistical analysis of the tests (i.e. pre-test and post-test) were carried out during the next phase. The mean, standard deviation and the t-tests of the experimental and control groups were computed. The t-test was used to investigate whether any differences existed between the experimental and control groups" mean scores in the pre-test. It was also used to find-out whether there were any significant differences in the performance of the students in the treatment and control groups after the post-test. Also the t- test was used to investigate whether there were any significant differences between the experimental group"s mean scores before and after the treatment.

The next phase of the analysis was done to find out the views of students about the collaborative learning method developed as provided on the interview schedule. In this instance, qualitative analysis was done on the data gathered through the interviews. The recorded conversations were transcribed, analyzed and summarized thematically after the interview sessions. Using the constant comparative method of analysis, the researcher read through the transcript for each interview to get a sense of the uniqueness of that story. Each transcript was carefully reviewed, sentence by sentence, in order to identify words and phrases that were descriptive and represented a particular concept. Central themes were extracted as the transcript was read and re-read several times.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 Overview

This chapter is devoted to analysis of the data collected using the various instruments. It ends with the discussion of the results.

4.2 Background Information about the Sample

As indicated earlier, all the respondent were students from the Saint Mary‟s Boys SHS situated at Apowa in the western region. Their age distribution is as displayed on Figure 1.

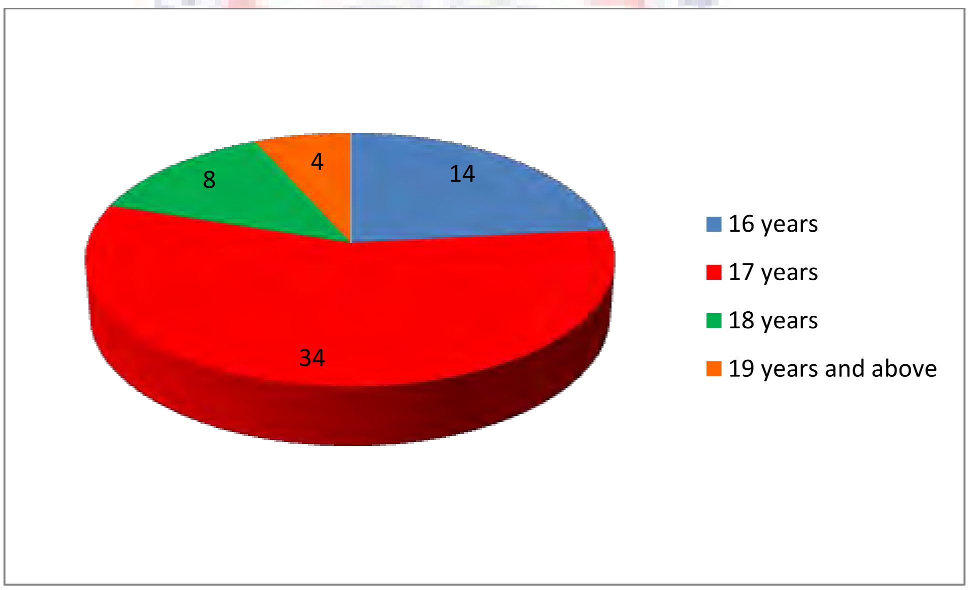

Figure 1: Age distribution of respondents

From Figure 1, it is seen that 7 out of the 60 respondents were 16-year olds. Majority of the students were 17 years of age. Eight of the students were 18 years old. Only 2 out of the 60 students were above 18 years.

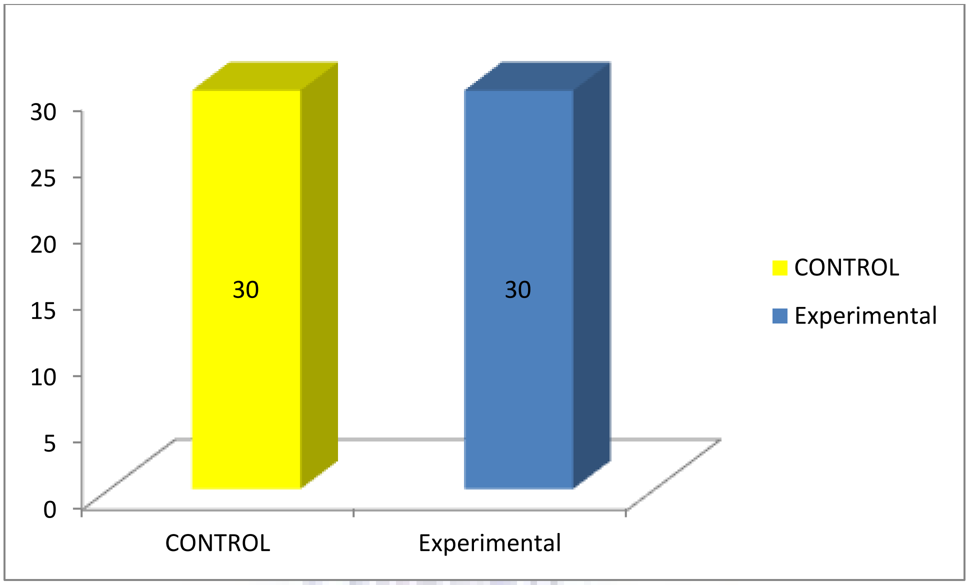

Figure 2: Distribution of students from experimental and control groups

Figure 2 shows the distribution of students from the control and experimental groups. Thirty students each were from the control and experimental groups respectively.

4.3 Research Question 1: What are the views of students on biology as a subject of study?

Research question one was answered using the responses of students to various items on the questionnaire. The responses of the 60 respondent students in both the control and experimental groups are as summarized in Table 2.

Table 2: Views of students about biology as a subject of study

Item	SA	A	NC	D	SD
1. Having a better understanding of Biology will help me earn a living in the future	50(30)	30(18)	3(2)	13.3(8)	3.3(2)
2. I don‛t intend to further pursue biology after my secondary education	41.7(25)	26.7(16)	1.6 (1)	21.7(13)	8.3(5)
3. Biology is a difficult subject to study compared to other science subjects	35(21)	26.7(16)	3.3(2)	(18.3)11	16.7(10)
4. I can‛t do well in Biology irrespective of any assistance I will be given	6.7(4)	8.3(5)	0	55(33)	30(18)
5. Biology is for only intelligent students	20(12)	23.3(14)	0	28.3(17)	28.3(17)
6. It is easy to get good grades in biology	5(3)	6.7(4)	0	43.3(26)	45(27)
7. I will need Biology for my future	10(6)	23.3(14)	0	40(24)	26.7(16)
8. My Biology teacher shows interest in my progress in the subject	10(6)	6.7(4)	1.6(1)	56.7(34)	25(15)

The first item sought to find-out the views of students on the relevance of biology to their future job prospects. A total of 48 students representing 80% of the total agreed with the notion that biology education is crucial to their future occupations. However 41 out of the 60 students indicated that they did not intend to pursue biology after their secondary education. With regards to the third item which sought to find the views of students as to whether they considered biology as being a difficult subject, 37 students in total were of the opinion that biology is a difficult subject. However a sizable number of the respondents (21 out of the 60 students) disagreed with the statement that biology was relatively more difficult than other science subjects. It can be seen on Table 2 that students mostly believed that their performance in biology could improve with the right intervention. Only 9 students held contrary views. Students seemed to be divided in their opinions as to whether biology was a preserve subject of intelligent students or not. A total of 26 students agreed with this assertion but the remaining 34 thought otherwise. Item 6 of the questionnaire sought to establish from students how easy or difficult it was to attain high scores in biology as a subject of study. Only 7 students indicated that it was easy to score high marks in the subject. This implies that a whooping 53 out of the 60 respondents thought it was difficult to score high marks in biology. Majority of the respondents also indicated that their biology tutors did not show interest in their progress in the subject. Only 10 students said their teachers showed interest in their achievements in the subject as seen on Table 2.

4.4 Research Question Two: What are the student's perceptions about the lessons during the interventions?

This research question was also answered with the aid of some questionnaire items as well as observations made by the researcher. It sought to find out the impressions of students in the experimental group about the effect of the use of animations during biology lessons. It is seen from Table 3 that students overwhelmingly agree that the use of animations in teaching of biology enables them to understand what they are being taught clearly. Only 3 out of the 30 students in the group assigned the treatment disagreed with the notion. Twenty-three of the students also pointed out that the use of biological animations made them more interested in biology lessons. However, 6 out of the 30 students were of the view that they found it easier to misbehave during biology lessons when the teacher employed the use of animations. The students generally agree disagreed with the statement that the use of biological animations led to a waste of time during lessons. Only 8 students held contrary views as seen on Table 3. Most of the respondents also did not share in the view that the use of animations during lessons should be discontinued. The breakdown of students‟ responses to all questionnaire items can be seen on Table 3.

Table 3: Views of students on the use of animations during biology lessons

	Item	SA	A	NC	D	SD
1.	Biological animations explain things clearly	56.7(17)	23.3(7)	10(3)	10(3)	0
2.	Biological animations make me interested in the biology lessons	36.7(11)	40(12)	3.3(1)	13.3(4)	6.7(2)
3.	Biological animations makes it easy for us to misbehave during the lesson	3.3(1)	16.7(5)	6.7(2)	43.3(13)	30(9)
4.	Biological animations leads to waste of time in the lesson	3.3(1)	23.3(7)	6.7(2)	46.7(14)	20(6)
5.	The use of Biological animations is expensive and must be Discontinued	0	6.7(2)	0	33.3(10)	60(18)

4.5 Research Question Three: What is the effect of the interventions on student's performance in biology?

The test results of the students in the experimental group were used in answering this research question. The researcher analysed both the pretest and posttest scores of students who were assigned the treatment. A breakdown of the analysis is represented in Tables 4 and 5. It can be seen from Table 4 that none of the students in the experimental group scored above 50% in the pre-test. A total of 20 out of the 30 students in the experimental group scored between 10 to 30 percent. The remaining 10 students in the group scored between 30 and 50% as displayed in Table 4. However it can be observed that there was a vast improvement in performance of the same group of students after the treatment. As seen on data available on Table 4, only 1 student in the group had a score which was less than 51%. Majority of the students scored between71 to 90. Three of the 30 respondents scored above 90% in the post-test.

Table 4: Test results of experimental group

Scores	10 -20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80	81 – 90	91 -100
Pre – test	9	11	6	4	0	0	0	0	0
Post – test	0	0	0	1	3	5	11	7	3

Table 5: t-test analysis of scores of students in the experimental group

Test	Number	Mean	Std. Deviation	p-value
Pre-test	30	37.67	5.42	.000*
Post-test	30	76.97	12.09	

A t-test was conducted to determine the impact of the treatment in the performance of students in biology as can be seen on Table 5. The average score of the students in the pre-test was 37.67. Significantly, the average score rose from 37.67 to 76.97 in the post-test. Thus this gives an indication that there was a tremendous improvement in student‟s understanding of concepts after they were taught using animations. The p-value attained was 0.00 which gives an indication that there had been a significant difference in the performance of students after the treatment.

4.6 Research Question Four: To what extent is the new approach better than the traditional approach of teaching?

The fourth research question was answered using the pre-test and post-test scores of students in both groups. Specifically, a comparison of the average scores attained by the students in the control group with that of their counterparts in the experimental group was undertaken to enable the researcher answer this research question.

The data provided on Table 6 shows that there wasn‟t much difference in the scores attained by the control group students in the pre-test and post-test. It should be noted though that a greater number of students in the control group scored above 50 in the post test compared to the pre-test.

Table 6: Frequency Distribution of Pre-test and Post-test Scores of Students in the Control Group

Scores	10 -20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80	81 – 90	91 -100
Pre – test	0	2	6	14	8	0	0	0	0
Post – test	0	3	6	10	11	0	0	0	0

Table 7: Frequency Distribution of Pre-test and Post-test Scores of the Experimental Group

Scores	10 -20	21 – 30	31 – 40	41 – 50	51 – 60	61 – 70	71 – 80	81 – 90	91 -100
Pre – test	9	11	6	4	0	0	0	0	0
Post – test	0	0	0	1	3	5	11	7	3

Table 8 provides a comparison of the performance of students from the two groups in the pre-test and post-test respectively.

From Table 8, the mean test score of the experimental group (37.67) in the pre-test was smaller than their control group counterparts who had an average mark of 43.34. The t-test analysis of the pre-test mean score of the 2 groups shows no significant difference ($t = 0.215$; $p > 0.05$). This showed that there was no significant difference in performance between the 2 groups at the beginning of the study. This indicates that the 2 groups were comparable on their achievements in biology.

From Table 8, the mean test score of the experimental group (76.97) was higher than their control group (55.17) counterparts in the post-test. The t- test analysis of the mean score on the post-test shows a significant difference between the 2 groups ($t = 3.142$; $p <$

0.05). There is a significant difference between the performance of the students taught using biological animations and those taught using the traditional approach. The experimental group performed better than the control group in the post-test. This indicates that the experimental group had better understanding of biology than the control group after the treatment. Thus this confirms that the use of animations in biology lessons is a useful way of boosting student"s understanding and interest in the subject.

Table 8: Means, Standard Deviations and t-Tests of Pre-test and Post-test Scores of the Experimental and Control Groups

Groups Compared	Test	Mean Test Scores	Standard Deviation	t- Value	p-Value
Experimental	Pre-test	37.67	4.21	0.215	.341
Control	Pre-test	43.34	3.64		
Experimental	Post-test	76.97	9.12	3.142	.003
Control	Post-test	55.17	8.72		

*$p < 0.05$.

4.7 Interview of Students

4.7.1 Students' Perspectives

Students reported on four major advantages of working with the computer animation. The first one is that the activity helped the students to visualize the abstract concepts and processes by representing the subject matter in a more concrete manner. Students said: „„The computer animation helped me very much. It demonstrated the topic, since one could really see it"", and, „„It was like I could see it in front of my eyes, and that"s how I could connect between things"", or „„When you see it as a computer animation, it is much more easy to visualize the process in your head and to remember it.""

The second advantage that students raised was how this enabled them to work individually in their own time, to run the animation over and over as much as they needed, while controlling the pace of the animation. Students commented: „„It helped me more than the lesson in the class, since I could run it over and over as many times as I wanted, and I could do it also at my own pace.‟‟ Students also mentioned the benefit of the computer animation interactivity and its immediate feedback Students also mentioned that the individual animation activity freed the teachers to move between them and give them direct feedback as they worked.

Another advantage students mentioned was the contribution of the activities to the diversification of the lessons. Students said that the activities „„broke the routine‟‟ of the traditional lecture format. They said that they enjoyed the activity very much and would like to have more such activities in other biology topics too. Students from the computer group said: „„First of all, it is a new way to learn things. It is exciting, it is more interesting, it is different‟‟; and, „„It is more individual, more focused, and thus you can learn more quickly‟‟.

4.8 Discussion of Results

This study confirmed that teachers should use visualisation tools – such as animations- purposefully during the learning process. Understanding visualised material is easier than to read information from the paper- based instruction. As human beings are lazy by character so students would like to find the easiest way to understand difficult processes - at least to show to the teacher that they had understood the theme. Understanding paper-based instruction needs concentration and conceptualizing skills.

The findings showed that the animated cartoons that were used to synchronize lesson presentation to the experimental group in science produced greater academic performance in the post-test. Animation teaching therefore enhances learning of science subject. This finding is consistent with those of (Ijhedo, 1995) that effective and efficient use of animated cartoons in teaching and learning offer both audio and visual messages or information and these appeals to sense of sight and hearing, simultaneously. The study is in line with the findings of Vogel-Walcutt, Gebrin and Nicholas (2010) who demonstrated that animating mechanical systems leads to more efficient knowledge acquisition Students feel a sense of reality in what they learn, which is further supported by Onyegegbu, 2006. Another finding of Vogel-Walcutt, Gebrin and Nicholas (2010) was parallel to the initial study on knowledge acquisition and application as well as short term retention is better supported by animated imagery compared to static imagery when teaching human system interactions.

A lot of frustrating situations can be saved if our teachers use relevant synchronized animated cartoons during instructional development, among other efforts.

Students from the animation group got the whole information from the presentation and so they did not have to create their own understanding- the concept maps were similar and reminded the structure of the figure, which they had seen before.

Studies have pointed out that using animation in the lesson helps to increase learning motivation. It makes difficulty-understood problems easily understandable. Students explained the necessity and feasibility of the animation*:* Such teaching is more interesting and engaging, animation helps to understand the topic easily and clearly. Very often there is no use of explaining the theme only verbally, because the student is unable to imagine the process realistically and that is the reason she does not create links with other concepts and it is hard to memorize it. These (animations) makes the material understandable. With them it is easy to understand the motion of the particles and it is easy to explain everything, verbal explanations will justify it all.

Some intriguing questions arose while conducting this study: What do we expect as the learning outcome from the student? Do we prefer factual knowledge of concepts to the ability to connect concepts with each other and then using them widely? Should we raise students" motivation to learn some subject, while we same time retard the ability to analyze the process? How much should a student study individually in front of the computer?

The analysis shows how students watching the animations use expressions from their everyday life to talk about what is displayed on the screen. As they, in their capacity of being students, lack knowledge of the subject matter, they have to impose an interpretation of their own, and, they do this by drawing on a variety of resources. In their efforts to make the events in the animation meaningful, the students incorporate everyday language in their descriptions of the depicted processes. At times, this leads them to make unintended interpretations of the scientific model. However, such use of everyday language and even bodily experiences when attempting to grasp abstract phenomena, is not solely done by students, but also by professional scientists in their ordinary work (Ochs, Gonzales & Jacoby, 1996).

Consequently, we regard this as a pedagogical problem of a more general nature, and not specifically tied to the use of animations. The earlier documented problem, that students tend to focus on perceptually salient features of the animation, could also be observed in our material. In relation to these features, Lowe (2003) found a predisposition by novices to impose simple everyday cause-effect relations on the interpretations of the animations.

So, what kind of guidance would be necessary to overcome this problem then? An instructional text accompanying the animation could be one way of redeeming these issues, but this method offers no guarantee that the text will actually be attended to. Another suggested way of supporting animations has been narration co-ordinated with the animation (Mayer, 1997). Although Mayer et al. (2005) found no support for the superiority of computer based narrated animations over paper based annotated illustrations, they conclude that their study "should not be taken to controvert the value of animation as an instructional aid to learning. Instead, this research suggests that when computer-based animations are used in instruction, learners may need some assistance in how to process these animations" (p. 246). Obviously, teacher supervision could also provide students with the guidance needed for construing animations in an adequate way.

This however, being the panacea to all educational dilemmas, adds nothing new to our further understanding of the use of animations for specific learning purposes.

Another theme, worthy of further scrutiny and briefly touched upon in the analysis, is the topically isolated reasoning that can be observed in connection to the animations" superficial depiction of the biochemical processes. In biological terms, respiration takes place inside the cells and the gases are transported to and from the lungs with the blood.

As a general observation, students are often oriented towards the short-term goal of fulfilling a given task by the production of an answer to a specific question. When solving such a task, the students can use varying resources like earlier experiences, texts, instructional graphics and so on. Here, the conflict over *what* kind of resources they are expected to use, and *how* to use them, can be discerned in the students‟ argumentation. It is in this process that an explicit formulation of how to perform a given task can be interpreted as excluding other forms of resources. The formulation in the current assignment – "explain in your own words what you can see happening in the different animations" – did in this case lead some students to the conclusion that they, in their written answer, had to disregard their previous knowledge or what they could read in the text captioning the animations. Even though the intention with the question was to make the students draw their own conclusions from the animation and not only copy the text, this formulation in fact created an increased uncertainty of how to proceed. Considering this, it seems very important to pay great attention to the formulation of the assignments that students are going to perform in their work with animations.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, RECOMMENDATIONS AND SUGGESTIONS FOR FURTHER STUDIES

5.1 Overview

This chapter is the concluding chapter of the study. It begins with a brief summary of the main findings revealed in the present study, makes recommendations to stakeholders and also gives a conclusion of the whole study. It finally ends by providing suggestions to areas which could be focused on in subsequent studies concerned with use of animations in science classrooms.

5.2 Summary

The entire research work mainly concerned itself with the influence of animations on the academic performance of students in biology. Thus the study was guided by four main research questions. The key findings made in the course of the study are summarized thematically below.

5.2.1 Views of Students on Biology as a Subject of Study

Students generally view biology as a difficult subject to study. They also deem it as a reserve subject for only intelligent students. However the broad belief among students is that biology education is crucial to their future educational and job prospects. The students also indicated that their biology teachers mostly did not show any interest in their progress in the subject. Consequently most of them do not harbor the ambition to pursue the subject to a higher level.

5.2.2 Students Perception of Biological Animations

Students highlighted on the essential role played by the use of animations during classroom instructions. There was a shared belief among the students that the animations made them understand the lessons far more clearly. They also revealed that the use of biological animations whipped up their interest in biology. They encouraged the continual use animations in all biology lessons.

5.2.3 Influence of Biological Animations on Student's Performance in Biology

A comparison of the test results of students in the experimental group revealed that ultimately the use of the animations had a positive effect on the understanding and performance of students in biology. The above assertion was arrived upon through an analysis of the mean scores of the pre-test and post-test conducted for the experimental group students. A t-test conducted to that effect revealed that there was a significant difference in the performance of students after they were taught using animations.

5.2.4 Comparison between Traditional Method of Teaching and the Use of Animations in Lessons

There was a significant difference between the performance of students in the control and experimental groups. During the pre-test, students in the control group had a slightly greater mean mark than their colleagues in the experimental group. However in the post test, the experimental class performed better. A t-test conducted revealed that there was a significant difference in the achievement of students from the two groups in the post-test.

5.3 Conclusion

The use of multimedia teaching via cartoon and animation teaching is an innovative approach for teaching science subject. This method improves the teaching and learning of science subject in schools since students studying science subject performed poorly in their external examination. In an attempt to curb this ugly trend of student failure in science in secondary school, the use of animation would enable the students to retrieve or recall the previously learnt subject quickly and thereby enhance their fortune in teaching and learning science subject. These approaches can be effective additions to regular science instruction and can help students visualize unseen phenomena, develop scientific language, improve understanding of the scientific process and contribute to the development of scientific thinking.

The findings show that the students in the computer animation group significantly outperformed the control group on content knowledge measure. In order to enhance the effectiveness of computer animations, it is important to make it interactive and increase student involvement in the learning process. In reference to active involvement, it is suggested that hands-on activities and also mind-on activities must be incorporated into lessons by teachers. In this manner, while presenting the computer animation in class the teacher should require students to make predictions and answer challenging questions regarding the processes or structures that they are witnessing.

The present study provides support for the use of new technologies, such as computer animation, for instruction. Though the computer"s potential contribution to science education has been widely recognized, its use is still hampered by procedural and logistic limitations. One obvious limitation to the widespread use of computer software in general and computer animations in particular is the high cost involved. This current problem is likely to diminish with time as there are already many animations that appear free of charge on internet sites, and teachers can adjust them to their students" age and level of thinking by creating activities with instructions and guiding questions as we did.

A clear implication, moreover, for scientific educational research groups and science foundation organizations is the need to support the development of computerized didactic models for science education.

These results suggest that instruction including computer animations at the particulate level can help students understand biology concepts involving molecular processes. Some of these biology concepts include diffusion, osmosis, 3D structure of DNA, cellular transport mechanisms (membrane structure, passive and active transport, etc.), and enzyme-substrate complexes. Many newer versions of college biology textbooks are packaged with a CD-ROM containing instructional resources, including computer animations of molecular processes (Krogh 2000; Raven & Johnson 1999). Although the use of particulate drawings is being promoted by science education researchers, instructors who choose to use them in their instruction need to be made aware of the results of this research and what it can tell them about student learning in the classroom. Educational psychology research performed by Mayer and coworkers (Mayer & Gallini 1990; Mayer & Anderson 1991, 1992) suggests that instruction using computer animations is most effective when the words and pictures are presented simultaneously, rather than separated from one another in time or space. Greenbowe et al. (1995) reported that in order for students to have enough time to interpret the particulate drawings included in computer animations, these animations should be shown successively at least three times (with narration) to the students. They also reported that students' abilities to interpret particulate drawings in computer animations greatly improve as their exposure to these drawings and animations increases. Unfortunately, instructors who choose to incorporate computer animations and particulate drawings in their instruction and assessment may encounter difficulties. It can be very difficult for instructors to create particulate drawings that faithfully represent the scientific phenomena and that test the concepts of interest (Sanger & Greenbowe 2000). Another problem instructors may face is that because students are unfamiliar with particulate drawings, they may misinterpret these drawings. Ultimately, each instructor has to decide whether the additional information that can be presented using particulate drawings and computer animations

5.4 Recommendations

1. Science teachers at the St. Mary‟s Boys SHS should incorporate the use of cartoon style animation teaching to compliment their traditional chalk-talk method of instructional delivery.
2. Innovative methods of instruction must be applied by teachers at the St. Mary‟s Boys SHS to help students to be able to learn faster and enhance their understanding of various concepts. Teachers should be well educated on the relevance of adopting the use of biological animations during biology lessons. This would promote faster comprehension of topics by students.
3. Biology teachers of the St. Mary‟s Boys SHS should endeavour to make sure that their students play more prominent roles in their own learning. Thus it is suggested that teachers should use animations and other multi-media approaches

that would boost their interest and cause them to play more active roles during lessons.

4. The Head teacher of the St. Mary‟s Boys SHS needs to ensure that the biology department is well resourced with all the necessary instructional materials. Head teachers must make provisions for the organisation of field-trips, industrial visits and other educational tours. There must be the provision of special incentive packages and allowances for biology teachers as a way of motivating them to give off their best in the school.
5. Authorities at the St. Mary‟s Boys SHS must consider splitting large-sized classes into smaller and more controllable units which will enable teachers to be able to conduct lessons more effectively and easily. Consequently, more teachers must also be recruited to handle these new classes.
6. School authorities should invite specialists (educational technologists, instructional material technicians, computer experts, etc.) to assist science teachers with their animated cartoon packages that are relevant to the subject.

5.5 Suggestions for Further Studies

In this study we used the animation by itself. There was no communication between students and a teacher. Every student followed the animation individually. In the future we should find out if there are any variations, when a teacher uses the animation as a visualization tool in the lesson.

In future research works, it would be useful to compare the animation impact on long-term memory. While students like to follow animations in the lessons, we should analyze what kind of influence they have to the learning process, when the lesson is instructed by the teacher. Future studies should consider the use of animations in teaching other science subjects such as chemistry or physics at the second cycle level of schooling.

REFERENCES

Aikenhead, G. S. (1997).Toward a first nation‟s cross-cultural science and technology curriculum. *Science Education*, *81*, 217–238.

Aikenhead, G. S. (2005). Science-based occupations and the science curriculum: Concepts of evidence. *Science Education, 89,* 242-275.

American Association for the Advancement of Science. (1989). *Science for all Americans*. Washington: AAAS.

American Association for the Advancement of Science. (1993). *Benchmarks for science literacy: A Project 2061 report*. New York: Oxford University Press.

American Association for the Advancement of Science. (1998). *Blueprints for science literacy*. New York: Oxford University Press.

Anamuah-Mensah, J. (1994). The race against underdevelopment: Mirage or reality? *International Journal of Science Education, 14*, 32-39.

Anamuah-Mensah, J. (1998). Native science beliefs among Ghanaian students. *International Journal of Science Education*, *20*(1), 115-124.

Anamuah-Mensah, J. (2004) Vocational/Technological Education for Accelerated Wealth Creation: Critical Issues Facing the Nation. *Paper presented at the 56th New Year School Conference organised by the Institute of Adult Education at the University of Ghana, 30 December 2004.*

Anderson, I. (2006). *The Relevance of Science Education. As seen by Pupils in Ghanaian Junior Secondary Schools*. A doctoral thesis submitted to the Department of Mathematics and Science Education, University of the Western Cape.

Arreola, R. A. (1995). *Developing a comprehensive faculty evaluation system.* Bolton, MA: Anker Publishing.

Ayalon, H. (1995). Math as a gatekeeper: Ethnic and gender inequality in course taking of the sciences in Israel. *American Journal of Education*, *104*(1), 34-56.

Bajah, S. T. (1998). Stepping into science: The English Learner Subgroup Self Assessment way. *STAN Bulletin, 15*(2), 6-8.

Baram-Tsabari, A., Sethi, R. J., Bry, L., & Yarden, A. (2006). Using questions sent to an Ask-A-Scientist site to identify children‟s interests in science. *Science Education*, *90*(6), 1050-1072.

Baram-Tsabari, A., & Yarden, A. (2005). Characterizing children's spontaneous interests in science and technology. *International Journal of Science Education*, *27*(7), 803-826.

Baram-Tsabari, A., & Yarden, A. (2007). Interest in biology: A developmental shift characterized using self-generated questions. *The American Biology Teacher*, *69*(9), 546-554.

Barnes, D., & Blevins, D. (2003). An anecdotal comparison of three teaching methods used in the presentation of microeconomics. *Educational Research Quarterly*, *27*(4), 41-60.

Braskamp, L. A., & Ory, J. C. (1994). *Assessing faculty work: Enhancing individual and instructional performance*. San Francisco, CA: Jossey-Bass.

Bulte, A. M. W., Westbroek, H. B., de Jong, O., & Pilot, A. (2006). A research approach to designing chemistry education using authentic practices as contexts. *International Journal of Science Education*, *28*(9), 1063-1086.

Burns, R. (2000). *Introduction to research methods*. Melbourne, Australia: Addison Wesley Longman Australia Limited.

Busch, H. (2005). Is science education relevant? *Europhysics News*, *36*(5), 162-167.

Burns, R. (2000). *Introduction to research methods*. Melbourne, Australia: Addison Wesley Longman Australia Limited.

Casado, M. (2000). Teaching methods in higher education: A student perspective. *Journal of Hospitality & Tourism Education*, *12*, 65-70.

Castillo, J. J. (2009). *Convenience sampling*. Retrieved June 18, 2013 from Experiment Resources: http://www.experimentresources.com/convenience-sampling.html

Centra, J. A. (1993). *Reflective faculty evaluation*. San Francisco, CA: Jossey-Bass.

Chamany, K., Allen, D., & Tanner, K. (2008). Making Biology Learning Relevant to Students: Integrating People, History, and Context into College Biology Teaching. *Life Sciences Education*, *7*(3), 267–278.

Cobern, W. H. (1994). *Alternative constructs of science and science education.* Paper presented at the plenary presentation for the 2nd Annual Southern Africa Association for Mathematics and Science Education Research, Durban, South Africa.

Cohen, L., & Manion, L. (1994). *Research methods in education*. London: Routledge.

Cohen, L., Manion, L., & Morrison, K. (2000). *Research Methods in Education*. London: Routledge Falmer.

Conboy, J. E., & Fonseca, J. M. (2009). Student Generated Recommendations for Enhancing Success in Secondary Science and Mathematics. *Eurasia Journal of Mathematics, Science & Technology Education*, *5*(1), 3 -14.

Craven, J. A., & Penick, J. (2001). Preparing new teacher to teach: The role of the science teacher educator. *Electronic Journal of Science Education.* Retrieved January 1st, 2014 from http://unr.edu/homepage/crowther/elje/cravenpenick.html.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*, 297-334

Cuseo, J. (n.d.). *The case for student evaluation of college courses: Policy Center on the First Year of College*. Retrieved May 18, 2013, from http://www.brevard.edu/fyc/fya/CuseoLink.htm

Darby, L. (2009). Translating a "Relevance Imperative" into junior secondary mathematics and science pedagogy. *Eurasia Journal of Mathematics, Science & Technology Education*, *5*(3), 277 – 288.

Davie, R., & Galloway, D. 1996). *Listening to children in education*. London: David Fulton Publishers.

Dawson, C. (2000). Upper primary boys' and girls' interests in science: have they changed since 1980? *International Journal of Science Education*, *22*(6), 557-570.

Denzin, N. K., & Lincoln, Y. S. (2005). *Handbook of qualitative research.* Thousand Oaks, CA: Sage.

De Caprariis, P., Barman, C., & Magee, P. (2001). Monitoring the benefits of active learning exercises in introductory survey courses in science: An attempt to improve the education of prospective public school teachers. *The Journal of Scholarship of Teaching and Learning*, *1*(2), 1-11.

Doyle.T. (n.d.). *Evaluating Teachers Effectiveness*. Retrieved May 2013, 2008, from ferris.edu/fctl/Teaching_and_Learning_Tips/.../EvalTeachEffec.html.

Edelson, D. C., & Joseph, D. M. (2004, November). *The interest - driven learning design framework: motivating learning through usefulness*. Paper presented at the Proceedings of the 6th international conference on learning sciences Santa Monica, California.

Falchetti, E., Caravita, S., & Sperduti, A. (2003, August). *What lay people want to know from scientists: An analysis of the data base of "Scienzaonline"*. Paper presented at the 4th ESERA Conference, Noordwijkerhout, The Netherlands.

Fleming, D. (2000). *The AEL guide to action research*. Charleston, WV: Appalachia Educational Laboratory.

Fosnot, C. (1989). *Enquiring teachers, enquiring learners*. New York: Teachers College Press.

Franklin, J. (2001). Computer Generated Music as a Teaching Aid for First Year Computing. *Journal of Computing Sciences in College, 16* (4), 10-20.

Fredua-Kwarteng, Y., & Ahia, F. (2005). *Confronting National Mathematics Phobia in Ghana*. Ghanaweb: Retrieved July 1, 2013, from http://www.ghanaweb.com/GhanaHomePage/NewsArchive/artikel.php?ID=61432.

Gabel, D. L., Samuel, K.V., & Hunn, D. (1987). Understanding the particulate nature of matter. *Journal of Chemical Education*, *64*, 695-697.

Gall, M. D., Borg, W. R., & Gall, J. P. (1996). *Educational Research.* USA: White Plains, NY: Longman Publishers.

Giordan, A. (1998). *Learning*. Belin Publishers: Paris, France.

Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Hawthorne, NY: Aldine.

Golafshani, N. N. (2003). Understanding reliability and validity in qualitative research. *The Qualitative Report, 8*(4), 1-10.

Greenbowe, T. J., Sanger, M. J., Burke, K. A., & Lynch, M. D. (1995). *Results of Using Computer Animations on Conceptual Topics in the Lecture Presentation and their Effect on Student Performance on Examination Questions*. Paper presented at the national meeting of the American Chemical Society, //Chicago, IL.

Gronlund, N. E., & Linn, R. L. (1990). *Measurement and Evaluation in Teaching*. New York: Macmillan Publishers.

Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research*, *15*(9), 1277-1288.

Hunt, D., Haidet, P., Coverdale, J., & Richards, B. (2003). The effect of using team learning in an evidence-based medicine course for medical students. *Teaching and Learning in Medicine*, *15*(2), 131-139.

Hurd, P. D. (1993). *Biology in transition*. Colorado Springs, CO: BSCS.

Ijhedo, J. A. (1995). *A Quasi-experimental Research on the Effect of Synchronized Instructional Resources in Automobile Education: A Case Study at the University of London.* Unpublished master‟s thesis, University of London, London.

Intsiful, J., Okyere, P. F., & Osae, S. (2003). *Use of ICT for education, research and development in Ghana: challenges, opportunities and potentials*. 2003 Round Table on Developing Countries Access to Scientific Knowledge. The Abdus Salam ICTP, Trieste, Italy.

Jenkins, E. W. (1999). School science, citizenship and the public understanding of science. *International Journal of Science Education, 21*(7), 703-710.

Jenkins, E. W., & Nelson, N. W. (2005). Important but not for me: Students' attitudes towards secondary school science in England. *Research in Science & Technological Education*, *23*(1), 41-57.

Kahle, J. B., Parker, L. H., Rennie, L. J., & Riley, D. (1993). Gender differences in science education: Building a model. *Educational Psychologist, 28*(4), 379-404.

Kember, D., Ho, A., & Hong, C. (2008). The importance of establishing relevance in motivating student learning. *Active Learning in Higher Education*, *9*(3), 249-263.

Knight, P.T. (2002). *Being a teacher in higher education*. Buckingham: Open University Press.

Krapp, A. (2000). Interest and human development during adolescence: an educational-psychological approach. In J. Heckhausen (Ed.), *Motivational psychology of human development* (pp. 109-128). London: Elsevier.

Krogh, D. (2000). *Biology: A Guide to the Natural World*. Upper Saddle River, NJ: Prentice-Hall.

Lieberman, L., & Kirk, R. C. (2004). What should we teach about the concept of race? *Anthropology and Education Quarterly*, *35*(1), 137-146.

Lowe, R. K. (2003). Animation and learning: selective processing of information in dynamic graphics. *Learning and Instruction, 13*, 157-176.

Marshall, J. (1992). Researching women in management as a way of life. *Management Education and Development*, *23*(3), 281-289.

Mayer, R. E. (1997). Multimedia learning: are we asking the right questions? *Educational Psychologist, 32*, 1-19.

Mayer, R. E., & Anderson, R. B., (1991). Animations need narrations: An experimental test of a dual-coding hypothesis. *Journal of Educational Psychology*, *83*, 484-490.

Mayer, R. E., & Anderson, R. B. (1992). The instructive animation: Helping students build connections between words and pictures in multimedia learning. *Journal of Educational Psychology*, *84*, 444-452.

Mayer, R. E., & Gallini, J. K. (1990). When is an illustration worth ten thousand words? *Journal of Educational Psychology*, *82*, 715-726.

Mayer, R. E., Hegarty, M., Mayer, S., & Campbell, J. (2005). When Static Media Promote Active Learning: Annotated Illustrations Versus Narrated Animations in Multimedia Instruction. *Journal of Experimental Psychology, 11*(4), 256-265.

McNiff, J., Lomax., P., & Whitehead, J. (2001). *Action Research in Organisations, Routledge Studies in Human Resource Development*. London: Routledge.

McNiff, J., & Whitehead, J. (2002). *Action Research: Principles and Practice*. London: Routledge.

Merriam, S. B. (1998). *Qualitative research and case study applications in education*. San Francisco: Jossey Bass Publishers.

Montgomery, M. J.s (n. d). *An Analysis Of Student Feedback Systems*. Retrieved July 24, 2013, from http://www.sdsu.edu/campusinfo/mission.html).

Morgan, R., Whorton, J., & Gunsalus, C. (2000). A comparison of short term and long term retention: Lecture combined with discussion versus cooperative learning. *Journal of Instructional Psychology*, *27*(1), 53-58.

Murray, H. G. (1994). *Can Teaching Be Improved*? Canada: Brock University.

Murray, I., & Reiss, M. (2005). The student review of the science curriculum. *School Science Review*, *87*(318), 83-93.

Nakhleh, M. B. (1993). Are our students conceptual thinkers or algorithmic problem solvers? *Journal of Chemical Education*, *70*, 52-55.

National Research Council. (1996). *National science education standards*. Washington, DC: National Academic Press.

Ochs, E., Gonzales, P., & Jacoby, S. (1996). When I come down I'm in the domain state: grammar and graphic representation in the interpretive activity of physics. In E. Ochs & E. A. Schegloff (Eds.), *Grammar and interaction* (pp. 328-369). Cambridge, MA, England: Cambridge University Press.

Onyegegbu, N. (2006). *Using new technologies in creating excitement in Science Laboratory activities*. Proceedings of 47th STAN Annual Conference.

Ory, J. C. (2001). Faculty thoughts and concerns about student ratings. In K. G. Lewis (Ed.),*Techniques and strategies for interpreting student evaluations*. *New Directions for Teaching and Learning*, (87th ed., pp. 3-15). San Francisco, Ca: Jossey-Bass.

Osborne, J., & Collins, S. (2000). *Pupils' and Parents' Views of the School Science Curriculum*. London: King's College London.

Oversby, J. (1998). Science/technology/society: 21st century science education. *STAN Bulletin, 15*(2), 4-6.

O‟Leary, Z. (2001). Conversations in the Kitchen. In A. Bartlett & G. Mercer (eds), *Postgraduate Research Supervision: Transforming Relations* (pp. 195–208). New York: Peter Lang.

Perkins, D., & Saris, N. (2001). A jigsaw classroom technique for undergraduate statistics courses. *Teaching of Psychology*, *28*(2), 111-113.

Pickering, M. (1990). Further studies on concept learning versus problem solving. *Journal of Chemical Education*, *67*, 254-255.

Pintrich, P. R., & Schunk, D. H., (2002).*Motivation in education: Theory, research, and applications.* Upper Saddle River, NJ: Prentice Hall.

Pratt, D. (1997). Reconceptualizing the evaluation of teaching in higher education. *Higher Education*, *34*, 23- 44.

Qualters, D. (2001). Do students want to be active? *The Journal of Scholarship of Teaching and Learning*, *2*(1), 51-60.

Raven, P. H., & Johnson, G. B. (1999). *Biology*. Boston: McGraw-Hill.

Sagor, R. (2000). *Guiding school improvement with action research*. Alexandria, VA: Association of Supervision and Curriculum Development.

Sanger, M. J., & Greenbowe, T. J. (1997). Students' misconceptions in electrochemistry: Current flow in electrolyte solutions and the salt bridge. *Journal of Chemical Education*, *74*, 819-823.

Sanger, M. J., & Greenbowe, T. J. (2000). Addressing student misconceptions concerning electron flow in aqueous solutions with instruction including computer animations and conceptual change strategies. *International Journal of Science Education*, *22*, 521-537.

Sawrey, B. A. (1990). Concept learning versus problem solving: Revisited. *Journal of Chemical Education*, *67*, 253-254.

Schreiner, C. (2006). *Exploring a ROSE-garden: Norwegian youth's orientations towards science -seen as signs of late modern identities*. Oslo, Norway.

Schreiner, C., & Sjøberg, S. (2006). Science education and youths" identity construction– two incompartible projects? In D. Corrigan, Dillon, J. & Gunstone, R. (Eds.), The Re-emergence of Values in the Science Curriculum: Sense Publications.

Seiler, G. (2006). Student interest-focused curricula. In K. Tobin (Ed.), *Teaching and learning science: A handbook* (Vol. 2, pp. 336-344). Westport, Cincinnati: Praeger.

Shamos, M. H. (1995). *The myth of scientific literacy*. New Brunswick, NJ: Rutgers University Press.

Stawinski, W. (1984, February). *Development of students' interest in biology in Polish schools*. Paper presented at the Interests in Science and Technology Education: 12th IPN Symposium, Kiel, Germany.

Sulberger (2001). *Internet Service Providers and Communications Solutions in Ghana*. A paper presented to International Finance Corp. World Bank.

Tamir, P., & Gardner, P. L. (1989). The structure of interest in high school biology. *Research in Science & Technological Education*, *7*(2), 113-140.

Theall, M., & Franklin, J. (2001). Looking for Bias in all the Wrong Places – A Search for Truth or a Witch Hunt in Student Ratings of Instruction? In P, Theall, L, Abrami, & Mets, L. (Eds.), *The Student Ratings Debate: Are they Valid? How*

Can We Best Use Them? *New Directions in Educational Research*, (pp. 31- 40) 109. Jossey-Bass: San Francisco. 2001.

Tippins, D. J., & Ritchie, S. (2006). Culturally relevant pedagogy for science education. In K. Tobin (Ed.), *Teaching and Learning Science: A Handbook* (Vol. 2, pp. 277-282). Westport, CT, US: Praeger.

United Nations Educational, Scientific and Cultural Organization. (1994). *Conceptualising scientific and technological literacy (STL) for all*. Harare: UNESCO.

Vogel-Walcutt, J .J., Gebrin, J. B., & Nicholas, D. (2010). Animated versus Static Images of Team Processes to Affect Knowledge Acquisition and Learning Efficiency. *MERLOT Journal of Online Learning and Teaching*, *6*(1) 162-173.

Williamson, V. M., & Abraham, M. R. (1995). The effects of computer animation on the particulate mental models of college chemistry students. *Journal of Research in Science Teaching*, *32*, 521-534.

Yoder, J., & Hochevar, C. (2005). Encouraging active learning can improve students‟ performance on examinations. *Teaching of Psychology*, *32*(2), 91-95.

APPENDICES

APPENDIX A

QUESTIONNAIRE ON STUDENTS' VIEWS OF BIOLOGY

Dear Student,

This study is purely for academic purposes. You will be contributing to its success, if you provide responses to the items as frankly and honestly as possible. Your response will be kept confidential. Kindly read through each of the items carefully and indicate the opinion that is the nearest expression of your view on each of the issue raised.

General Instruction

Please tick [√] the appropriate bracket or column.

Section A: Bio Data

Age: below 15 yrs [ ] 15 yrs [ ] 16 yrs [ ] 17yrs [ ] 18 yrs [ ] 19 yrs [ ]

above 19 yrs [ ]

Form:

Statement	Strongly Agree	Agree	Not Certain	Disagree	Strongly Disagree
1. I am very interested in Biology					
2. Biological animations explains things clearly					
3. Biological animation make me interested in the Biology lesson					
4. Biological animations has helped me know everything that goes on in Biology lessons					
5. Biological animations makes it easy for us to fool during the lesson					

Statement	Strongly Agree	Agree	Not Certain	Disagree	Strongly Disagree
6. Biological animations makes the teacher to teach confidently					
7. Biological animations gives us a lot of free time in class					
8. Let us get away with a lot in the lessons					
9. Makes us afraid in the lesson					
10. Leads to waste of time in the lesson					
11. It is expensive and must be discontinued					

APPENDIX B

QUESTIONNAIRE ON STUDENTS' VIEWS OF BIOLOGICAL ANIMATIONS

Dear Student,

This study is purely for academic purposes. You will be contributing to its success, if you provide responses to the items as frankly and honestly as possible. Your response will be kept confidential. Kindly read through each of the items carefully and indicate the opinion that is the nearest expression of your view on each of the issue raised.

General Instruction

Please tick [√] the appropriate bracket or column.

Section A: Bio Data

Age:

Form:

Statement	Strongly Agree	Agree	Not Certain	Disagree	Strongly Disagree
1. I am very interested in Biology					
2. Biological animations explains things clearly					
3. Biological animation make me interested in the Biology lesson					
4. Biological animations has helped me know everything that goes on in Biology lessons					
5. Biological animations makes it easy for us to fool during the lesson					

Statement	**Strongly Agree**	**Agree**	**Not Certain**	**Disagree**	**Strongly Disagree**
6. Biological animations makes the teacher to teach confidently					
7. Biological animations gives us a lot of free time in class					
8. Let us get away with a lot in the lessons					
9. Makes us afraid in the lesson					
10. Leads to waste of time in the lesson					
11. It is expensive and must be discontinued					

APPENDIX C

INTERVIEW SCHEDULE ON THE USE OF BIOLOGICAL ANIMATIONS

1. What are your views about the use of animations in biology?
2. Did you enjoy the use of animations during the lessons?
3. In your opinion, what do you think makes animation-oriented teaching unique from other instructional methods?
4. What are the disadvantages associated with the use of animations?

5(a). Would you recommend the use of animations in all biology lessons?

(b) Give reasons for your answer

APPENDIX D

PRE-TEST ON BIOLOGICAL ANIMATIONS

This exercise is being conducted for research purposes only. Because of this, marks obtained on the test will be treated confidentially. It is hoped that the information gathered from your responses will be of much benefit to biology teachers as it will provide them with a guide in the planning and teaching of this topic in schools.

Thank you for your co-operation.

Duration: 30 minutes

Age: **Form:**

1. An insect with long proboscis and entire body covered with scales belongs to the order A) Diptera B) Isoptera C) Lepidoptera D) Odonata
2. The group of organisms which shares the same characteristics with the living and non-living things are A) Bacteria B) Fungi C) Protoctist D) Viruses
3. Which of the following organisms is a protoctist?

   A) Bracket fungus B) Bacterium C) Green alga D) Moss plant
4. One of the characteristics of the Kingdom Prokaryotae is the possession of

   A) Chlorophyll B) Flagella C) Hyphae D) Cell membrane
5. Cold-blooded vertebrates that spend part of their life in water and part on land but return to water to reproduce belong to the class

   A) Reptilia B) Mammals C) Amphibia D) Pisces
6. Which of the following is the correct sequence of structural organization in living organization?

   A) Tissue---cell---organ---system B) Cell---organ---tissue---system

C) Cell---tissue---organ---system D) Cell---tissue---organ---system

7. The blackish fluffy growth on stale bread is likely to be

A) mushroom B) bacteria C) rhizopus D) virus

8. The characteristic component of plant cell walls is

A) Cellulose B) Lignin C) Pectin D) Tannin

9. The male agama lizard frightens its enemy with the

A) Bulging eyes B) Gular fold C) Nuchal crest D) Spiny scales

10. A monoecious plant

A) Produces bisexual flowers only B) Has unisexual flowers occurring on two separate plants C) Has unisexual flowers occurring on the same plant D) Produces unisexual flowers only

11. Which of the following is not a typical shape in bacteria?

A) Rod-shape B) Irregular shape C) Comma-shape D) Spiral-shape

12. A flower with both stamens and carpel"s is said to be

A) Irregular B) A hermaphrodites C) dioecious D) monoecious

13. Organisms with their nuclear material scattered in their cytoplasm belongs to the group known as

A. Prokaryotae B. Protoctista C. Fungi D. Animalia

14. Amoeba can be found in all of the following habitats except

A. damp soils B. muddy ponds C. ditches D. lagoons

15. All the members of the lingdom Plantae do not possess

A. Cellulose cell wall. B. Chlorophyll C. Sticky stigma surface

D. Stamens with long filaments.

16. A cell is said to be plasmolysed if

A. it loses its water content and dries up. B. It imbibes water and swells up

C. The cytoplasm pulls away from the cell wall   D. the nuclear membrane ruptures to release its content.

17. Nutrients taken away by living organisms help them to

A. breathe   B. Excrete   C. grow   D. respond to stimuli

18. The organelle in the cell usually referred to as the powerhouse of the cell is

A. golgi apparatus   B. Mitochondrion   C. Endoplasmic Reticulum

D. Ribosome

19. Which of the following statements about the cell membrane is not true?

A. They are formed from proteins and lipids. B. Can expand indefinitely

C. They are semi-permeable   D. They contain cellulose

20. Which of the following protozoa feed autotrophically?

A. Euglena   B. Amoeba   C. Paramecium   D. Plasmodium

APPENDIX E

POST-TEST ON BIOLOGICAL ANIMATIONS

This exercise is being conducted for research purposes only. Because of this, marks obtained on the test will be treated confidentially. It is hoped that the information gathered from your responses will be of much benefit to biology teachers as it will provide them with a guide in the planning and teaching of this topic in schools.

Thank you for your co-operation

Duration: 30 minutes

Age: **Form:**

1. The organelle of an animal cell which forms spindle fibres during cell division is the

   A. Centriole B. lysosome C. endoplasmic reticulum D. golgi body

2. Osmoregulation is carried out in paramecium by the

   A. Anal pore B. Oral groove C. pellicle D. vacuole

3. The organisms that feed on dead animals are called

   A. Scavengers B. carnivores C. Omnivores D. herbivores

4. Which of these organelles absorb light energy?

   A. Ribosome B. Chloroplast C. Mitochondrion D. lysosome

5. Rhizopus is a saprophyte because it

   A. It is a chemosynthesizer B. it digests its food extracellularly

   C. feeds on other organisms D. grows on trees

6. Euglena may be considered as an animal because it possesses

   A. Flagellum B. nucleus C. pyrenoid D. vacuole

7. Viruses are considered as particles rather than living things because they

   A. Are extremely small in size B. occur in different shapes C. lack nucleus, cytoplasm and cell membrane D. cause a variety of diseases in plants and animals

8. The group of organisms which share the same characteristics with both living and non-living organisms are

   A. Bacteria B. fungi C. protoctista D. viruses

9. Houseflies are vectors of all of the following diseases except

   A. Poliomyelitis B. malaria C. typhoid D. dysentery

10. Which of the following organisms exhibits both plant and animal-like features?

    A. Amoeba B. Euglena C. paramecium D. Spirogyra

11. A monoecious plant A)Produces bisexual flowers only B) Has unisexual flowers occurring on two separate plants C)Has unisexual flowers occurring on the same plant D)Produces unisexual flowers only

12. Which of the following is not a typical shape in bacteria? A) Rod-shape B) Irregular shape C) Comma-shape D) Spiral-shape

13. A flower with both stamens and carpel‟s is said to be

    A) Irregular B) A hermaphrodites C) dioecious D)monoecious

14. Organisms with their nuclear material scattered in their cytoplasm belongs to the group known as

A. Prokaryotae B. Protoctista C. Fungi D. Animalia

15. All the members of the lingdom Plantae do not possess

A. Cellulose cell wall. B. Chlorophyll C. Sticky stigma surface D. Stamens with long filaments

16. A cell is said to be plasmolysed if

A. it loses its water content and dries up. B. It imbibes water and swells up

C. The cytoplasm pulls away from the cell wall D. the nuclear membrane ruptures to release its content.

17. Nutrients taken away by living organisms help them to

A. breathe B. Excrete C. grow D. respond to stimuli

18. Which of the following organisms is a protoctist? A)Bracket fungus B)Bacterium C)Green alga D) Moss plant

19. One of the characteristics of the Kingdom Prokaryotae is the possession of A)chlorophyll B) flagella C) hyphae D)cell membrane

20. Cold-blooded vertebrates that spend part of their life in water and part on land but return to water to reproduce belong to the class

A)Reptilia B)Mammals C)Amphibia D)Pisces

APPENDIX F

RELIABILITY COEFFICIENTS OF QUESTIONNAIRE ON STUDENTS VIEWS ABOUT BIOLOGY

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.810	0.820	11

Case Processing Summary

		N	%
Cases	Valid	60	100.0
	Excluded[a]	0	.0
	Total	60	100.0

a. Listwise deletion based on all variables in the procedure.

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum/ Minimum	Variance	N of Items
Item Means	1.662	1.100	2.700	1.600	2.455	.145	39
Item Variances	.463	.100	.933	.833	9.333	.072	39
Inter-Item Covariances	.063	-.533	.933	1.467	-1.750	.031	39
Inter-Item Correlations	.138	-1.000	1.000	2.000	-1.000	.148	39

APPENDIX G

RELIABILITY COEFFICIENTS OF QUESTIONNAIRE ON STUDENTS VIEWS ABOUT BIOLOGICAL ANIMATIONS

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.770	0.790	11

Case Processing Summary

		N	%
Cases	Valid	60	100.0
	Excluded[a]	0	.0
	Total	60	100.0

a. Listwise deletion based on all variables in the procedure.

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum/ Minimum	Variance	N of Items
Item Means	1.662	1.100	2.700	1.600	2.455	.145	39
Item Variances	.463	.100	.933	.833	9.333	.072	39
Inter-Item Covariances	.063	-.533	.933	1.467	-1.750	.031	39
Inter-Item Correlations	.138	-1.000	1.000	2.000	-1.000	.148	39

APPENDIX H

RELIABILITY COEFFICIENTS OF PRE-TEST

Case Processing Summary

		N	%
Cases	Valid	20	100.0
	Excluded[a]	0	.0
	Total	50	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.751	.762	20

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum/ Minimum	Variance	N of Items
Inter-Item Correlations	.977	.912	1.000	.088	1.097	.001	30

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
37.6000	60.735	7.79325	30

APPENDIX I

RELIABILITY COEFFICIENTS OF POST-TEST

Case Processing Summary

		N	%
Cases	Valid	20	100.0
	Excluded[a]	0	.0
	Total	20	100.0

a. Listwise deletion based on all variables in the procedure.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.850	.862	20

Summary Item Statistics

	Mean	Minimum	Maximum	Range	Maximum/ Minimum	Variance	N of Items
Inter-Item Correlations	.882	.912	1.000	.088	1.097	.0136	20

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
72.2000	58.735	8.9449325	20