UNIVERSITY OF EDUCATION, WINNEBA

INTEGRATION OF COMPUTER TECHNOLOGY INTO THE TEACHING AND LEARNING OF NUCLEAR PHYSICS

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DECLARATION

STUDENT'S DECLARATION

I, Francis Akwasi Manu declare that the Integration of computer technology into the teaching and learning of nuclear physics with the exception of quotations and citations contained in published works which have all been identified and duly acknowledged, is entirely my own original work, and it has not been submitted, either in part or whole, for another degree elsewhere.

Signature: ……………………………………………………

Date: ………………………………………………………………

SUPERVISOR'S DECLARATION

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

Name of Supervisor: Dr. I. K. Anderson

Signature: ……………………………………………………

Date: ……………………………………………………………

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DEDICATION

I dedicate this thesis to my mother Mrs. Diana Adubea and my father Mr. Joseph Kofi Nti of blessed memory for being the vessel for me to come to this world.

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ABSTRACT

This study investigated the effect of integration of computer technology such as computer animation into the teaching and learning of nuclear physics. The study involved one class of form three physics students in Anglican Senior High School in Kumasi. Purposive and convenience sampling techniques were used to select 70 students (13 females and 57 males). Both quantitative and qualitative data were collected using test and unstructured interviews respectively. The students wrote a pre-intervention test after which the computer animations were used to teach the lesson. The students then wrote a similar test as a post-intervention test. In the analysis of data, SPSS was used to find out whether there was a significant improvement in students' performance in relation to the lesson taught using traditional and computer animation methods of teaching. A paired sample t-test conducted showed that there was a significant difference in the pre-intervention test and post-intervention test scores at p-value of 0.00 ($\alpha \leq 0.05$). The findings further revealed that the students perceived the computer animation method of teaching to be very effective since it enhanced their performance. The study recommends the use of computer animation method of teaching in physics lessons at the SHS level.

CHAPTER ONE

INTRODUCTION

1.0 Overview

This chapter covers the background of the study, statement of the problem and purpose of the study. The structure of the chapter also includes the objectives, research questions and significance of the study as well as the delimitations and limitations of the study. This chapter concludes with the organisation of the study.

1.1 Background of the Study

It is easy to observe that the use of Computer Technology has seen remarkable progress in the recent and past years because of its noteworthy impact on all areas of human endeavour. The field of education is not left out as technology has positively affected teaching, learning and research in many ways (Fisseha, 2011). Yusuf (2006) opined that computer technologies have the potential to accelerate, enrich and deepen skills, to motivate and engage students, to help relate the school knowledge to work practices, create economic practicability for tomorrow's workers as well as strengthening teaching and helping schools change.

Tinio (2002) articulates that the promises of computer technologies are increasing access and improving relevance and the quality of education in developing countries. Tinio further states the capabilities of computer technology. These are that computer technologies momentously accelerates the acquisition and absorption of knowledge, offering developing countries the exceptional opportunities to enhance educational systems, improve policy formulation and execution, and broaden the range of prospects for business and the poor. In Watson's (2001) account, computer technologies have revolutionised the way people work today and are now transforming education systems. As a result, if schools trained children in yesterday's skills and technologies, they may not be effective and fit in tomorrow's world. This is a sufficient reason for computer technologies to win global recognition and attention. For example, computer technologies are trustworthy tools in assisting the attainment of one of the Millennium Development Goals (MDGs) which is the achievement of universal primary education by the year 2015. Kofi Annan, the former United Nations Secretary General, points out that in order to attain the goal of Universal Primary Education by the year 2015; we must ensure that computer technologies unlock the door of education systems. This indicates the growing demand and an increasingly important place that computer technologies could receive in education. Since computer technologies offer greater opportunity for students and teachers to adjust to the learning and teaching to individual needs, society is forcing schools to give an appropriate response to this technical innovation (Fisseha, 2011).

For any nation to achieve the status of self-reliance, science and technology must be an essential constituent of the knowledge to be given to her citizens regardless of tribe or ethnicity, creed or gender (Ezenwa & Gambari, 2011). Among the perceived aims of physics education is the training of students to acquire proper understanding of basic principles as well as their applications. It is also to develop in them appropriate scientific skills and attitudes as a pre-requisite for future scientific activities. To achieve these objectives, modern teaching techniques, active involvement and collaborative learning activities become imperative and these would need a functional instructional medium to make physics instruction effective (Onwioduokit, 2000).

In developing countries particularly in Ghana, the image of the information age has generated a whole set of conjectures about the need for educational reforms that will accommodate the new tool, “computer”, as indicated by Pelgrum (2001). Government and Educational Planners in Ghana are seen to have responded to the challenge by creating national programmes to incorporate new technology (e.g. Computer and Internet) at all educational levels. Hence it appears computer technology is attracting a large proportion of the country’s limited budget for education. Earle (2002) noted that the use of computers in teaching or instruction does promote learning but Solomon (2002) added that the revolutionary change in educational learning in particular, has not been realised in terms of the use of computers. One of the reasons apportioned to this, according to Solomon (2002), is that computer users in educational settings thinking that computer alone will bring revolutionary change in learning mostly focus on access to computer rather than on effective instructional principles designed by teachers using computers. This study focused on the integration of computer technology into the teaching and learning of some concepts in nuclear physics. In this study computer technology will focus on computer animation.

1.2 Statement of the Problem

In spite of the relevance of physics as a requirement for many specialised science and technology courses, it is sad to note that students’ performance at the Senior High School level in physics has not been encouraging. The West African Examinations Council

(WAEC) through the Chief Examiners has repeatedly reported poor performance in physics (WAEC., 2014). This problem has major implications on university and other tertiary admissions. Some of the implications are that schools no longer produce adequate number of qualified candidates in science-based courses for those admissions. In addition, it prevents the educational system in Ghana from producing the required number of qualified scientists and technologists. In order to mitigate this problem, there must be modern tools that will make teaching and learning of physics concepts easier and for better understanding. The computer animation package could be one of such modern tools that can be used to teach physics concepts.

1.3 Purpose of the Study

The purpose of this study was to investigate the effect of integration of computer technology in the teaching and learning of some concepts in nuclear physics.

1.4 Objectives

The objectives of the study were to determine:

1. The knowledge level students have about some concepts in nuclear physics before the introduction of computer technology in teaching.
2. The knowledge level students have about some concepts in nuclear physics after the introduction of computer technology in teaching.
3. The perception of students about the integration of computer technology in teaching.

1.5 Research questions

The study was guided by the following research questions to ascertain the effect of integration of computer technology into the teaching and learning of nuclear physics in Anglican Senior High School, Kumasi:

1. What is the knowledge level student had about some concepts in nuclear physics before the introduction of the computer technology?
2. What is the knowledge level student had about some concepts in nuclear physics after the introduction of computer technology?
3. What is the perception of students about the integration of computer technology in teaching?

1.6 Significance of the Study

The outcome of the study is likely to help improve the performance of physics students in the concept of nuclear physics. It may also encourage students to use this instructional strategy in studying other concepts in physics. The findings of the study might inform physics teachers about teaching strategy that involves the use of computer technology such as computer animation to enhance the teaching and learning of physics concepts in the Senior High School level.

1.7 Delimitations of the Study

The study was confined to the integration of computer technology into the teaching and learning of some concepts in nuclear physics. Only science students of Anglican Senior

High School, Kumasi in the Ashanti Region were part of the study. Only form three (3) physics students were sampled for the study.

1.8 Limitations of the Study

Time and cost constraints prevented the extension of the study to other institutions.

1.9 Organisation of the Study

The study was organised in five chapters. Chapter one deals with the background of the study, statement of the problem, purpose of the study, objectives, research questions, significance of the study, delimitations of the study, limitations of the study and the organisation of the study. Chapter two covers the review of relevant literature to the study with chapter three focusing on the population, instrument for data collection and the procedure used in the data analysis. Chapter four involves the presentation of data, the analysis and discussion of the results. Chapter five dealt with the summary of the research findings, conclusion, recommendations and areas for further study.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Overview

The literature review on the integration of computer technology into the teaching and learning of nuclear physics in Senior High School (SHS) draws on the meaning and importance of computer technology, integration of computer technology into teaching, factors that hinder computer technology integration in schools, teachers' attitudes and beliefs in the use of computer technology, teachers' knowledge and skills in computer technology, utilisation of computer technology facilities by teachers and students, students' performance in physics, using computer technology to teach physics, computer technology and the theoretical framework of the study.

2.1 Meaning and Importance of Computer Technology

Computer technology in education can be understood as the application of digital equipment to all aspects of teaching and learning. Educational technology is affected by many things such as social, cultural, political, economic and educational changes.

Hernes (2003) mentioned that computers were now being seen as essential family and workplace technologies due to our increasing reliance on them. Hernes also noted that the methods in which hardware has been produced and worked are expressions of globalisation and there are now widespread global recognition of brand names such as Microsoft, Apple, Panasonic, Sony, Intel and Nokia.

It is easy to observe that the use of computer technology has become more common during the last two decades with the existence of the Internet and the World Wide Web. The Internet is fast becoming the largest collection of information in the world. Importantly, teachers can use the Internet to enhance teaching and learning but this strategy needs to be well structured and sequenced (Pachler, 1999). Pachler suggested that pupils need to be prepared well for using the Internet. They need to be clear about the intended learning outcomes and have clearly differentiated tasks to work on. Accordingly, students can develop as highly motivated and successful learners provided that schools do not implement computer technology superficially with existing classroom curricula and pedagogies, using it to make their schools appear modern without ensuring the efficacy of its usage. Computer technology has changed the quality of education and it is clear for many educators that students are changing by using computer technology tools (Finger, Russell, Jamieson-Proctor, & Russell, 2007).

In Australia, a survey of the computer skills and knowledge of 6,213 students (Meredyth, Russell, Blackwood, Thomas, & Wise, 1999) tested four domains of computer technology activity. These are creativity, information, communication, and educational programmes and games. Teachers reported that computer technology was most frequently used for information purposes (70% of teachers), creative purposes (50% of teachers) and educational programmes and games (43% of teachers). The use of computer technology and the internet in education particularly in the teaching and learning process will result in academic enhancements globally (Butzin, 2000; Erickson & Lehrer, 2000). As a result, there are concerns for those who have had little or no experience with computer technology and most of them are in the developing countries (Cawthera, 2003) and Ghana is not an exception to this concern.

Computer-based technology allows teachers to move from the role of dispenser of knowledge to a facilitator or coach, allowing the teacher to encourage and guide students in becoming active learners. Spending more time with individual students will be a reason for teachers to exploit the computer potentials. Computer-based technology will permit the teacher to present more complex material and expect more from the students (Office of Technology Assessment (OTA), 1995). Personal influences will include improving classroom management and increase positive feelings of self-worth. The computer allows the teacher to easily keep track of grades. Gaining new technical skills are viewed as important and keeping current with developments in the teachers' field results to increase self-worth (OTA, 1995). There are several perception of teachers in the use of computer-based technology that seem to be significant. Some of the perceptions are that

1. technology will support superior forms of learning (Collis, Betty, Antoinette, & Wes Sherra, 1988).
2. computer-based technology can change the way teaching and learning occurs (Compeau & Higgins, 1995; OTA, 1995).
3. computer-based technology helps teachers to accomplish things that they cannot do by themselves (Wild, 1996).
4. computer-based technology enhances teacher or student productivity (OTA, 1995).

5. computer-based technology prepares students for the work world (Yuen & Ma, 2002).

Teachers who hold these insights tend to be more successful in adopting and using computer-based technology. The perception that technology supports superior forms of learning comes from cognitive psychology (Veen, 1993). Veen concludes that advance skills of comprehension, reasoning and experimentation are acquired through the learners' skills within authentic contexts (hence more complex problems) for modelling expert thought processes and for providing collaboration and external supports to permit students to achieve intellectual accomplishments they could not do on their own, provides a wellspring of ideas for many of this decades curriculum and instruction reform efforts. Computer-based technology can change the way teaching occurs (OTA, 1995). Some of the changes in the way of teaching are

1. a move from the teacher as a dispenser of knowledge to the teacher as a facilitator or coach.
2. teachers expected more from students and presents more complex materials.
3. to create more opportunity for individualised instruction.
4. teachers spending less time lecturing to the whole class.
5. more comfortable with small group activities.
6. team teaching.
7. interdisciplinary project-based instruction.
8. to alter the master schedule.

2.2 Integration of computer technology into teaching

It is easy to observe that the developments in computer technology have affected all sectors of society including the education sector and especially education curricula. Numerous authors have argued that the integration of new technologies into education can improve students learning (Bigum, 2003; Lankshear & Knobel, 2003; Gilbert, 2005). Khine and Fisher (2003) have discussed how the introduction of integrated computer technology in education has led many educators to improve the way they teach and structure their pedagogy. Many academics have argued that frequent use of digital technologies has the potential to empower secondary students to develop new ways of thinking, life and acting in the world, and to gain learning goals that people in industrial generations may not have been able to achieve (Khine & Fisher, 2003). For example, students can search on the Internet and read on a topic, thus learning new information and becoming more familiar with accessing electronic information.

Technology has long been a part of science instruction with science teachers often being considered pacesetters and leaders in the use of technology over many decades (McCrory, 2006). In recent times the technologies used in science teaching have been specifically digital technologies, be they online resources, software or physical computers and devices. Some of the latest practices and research in teaching science have been around the use of tablets such as iPads (Miller, Krockover, & Doughty, 2013). The use of technology in the classroom has been shown to increase motivation and learning and offer new opportunities through various simulations (Wieman, Adams, & Perkins, 2008; Khan, 2010; Quellmalz, Timms, Silberglitt & Buckley, 2012) and science software (Baggott la Velle, Wishart, McFarlane, Brawn, & John, 2007; Zheng, Warschauer, Hwang, & Collins, 2014).

Harrison (2005) mentioned that students use computer technology to plan and build models, and use the Internet to bring a new dimension to their learning. By using software and the Internet, students manage and reduce the time typically given to design a prototype. Also, students test out their ideas in a flexible way, for example, using a Computer-Aided Design (CAD) package to design a house was easier than designing it by hand. Thus computer technology can be used in technology pedagogy to find things out, develop ideas, make things happen, exchange and share information, and review and modify products (Harrison, 2005). Likewise, students who are confident with the basic computer technology tasks have been found to have the highest scientific literacy (Luu & Freeman, 2011). New tools are also evolving that might change the landscape of science teaching such as those that can automatically score students work, offering personalised guidance in science inquiry (Linn, Gerard, Ryoo, McElhaney, Liu, & Rafferty, 2014).

To understand the role of technology in science attainment, researchers have examined computer technology access and use in relation to international attainments in scientific literacy as assessed by PISA (Luu & Freeman, 2011; eSilva, 2014). After controlling for demographic characteristics, the use of technology was found to have a modest but consistent positive impact upon scientific literacy. However, Luu and Freeman (2011) pointed out that the ways in which students use computers in schools may have a stronger effect than how often computers are accessed. In the same vein eSilva (2014) said that what we lose in these huge statistical studies is the detail, we need to know what works and what does not work in each situation.

However, the details on the implementation of innovative technology tools by science teachers are very much dependent on their personal beliefs, motivations and contexts regarding technology and science teaching as a whole (Stylianidou, Boohan, & Ogborn, 2005; Kim, Hannafin, & Bryan, 2007). It is easy to observe that in technologically enhanced environments, student-centred approaches have been demonstrated to be more effective than teacher-guided approaches and to facilitate significantly higher emotional engagement with the students. Hence such self-guided computer technology application provides chances for students to improve new skills and abilities that will enable them to learn more effectively in a computer technology rich world and workforce. However, Khine and Fisher (2003) said whilst a small number of evaluations of computer technology initiatives in educational settings have developed research methodologies that facilitate deep analysis of the learning methods and outcomes that might be happening for students using computer technology in these ways, after two decades of research we still have a very fragmented perception of these issues.

Although teachers were continuously increasing the use of computer technology in their work, researchers suggested that the level of computer technology integration still remained too low (Lai, Pratt, & Trewern, 2002). Teachers choose computer technology applications and approaches to suit their own perspectives on teaching and learning methods (Niederhauser & Stoddart, 2001). Hennessy, Ruthven and Brindley (2005) noted that the teachers were flexible enough to choose a teaching technique that did justice to their subject. Thus, pedagogic perspectives that differ between subject disciplines will influence the evolution of a subject and the integration of technology within it. In order to integrate computer technology effectively into their pedagogy, teachers need both the commitment and the professional knowledge to do so (Finger, Russell, Jamieson-Proctor, & Russell, 2007). Despite the presence of literature showing the cognitive opportunities that the computer technology provides for learning (Lim & Khine, 2006), stories describing the difficult and ineffective integration of computer technology in schools are common.

Some researchers argue that there is no evidence that using computer technology in education will improve student learning (Macho, 2005). Macho suggested that children differences in achievement are more related to the qualifications of their parents than to the availability of computer technology at home. Some in the literature have argued that we spend billions of dollars on buying new computers and software packages which is wasteful. For example, Cuban (2002) argued that there is no clear commanding body of evidence that sustained the use of multimedia machines, word processing, spreadsheets and other popular applications have any impact on academic achievement. Cuban (2002) also argued that there was no clear evidence that revealed gains in academic achievement result from using computer technology in the classroom. That is computers have changed classrooms much and they have hardly changed pedagogy. Khine and Fisher (2003) argued that computer technology usage might lead students to become more inactive, more introverted and less able to use their brains, set goals, concentrate, communicate or improve their level at school. Others in the literature for example, Tranwell (2008) believes that we spend billions of dollars on buying new computers and software packages but that is a waste. Tranwell agreed with Cuban, stating that teenagers use technology as a social positioning tool. At the same time advertisements target education decision makers and parents, playing on their fears and proposing that their products will solve student learning and teaching problems (Hope, 2007).

Macho (2005) studied how family affluence improves children learning and found that the highest level of education within the family was the only improvement factor of student performance. Parents' qualifications rather than Internet access or household income determine a student level of success. Macho argues that having access to computer technology can improve student performance and can make a change in the nature of core subject practice and pedagogy but only with the proper guidance. Educated parents or teachers will often be able to provide the best of such guidance.

2.3 Factors that hinder computer technology integration in schools

There are many factors which may serve as a deterrent to the integration of computer-based technology in high schools. Pelgrum (2001) presents a list of ten such factors that impede computer technology integration in schools. Out of the ten, the research identified four major ones. These are the personal ideas about the contribution that technology can make to the processes of teaching and learning and classroom management; teachers lack of knowledge and skills; insufficient number of computers and computer technology infrastructure; and difficulty in integrating computer technology instruction in classrooms. In relationship to the study, Ely (1993) equally distinguishes three major conditions relevant to computer technology integration in classrooms. These are the dissatisfaction with the status quo; existence of knowledge and skills; and availability of resources. The two categories identify more or less the same issues. Ely's existence of knowledge and skills related to Pelgrum's factor relating to teachers lack of knowledge and skills. Also, Ely's availability of resources is similar to Pelgrum's insufficient number of computers and computer technology infrastructure.

Finally, Ely's dissatisfaction with the status quo is directly related to what Zhao and Cziko (2001) term as discrepancies that activate the individual. Mooij and Smeets (2001) explained that if teachers are not confident in their ability or competence to handle computers, this may thwart their willingness to introduce technology in their classroom. This computer technology competence is the same that Zhao and Cziko (2001) referred to as Control Principle. A teacher claiming to follow more innovative educational practices such as the use of inquiry, project-based work and hands-on activities are more likely to use new technologies than those who stick to more traditional instructional approaches. According to Mooij and Smeets (2001), school managers policy and budgetary decisions and in general the attitude of the school managers are expected to be relevant to the computer technology innovation process.

2.4 Teachers' attitudes and beliefs in the use of computer technology

International experience has revealed that teachers play an essential role in diffusing and utilising computer technologies in classrooms. Teachers' attitudes and beliefs affect the way technological innovation is applied in education. They tend to use technology in ways that will shape their own personal perspectives on the curriculum and on their pedagogical practices (Cuban, 1986; Cohen, 1987; Czemink & Lumpe, 1996).

Hennessy, Ruthven and Brindley (2005) identified that the teachers who use computer technology do so in order to support and expand their existing classroom practice. Primarily this expansion is in the area of student led investigative or experimental learning (where students can work by themselves to make sense of a much broader range of information and processes than they could without computer technology). Teachers also expressed appreciation for the way that computer technology mediums can allow them to present complex and even potentially dangerous issues in appropriate and attractive ways for students (using audio-visual presentations for example).

Cuban's (2001) study of Californian high schools and universities long exposed to computer technology found that teachers actually used the new technology to do what they had always done, despite the fact that they often claimed to have transformed their practice. Becker (2000) noted that while technologies have allowed some teachers to put into practice a more student-centred pedagogy better attuned to their pedagogy, they have not changed the teaching practices of the majority of teachers, particularly secondary school teachers. Likewise, in a study of two secondary schools with reputations for technology incorporation, Cuban (2001) found that most teachers had integrated computer technology to fit recognisable instructional practices with only a few reporting that they had adapted their practice in many ways. One possible reason for this is that classroom educators have previously had little say in implementing development plans for integrating technology within their schools and for defining its position within subject curriculum (Hennessy, Ruthven, & Brindley, 2005). Hennessy, Ruthven and Brindley (2005) added that this is true in England and other countries with a centralised curriculum and a corresponding lack of professional autonomy.

Olson (2000) suggested that such policy decisions and change strategies are strongly politicised and it is not highly connected to the culture of classroom practice and the essential role of the teacher in effecting change. Olson also added that integrating new technologies challenges teachers and thus leaders need to understand and engage in conversations with teachers about their work culture, the technologies that sustain it and the implications of new approaches for those technologies. Bullock (2004) found that teachers' attitudes are a major enabling or disabling factor in the adoption of technology. In the same way, Kersaint, Horton, Stohl and Garofalo (2003) found that teachers who have positive attitudes towards technology feels more comfortable using it and usually incorporate it into their teaching. Woodrow (1992) asserts that any efficacious transformation in educational practice requires the development of positive user attitudes toward the new technology.

The development of teachers' positive attitudes towards computer technology is a key factor not only for improving computer integration but also for sidestepping teachers' resistance to computer use (Watson, 1998). Watson warns against the severance of innovation from the classroom teacher and the idea that the teacher is an empty vessel into which this externally defined innovation must be poured. The teachers' attitudes and beliefs also influence what they themselves learn from education and training programmes and what didactic practices they make use of in their classrooms (Clark & Peterson, 1986; Pajares, 1992; Fang, 1996). Research has revealed that many educational reform initiatives have failed precisely because they did not influence the beliefs or the practices of the teachers (Mehan, 1989; Cohen & Ball, 1990). Nevertheless, substantial positive correlations may exist between teachers' attitudes towards computer technologies and the independent variables. These includes cultural perceptions, computer competence, computer access and computer training (Imhanlahimi & Imhanlahimi, 2008).

2.5 Teachers' knowledge and skills in computer technology

The effective use of computers by teachers depends not only on their attitude but also on the training they have received (Clark & Peterson, 1986). Teachers' competence in computer technology presupposes the positive attitudes to computer technology, understanding of the educational potential of computer technology, ability to use computer technology effectively in the curriculum, ability to manage computer technology use in the classroom, ability to evaluate computer technology use, ability to ensure differentiation and progression and technical capability (Grossman, Wilson & Shulman, 1989; Beck, 1997). It is also worth noting that insufficient pre-service training will be another obstacle for many teachers to integrate technology into their classroom teaching (Yaghi, 1997; Yildirim, 2000). There are enough literature that supports the same position that teachers should receive effective, timely and continuous training to promote technology in their teaching (Yildirim & Kiraz, 1999; Kasli, 2000; Yildirim, 2000; Wilson, Notar & Yunker, 2003).

In-service training is a key factor in cultivating positive attitudes to the use of computers (Kara & Yakar, 2008). Teachers' pedagogical decisions and actions are closely tied up to their professional growth. Their professional knowledge might change by means of experience, curriculum directives and in-service training. Quality in-service training can support the process of changing teachers' thinking and practice, recognising that teaching is a difficult, complex and multifaceted process (Wood & Bennett, 2000). Lai, Pratt and Trewern (2001) revealed that school-based professional development is better when organised and facilitated by computer technology coordinators, who usually have adequate training and a deeper understanding of integrating computer technologies into the school curriculum and can provide role models for teachers. Nonetheless, research into in-service training has shown that training programmes have to be offered to meet the teachers' real needs (Crook, 1994; Kozma & Meghee, 2003). A decisive factor in the effective integration of computer use in the school curriculum is the provision of appropriate in-service training to the teachers and the training to show them how to use the new tools in their everyday teaching practice. In-service training focuses not on the technical but on the pedagogical and didactic aspects of computer technology use in the classroom (Pelgrum & Plomp, 1996; Lai, Pratt & Trewern, 2001).

Many recent studies on the state of computer technologies integration in schools also show that many institutions are failing to integrate technology into the existing context. Safo and Elen (2007) indicated in their study that although teachers have sufficient skills, innovative and easily overcome obstacles, they did not integrate technology consistently both in teaching and learning. Reynolds, Trehame and Tripp (2003) also underscored continuing problems in the adoption of computer technologies by teachers and stated the need for further research on how computer technology can improve education. It is worth noting that the reviewed literature failed to explore how the computer technology policy framework supports computer technologies integration in schools in the various countries.

2.6 Utilisation of computer technology facilities by teachers and students

It is easy to observe that the availability of computer technology infrastructure is a major variety of computer technology integration in schools. Tabassum (2004) reveals that one fundamental problem facing the computer technology integration in schools is the lack of computer infrastructure. In a related study, Bybee, Smith, Williams, Conway, Robinson and Franks (2008) revealed that appropriate access to technology infrastructure is another key factor in the effective technology integration process. The study reveals substantive correlation between technology access and use. In another study, Yildirim (2007) discloses that teachers agreed that access to computer technology infrastructure is one of the effective means to integrate computer technology in classrooms. Together education and employment are key building blocks of strategies to eradicate poverty. Computer technology is increasingly being used to improve young peoples' access to educational opportunities as well as to enhance the quality of their education through the new modes. Through computer technology, curricula can be more easily updated, adapted, enriched and personalised to satisfy a broad range of learning needs.

Waite (2004) indicates that even though teachers show great interest and motivation to learn about the potential of computer technology in practice, the use of computer technology is relatively low and focuses on a narrow range of applications with word processing being the predominant use. The research discovered that the role of other computer technology tools such as video conferencing, emailing and the internet is rarely practiced. The study also revealed the lack of computer technology infrastructure as one of the factors for non-usage of those tools. Another research study suggests that computer technology as a tool to promote learning is not generally well embedded in teachers' practice (Cox, Preston & Cox, 1999; Zhao & Cziko, 2001; Dynaski, Mazzeo, Raffield, Checketts, Druesne & Muhl-Stein, 2007) and that information technology in the classroom will be used in an ineffective way and may prove difficult to integrate with traditional curriculum settings (Van Belle & Soetaert, 2001).

2.7 Students' performance in physics

Performance of students' in physics, for example, in Ghana has generally and consistently been poor over the years. Relevant data collected on SHS students' achievement in biology, chemistry, physics and mathematics from 1993 to 2007 for PRACTICAL project showed an abysmal performance in physics (Anamuah-Mensah, 2007). Moreover, performance statistics by West African Examination Council (WAEC) from 2007 to 2014 shows that majority of the physics candidates did perform poorly and could not qualify for admission to tertiary institutions (WAEC., 2014).

The WAEC (2014) reported that quite a number of candidates could not solve mathematically related problems accurately and painted a very gloomy picture of students' performance in physics. It was also tempted to conclude that the standard of the paper was lower than the previous. However, the performance of candidates did not lend support to this assertion. The performance could be described as woefully marginal. Only a few candidates could show a good knowledge of the subject and could also apply the principles. Candidates' answers showed lack of understanding of the principles of the subject.

Buabeng, Ossei-Anto and Ampiah (2014) also observed that over the years, students' achievement in physics has prompted educational researchers to continuously make relentless efforts at identifying mitigating factors that might account for the observed poor performance. Some research studies suggest that factors inside and outside the classroom affect students' achievement and interest (Orleans, 2007; Buabeng, Ossei-Anto & Ampiah, 2014). Wambugu and Changeiywo (2008) stated that teaching methods are crucial factors that affect the academic achievement of students and no matter how well-developed and comprehensive a curriculum is, its success is dependent on the quality of the teachers implementing it (Ughamadu, 2005; Ajaja, 2009).

In the attempt to help improve upon the teaching and learning of the sciences, the Government of Ghana in 1987 implemented an educational reform nationwide with the aim of providing a system of education that will serve the needs of the individual, the community and the country as a whole (Tuffour, 1989). Tuffour (1989) reported that though there were some challenges after almost a period of time, the Ministry of Education (MOE) and Ghana Education Service (GES) made a considerable success in recruiting teachers for all the schools, the supply of inputs namely: science syllabi, textbooks and laboratory kits; the effect of orientation for teachers and the general interest of teachers in the programme.

Likewise, the Government of Ghana in 1995 through the Ministry of Education (MOE) and Ghana Education Service (GES) further established Science Resource Centres (SRCs) in 110 SHS spread throughout the country to help bridge the gap between schools with well resourced science laboratories both human and material resources. This project was initiated to ensure equity in students' learning across the rural-urban divide (Ministry of Education, 2012). The SRCs were equipped with basic science equipment including modern electronic devices and computers to be used in the teaching and learning of science including physics and thereby improving students' performance (Ampiah, 2004). In spite of these projects and implementations, WAEC (2014) report shows that the performance of students in science with physics in particular, has not been any better as indicated earlier. It is not clear where the responsibility lies as little is known about physics teaching in the SHS. It would be interesting, therefore, to investigate whether integrating computer technology into teaching such as computer animation could affect the performance of physics students in SHS positively.

2.8 Using computer technology to teach physics

Science comprises of disciplines such as Physics, Chemistry and Biology. Essentially, science and technology would be incomplete without Physics. According to Gambari (2010), physics has proven its benefits to mankind as almost every human activity and virtually every profession involves some elements of Physics. Physics education is aimed at training students to acquire proper understanding of basic principles as well as their applications and is taught at the senior high school level of the educational system in Ghana. In spite of the importance of physics as a requirement for many specialised science and engineering courses in the universities and other tertiary institutions, students' performance in the subject in Senior Secondary School Certificate Examinations (SSSCE) is not beyond the average (Gambari, 2010). For example, effective teaching of the concept of Waves fundamentally requires a Ripple Tank which is not available in nearly all the senior high schools in Ghana. In another study it was found and reported that students taught using computer technology package performed better than those taught using the conventional method. Jegede (1991) taught Senior Secondary School Biology students with the help of the computer and found that their attitude towards the subject improved after the lesson. Matthew (1990) also discovered that the use of Computer-Assisted Algebra System Package had a desirable effect on the learning and teaching of calculus. However, Hall (2000) did not find any difference between the performance of students taught with computer technology and those taught with traditional method.

It is easy to observe that gender issues have been linked to students' achievement in science subjects but without any definite conclusion. Some studies revealed that male students performed better than the female in science courses. For instance, Kost, Pollock and Finkelstein (2009) found that male students performed better than female in interactive Physics whilst Anagbogu and Ezeliora (2007) found that female students performed better than their male counterparts using science process skills method of teaching.

2.9 Computer Technology

Computer Technology has a rich history and developed concurrently with development of electronic computers (Daniel, 1999). Despite the fact that educational effectiveness and implementation issues have been common, computer technology has remained popular among educators who maintain a belief that it is a useful supplement to classroom activities. A number of studies have reported that it is a useful tool for raising exam scores, improving student attitudes and reducing the time needed to master course materials (Osborne & Wittrock, 1985; Canham, Geoffrey, Rayner & William, 1986; Collis, Betty, Antoinette & Wes Sherra, 1988). Again, it has been shown that students like the mode of presentation (Brown, 1995). However, Kulik and Kulik (1989) concluded that more well-designed research is needed before any real conclusions about the effectiveness of computer technology can be drawn. Schacter (1999) suggests that much of what is available is of little use. Cherry (1991) found that there was no significant difference between computer technology and conventional method as an effective teaching technique. In the same vein Garrett (1995) reported mixed results when comparing computer technology and traditional method of teaching. Thus, while educational effectiveness may exist for specific applications, it is difficult to conclude that such effectiveness is common across a large range of discipline. Hence computer animation was initiated into the teaching and learning of some concepts in nuclear physics to find out the impact that it has on form three (3) physics students in Anglican Senior High School, Kumasi.

2.10 Theoretical Framework of the Study

The study is grounded on the theory of Diffusion of Innovations (Rogers, 2003). According to Rogers, diffusion research centres on the condition which increases or decreases the likelihood that members of a given culture will adapt to a novel idea, product or practice. According to Rogers, peoples' attitude toward a new technology is a key element in its diffusion. Since Rogers uses the term innovation and technology interchangeably, the diffusion of innovation framework seems particularly suited for the study of integration of computer technology into the teaching and learning of some concepts in nuclear physics. Rogers Innovation Decision Process Theory states that innovation diffusion is a process that occurs over time through five stages. These are knowledge, persuasion, decision, implementation and confirmation. Due to the novelty of computers and their related technologies, studies concerning computer technology integration in education have often focused on the first three phases of the innovation decision process. But in most developing countries where technology has been recently introduced into the education system, the studies mainly concentrated on the first two stages. These are knowledge of an innovation and attitudes towards it.

Diffusion of innovation theory envisages that media as well as interpersonal contacts provide information and influence opinion and judgment. Rogers (2003) argues that it consists of four stages. These are invention, diffusion or communication through the social system, time and consequences. Information flows through networks and the nature of networks and the roles of opinion leaders play in the determination of the likelihood that the innovation will be espoused. Myhre (1998) reported that teachers initially focus on their own interaction with the new medium and as they gradually become comfortable with the technology they start deliberating upon the prospective benefits that would result from the use of the computer. Myhre (1998) concludes that this increase in familiarity with computers allows teachers to turn their interest to the pedagogical use of technology rather than its operational issues but also underscores that such change processes do not occur rapidly and are not easily achieved.

CHAPTER THREE

METHODOLOGY

3.0 Overview

The purpose of this study was to investigate the integration of computer technology into the teaching and learning of some concepts in nuclear physics to determine the impact it has on physics students through the use of pre-intervention test, post-intervention test and unstructured interview. This chapter consists of the methodology, study area, the research design, population, sample and sample size, sampling techniques, variables for the study, the research instrument used for the study (pre-intervention test, post-intervention test and unstructured interview) and the intervention activities. The reliability and validity of the instrument were also considered in this chapter. This chapter also consists of the data collection procedure and the data analysis of the study. A mixed method composes of qualitative and quantitative methodology was employed.

3.1 Methodology of the Study

The study employed mixed method where both quantitative and qualitative approaches were adopted. According to Johnson and Onwuegbuzie (2004), mixed method research involves combining in a single study technique, methods, approaches and language of both quantitative and qualitative traditions. Burns and Groove (1993) defined quantitative research as a formal, objective and systematic process to describe and test relationships and examine cause and effect interaction among variables using mathematical means or statistical analysis of data. Qualitative research on the other hand, seeks to discover the meaning that participants attach to their behaviour, how they interpret situations and their perceptions on particular issues (Measor & Woods, 1984). Mixed method approach is more than simply collecting and analysing either qualitative data or quantitative data but it involves the use of both approaches in tandem so that the overall strength of the study is greater than either qualitative or quantitative research (Creswell & Plano-Clark, 2007).

In order to gather the quantitative data, a pre-intervention test and post-intervention test were conducted to assess students' performance before and after the intervention so as to check the effective gain in students' performance. In gathering qualitative data, an unstructured interview was conducted to ascertain the perception of physics students about the integration of computer technology in teaching. Hence, in investigating the integration of computer technology into the teaching and learning of some concepts in nuclear physics both quantitative and qualitative approaches were employed.

3.2 The study area

The study area was Anglican Senior High school, Kumasi in the Ashanti Region. The school is located at the centre of Kumasi Metropolitan Assembly. The school is directly opposite to the Kumasi Technical University and adjacent to the Kumasi Technical Institute and WAEC office in Kumasi.

3.3 Research design

The study used an experimental design. According to Ogula (1999), experimental research design attempts to accurately identify a given situation and it is used to observe, collect information, record the information collected, analyse and report conditions that existed. Moulton (1996) further explained that an experimental design is a study design that gives the most reliable proof of causation. In an experimental study, individuals are randomly allotted to at least two groups; one group is subject to an intervention while the other group is not (Moulton, 1996). Moulton (1996) added that the outcome of the intervention or the effect of the intervention on the dependent variable or the problem is obtained by comparing the two situations or groups. The design helps to examine the impact the intervention has on the third year physics students' on some concepts in nuclear physics.

3.4 Population

The entire group of interest for a research forms a population (Gravetter & Forzano, 2006). The target population for this study was all physics students in Anglican Senior High School, Kumasi and due to a number of constraints such as financial resource and time not all of the population was used for the study. The accessible population were all form three (3) physics students. Physics students' from one form three (3) class C_5 were selected for the study.

3.5 Sample and Sample Size

The students for the study comprised of an intact class of 70 form three ($3C_5$) physics students of Anglican Senior High School, Kumasi. The students consist of 13 females representing 19% and 57 males representing 81%.

3.6 Sampling Technique

The sample technique used was purposive sampling to select the class level for the study. In the purposive sampling, Orodho (2009) states that this method is typically used when focusing on a limited number of informants whom we select strategically so that their in-depth information will give optimal insight into an issue about which little is known. The class $3C_5$ was chosen because of their perceived poor performance in physics. The sampled class was then assigned to a pre-intervention test, a post-intervention test and an unstructured interview.

3.7 Variables for the study

The independent variable in this study was a six (6) week teaching instructional strategy that was administered to an intact third year physics class C_5. The dependent variable in this study was the students' scores obtained in the traditional method of teaching and the computer animation method of teaching on some concepts in nuclear physics.

3.8 Research Instruments

The instruments used for the study were a pre-intervention test, a post-intervention test and an unstructured interview. A multiple choice test items were adapted from radioactivity, half-life and nuclear reactor were given to the students as a pre-intervention test and a post-intervention test to assess the gain in performance. From Smith (1987) view, the multiple choice questions were appropriate for this study since it allows respondents to choose between the options provided by the researcher. An unstructured interview was conducted to ascertain the perception of students about the use of computer technology such as computer animation in teaching.

3.9 Intervention Activities

The instructional strategies used were traditional strategy and computer animation strategy. The students were subjected to the same treatment for three weeks each. The students were first taken through the traditional method of teaching of the concepts of radioactivity, half-life and nuclear reactor. After using the traditional method of teaching for three weeks, a pre-intervention test was conducted to assess the performance of the students on the lesson taught. The test consisted of 20 multiple choice questions. The students' response was collected, marked and recorded.

The students were taught using the computer animation approach for the next three weeks. The computer animation model was used to teach the concepts of radioactivity, half-life and nuclear reactor where some computer animations were shown directly to students in the classroom by using the required tools. During the presentation of the computer animations in the classroom, students were assisted to both join the lesson and make a connection between basic nuclear physics concepts and the computer animations with the help of a few questions. This contributed to the maximum participation of students in the lesson. At the end of the computer animation presentation, the teacher explained the similarities and differences between the computer animation and the actual concept again. Therefore, the students who made an incorrect connection between the computer animation and the actual concept were able to re-organise their opinions.

After the three weeks, a post-intervention test was conducted to assess the performance of the students on the lesson taught. The test consisted of 20 multiple choice questions. The students' response was collected, marked and recorded.

3.10 Validity of the Instrument

Validity in quantitative research determines whether the research truly measures what it was designated to measure or what it was set out to measure how truthfully the research results are (Joppe, 2000). In order to ensure that the test items for the study were valid it was given to a supervisor for a thorough examination to ensure that it measures the total content area (content validity) of the study. According to Merriam (1998), to ensure internal validity, three physics experts were employed to study the test items and comment on it.

3.11 Reliability of the Instrument

Reliability refers to the extent to which research findings can be replicated (Merriam, 1998). In other words, if the research is repeated by another researcher they will arrive at similar findings and conclusions (Yin, 2003). A reliability test was performed to ensure accurate measurement of the instrument. These tests were aimed at finding out the performance of students before and after the intervention. Jonassen (2000) believes that once an instrument is valid, it is certainly reliable. To ensure the reliability of the instrument, a pilot testing was done on a similar pre-intervention test. This was done with form three (3) physics students from C_1 class in Anglican Senior High School, Kumasi who were not part of the sample for the study. The physics students from $3C_1$ were chosen because they are perceived to perform better in physics as compare to the $3C_5$ class which makes the instrument reliable for this study. The post-intervention test was not pilot tested since it had a similar in structure with the pre-intervention test. Hence the corrections that were done on the pre-intervention test informed that of the post-intervention test. Data from the pilot test were statistically analysed to determine the reliability of the test instruments using Cronbach's alpha formula. The analysis yielded reliability co-efficient of 0.75 and 0.78 for the pre-intervention test and post-intervention test respectively as shown in Table 3.1.

Table 3.1 The Research Instrument Reliability Co-efficient

Research Instrument	Number of Students	Reliability Co-efficient
Pre-Intervention test	70	0.75
Post-Intervention test	70	0.78

According to Miles and Huberman (1994), if the measurement results are to be used for making a decision about a group or for research purposes or if an erroneous initial decision can be easily corrected, then the scores with the modest reliability co-efficient in the range of 0.50 to 0.60 may be accepted. From the above reliability co-efficient for the pre-intervention test and post-intervention test signifies that both test instruments are considerably reliable.

3.12 Data Collection Procedure

The test items were administered under the researcher's supervision to prevent students copying from their colleagues. The test items were marked promptly and marks recorded. Again for respondents to be candid about their responses they were made aware of the fact that the test was for academic purpose only and that the information provided would be kept strictly confidential. The sampled physics students for the study were interviewed on their perception about the integration of computer technology in teaching. Each interview was unstructured in a format that included general guiding questions and open ended questions as suggested by Bodgan and Biklen (2003). In the same manner Gall, Gall and Borg (2003) intended to elicit a detailed account of each participant's perception of the current state of integration of computer technology into the teaching and learning environment. In order to establish an environment of trust, each student was reminded that their participation was voluntary and their responses were going to be kept confidential. Using the suggested process of member checking, each participant was provided with a transcript of their respective interview and asked to review and provide corrections in order to ensure accuracy of recorded responses (Gall, Gall, & Borg, 2003). Corrections to the transcripts were made as requested by each participant respectively.

3.13 Data Analysis

The data collected was examined for consistency and accuracy by reading through all the responses that were provided by the students. The responses from the test items were analysed using Statistical Package for Social Sciences (SPSS). The SPSS was chosen for the data analysis because it was user friendly and does most of the data analysis one need as far as quantitative and qualitative analysis is concerned (Muijs, 2004). In order to assess whether there was a significant difference in achievement, the t-test was used. A paired sample t-test was conducted on the sample to ascertain the difference before and after the intervention and whether it is significant at 95% of confidence interval taken into consideration the mean scores, standard deviations, mean difference and p-value.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.0 Overview

This chapter is about the presentation of the data collected, analysis and discussion of the results. Percentages, frequencies, mean, standard deviation (Sd), mean difference and probability (p-value) were employed to analyse the data collected. The data collected from pre-intervention test after the students have been taught through the traditional method was analysed. Also the data collected from post-intervention test after they have been taught through the computer animation strategy was analysed.

4.1 Data Analysis and Discussion

The data collected from the students' pre-intervention test, post-intervention test and unstructured interviews were analysed and discussed based on the research questions for this study.

4.2 Analysis and discussion with respect to Research Question One

Research Question 1: What is the knowledge level student had about some concepts in nuclear physics before the introduction of the computer technology?

This question sought to find out the knowledge level students had on radioactivity, half-life and nuclear reactor during the traditional method of teaching. A 20 multiple choice test items on radioactivity, half-life and nuclear reactor were administered after the topics were taught using the traditional method of teaching. Table 4.1 showed the raw scores of the students and their corresponding percentile marks. Table 4.2 showed the grades of the students based on WAEC and GES grading system. The total score was 20 marks and the number of respondents was 70.

4.2.1 Pre-Intervention Test Scores of Students

The Table 4.1 presents the raw scores of the students and their corresponding converted percentile scores based on WAEC and GES standards with its frequencies and percentages.

Table 4.1: Frequency and Percentile Distribution of students' raw scores at pre-intervention test

Raw score	Percentile score	Frequency	Percentage frequency
7	35	7	10
8	40	14	20
9	45	17	24
10	50	10	14
11	55	6	9
12	60	6	9
13	65	4	6
14	70	3	4
15	75	2	3
16	80	1	1
Total		**70**	**100**

From Table 4.1, each raw score was giving a weight of 5% which implies that a total score of 20 is a 100% on the percentile score. The raw scores obtained ranged from 7 to 16 which were converted from 35% to 80% on the percentile scale. Gravetter and Wallnau (2004) defined a raw score as a single score that is derived from a test or an observation whilst cumulative percentages determine placement among a group of scores. Converting raw scores into cumulative percentages allow for meaningful comparisons (Gravetter & Wallnau, 2004). The Table 4.1 therefore presents the percentile score of 35 as the least percentile score which was obtained by 7 students representing 10% of the respondents. Also 1 student obtained the highest percentile score of 80 representing 1% of the sample. In Table 4.1, the percentile score of 45 was recorded as the highest frequency mark for 17 students representing 24% of the sample obtained.

4.2.2 Pre-Intervention Test Grades of Students

The Table 4.2 presents the pre-intervention test grades of the students during the traditional method of teaching based on the WAEC and GES grading system. This shows how the students had performed on the WAEC and GES grading standards.

Table 4.2: Pre-Intervention Test Grades obtained by the students

Performance range	Grade	Remarks	Frequency	Percentages
0–39	F9	Fail	7	10
40–54	D7–E8	Pass	41	59
55–69	C4–C6	Credit	16	23
70–74	B3	Good	3	4
75–79	B2	Very Good	2	3
80–100	A1	Excellent	1	1
Total			**70**	**100**

From Table 4.2, the best grade was A1 which had a frequency of 1 thus representing 1% followed by grade B2 with a frequency of 2 representing 3% then grade B3 with frequency of 3 representing 4%, grade C4 to C6 with frequency of 16 representing 23%, also grade D7 to E8 had frequency of 41 representing 59% and finally grade F9 representing 10% of the sample obtained. The best grade obtained during the pre-intervention test was A1 and the least was F9 whiles the grade obtained by majority of the students (41 students) was D7 to E8 which represented 59%. The results showed that majority of the students had pass remark according to the WAEC and GES grading system. This implies that more than one-third of the sample obtained a pass which on the WAEC was rated as a very poor remark.

Cullen, Richardson and O'Brien (2004) findings revealed that there was a positive influence in students' research abilities when traditional instructional strategy was employed. However, in the findings of Clinton and Kohlmeyer (2005), it proved that during the instruction with traditional method, there was no change in the students' results of the concept taught. Therefore in this study, students' results at pre-intervention test were compared to their usual performance before the intervention activities and the results showed that there was no significant change in their performance.

4.3 Analysis and discussion with respect to Research Question Two

Research Question 2: What is the knowledge level student had about some concepts in nuclear physics after the introduction of the computer technology?

This question sought to find out the knowledge level students had on radioactivity, half-life and nuclear reactor during the computer animation method of teaching. A 20 multiple choice test items on radioactivity, half-life and nuclear reactor were administered after the topics were taught using the computer animation method of teaching. The Table 4.3 showed the raw scores of the students and their corresponding percentile marks.

Table 4.4 showed the grades of the students based on WAEC and GES grading system. The total score was 20 marks and the number of respondents was 70.

4.3.1 Post-Intervention Test Scores of Students

The Table 4.3 presents the raw scores of the students and their corresponding converted percentile scores based on WAEC and GES standards with its frequencies and percentages.

Table 4.3: Frequency and Percentile Distribution of students' raw scores at post-intervention test

Raw score	Percentile score	Frequency	Percentage frequency
11	55	4	6
12	60	9	13
13	65	10	14
14	70	14	20
15	75	10	14
16	80	6	9
17	85	5	7
18	90	5	7
19	95	4	6
20	100	3	4
Total		**70**	**100**

From Table 4.3, each raw score was giving a weight of 5% which implies that a total score of 20 is a 100% on the percentile score. The raw scores obtained ranged from 11 to 20 which were converted from 55% to 100% on the percentile scale during the post-intervention test. The Table 4.3 therefore presents the percentile score of 55 as the least percentile score which was obtained by 4 students representing 6% of the respondents. Also 3 students obtained the highest percentile score of 100 representing 4% of the respondents. In Table 4.3, the percentile score of 70 was recorded as the highest frequency mark for 14 students representing 20% of the sample obtained.

4.3.2 Post-Intervention Test Grades of Students

The Table 4.4 presents the post-intervention test grades of the students during the computer animation method of teaching based on the WAEC and GES grading system. This shows how the subjects had performed on the WAEC and GES grading standards.

Table 4.4: Post-Intervention Test Grades obtained by the students

Performance range	Grade	Remarks	Frequency	Percentages
55–69	C4–C6	Credit	23	33
70–74	B3	Good	14	20
75–79	B2	Very Good	10	14
80–100	A1	Excellent	23	33
Total			**70**	**100**

From Table 4.4, the best grade was A1 which had a frequency of 23 thus representing 33% followed by grade B2 with a frequency of 10 representing 14% then grade B3 with frequency of 14 representing 20% and finally grade C4 to C6 with frequency of 23 representing 33%. From Table 4.4 the best grade obtained at the post-intervention test was A1 and the least was C4 to C6 whiles the grade obtained by majority of the students were A1 and C4 to C6 which represents 33% each and the least was a B2. The results showed that majority of the students had excellent and credit remark according to the WAEC and GES grading system.

In this study, the data collected on the post-intervention test was in support of Cardoso, Cristiano and Arent (2009) study which recommended the need for the development and implementation of new educational practices to make classrooms more interesting and interactive even in a lecture format and also increase the performance of students.

4.4 T-test Analysis

With the administration of the test items, the researcher was interested in finding out whether the computer animation method of teaching had any effect on the performance of the students as against the traditional method of teaching. Therefore T-test analysis was performed on the mean scores for pre-intervention test and post-intervention test. This was done to determine whether significant difference exist between the mean scores.

Table 4.5: Pre-Intervention and Post-Intervention T-test Analysis

Test	N	Mean	Sd	Mean difference	p-value
Post-Intervention	70	14.79	2.425	4.9	0.000
Pre-Intervention	70	9.89	2.204		

***p<0.05, N-Number of Students**

The Table 4.5 presents the mean score for pre-intervention test of students taught through the traditional method of teaching and the mean score for post-intervention test of students taught through the computer animation method of teaching. It is observed that the mean score of the post-intervention test (Mean = 14.79, Sd = 2.425) is much higher than the mean score of the pre-intervention test (Mean = 9.89, Sd = 2.204). Also the total performance scores of the entire students put together on the post-intervention test (1035) was higher than the total scores at the pre-intervention test (692). This implies that there was an improvement in performance of 33.1% during the post-intervention test.

A paired t-test conducted to evaluate whether a significant change occurred between the pre-intervention test and post-intervention test results showed that the difference between the mean scores was significant at p-value of 0.000 which the significant was set at alpha (α) value of 0.05 hence there was a significant difference. The researcher therefore concludes with 95% confidence that the students performed better at the post-intervention test. The researcher therefore had sufficient information to conclude that there was a significant difference between the computer animation method of teaching and the traditional method of teaching. Difference in the mean values of the pre-intervention test (9.89) and post-intervention test (14.79) was 4.9 indicating that there was a moderate effect. This implies that there was an appreciable improvement in the post-intervention test as compared to the pre-intervention test.

4.5 Analysis and discussion with respect to Research Question Three

Research Question 3: What is the perception of students about the integration of computer technology in teaching?

This question sought to establish the perception of students about the use of computer animation method of teaching as compared to the traditional method of teaching. As indicated earlier, unstructured interview was conducted to gather the views of the students on the perception of the computer animation and traditional method of teaching. The questions covered the assimilation of the concept and their preference in terms of the teaching strategies they were exposed to. Majority of the students said they perceived the computer animation method of teaching to be illustrative, quick and practical as it relates familiar objects and learners' environment to abstract concepts. Out of the total sample, majority of the students also said that the computer animation method of teaching allowed them with different learning skills to communicate with the lesson at their own best ways. The entire students said that the computer animation method of teaching guided them to understand better the concepts of radioactivity, half-life and nuclear reactor. The students said that when the traditional method was employed there were not such clarity and understanding of the concepts.

4.5.1 Absorption of the concept taught using the computer animation strategy

The students said they absorbed much on the computer animation method of teaching than the traditional method of teaching since the animations aided them to understand better the concepts of radioactivity, half-life and nuclear reactor. They said the computer animation method of teaching helped them built up a mental picture on their brains on the concepts taught as compared to the traditional method of teaching. Therefore the samples found it interesting and thus motivated them to learn.

4.5.2 Preference of the computer animation method of teaching

The students said they preferred the computer animation method of teaching since they could remember what was taught and could narrate enough what they observed and viewed on the computer animation method than that of the traditional method.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

5.0 Overview

This chapter summaries and conclude the study as well as the recommendations and areas for further studies. The areas of focus included the knowledge of students on the concepts of radioactivity, half-life and nuclear reactor based on the traditional method before the use of computer animation method of teaching.

5.1 Summary of findings

The purpose of the study was to find out if there was any significant difference in the application of traditional method of teaching and that of computer animation method of teaching on some concepts in nuclear physics in Anglican Senior High School, Kumasi. Pre-intervention and post-intervention tests with 20 multiple choice test items each were administered to find out the performance of students on both the traditional and computer animation methods of teaching. The pre-intervention activities was when the students were taught for three weeks with the traditional method of teaching and the post-intervention activities was when the computer animation method of teaching was also employed for three weeks on the students.

An intact class of seventy (70) form three ($3C_5$) physics students from Anglican Senior High School, Kumasi in the Kumasi Metropolitan Assembly in the Ashanti Region of Ghana was the sample used for the research. The results from the pre-intervention and post-intervention tests were collected, marked, recorded, analysed and discussed.

A paired sample t-test conducted showed a significant difference in the pre-intervention test and post-intervention test scores at p-value of 0.000 ($\alpha \leq 0.05$). Hence there was a significant difference between the pre-intervention and post-intervention test scores indicating that students of Anglican Senior High School, Kumasi did perform better when taught through the computer animation method of teaching than that of the traditional method of teaching. The findings from the interviews with the students of Anglican Senior High School, Kumasi showed that majority of the students absorbed the concept taught using the computer animation method of teaching and that they preferred the computer animation method of teaching to the traditional method of teaching.

5.2 Conclusions

The computer animation teaching strategy provides an equal opportunity for every student to eventually achieve and enhance performance and conceptual understanding of the concept taught. The findings from the pre-intervention and post-intervention test scores showed that the students' of Anglican Senior High School, Kumasi conceptual understanding and performance had improved. The results from this study also indicated that majority of the students of Anglican Senior High School, Kumasi enjoyed the interactive lessons with the computer animation which motivated them to participate actively in the lessons. Therefore they preferred the computer animation method of teaching to the traditional method of teaching.

Finally, it was concluded that the integration of computer technology such as computer animation method of teaching was an effective way of improving the performance of students' of Anglican Senior High School, Kumasi in the teaching and learning of some concepts in nuclear physics.

5.3 Recommendations

From the study, the following guidelines are recommended to schools and teachers in the Kumasi Metropolitan Assembly especially Anglican Senior High School, Kumasi who would like to integrate computer technology into the teaching and learning of physics.

- Science teachers should be encouraged to integrate computer technology such as computer animation method of teaching in the delivery of their lessons so that students' can perform better.
- Science teachers are encouraged to improvise in the absence of real materials to make their science lessons practically oriented. The Ministry of Education through the GES should organise workshops and in-service training frequently for science teachers on the practical use of computer animation in their teaching.
- Science teachers are encouraged to get personal training on the use of computer technology that could enhance their teaching.
- Head of Institutions should encourage their science teachers to employ computer technology such as computer animation in the delivery of their lessons.

5.4 Areas for Further Studies

Reflecting on the findings of this study, the following recommendations are made for further studies with respect to the integration of computer technology into the teaching and learning of nuclear physics.

- The attitude of SHS physics teachers to the use of computer animation method of teaching in delivering their lessons.
- The effects of computer animation instructional strategy on students' performance in the concept of electronics.
- A study should be carried out to find out the number of science teachers who are familiar with computer animation, uses computer animation and the number of times they use it in the delivery of their lessons.

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APPENDIX 1

UNIVERSITY OF EDUCATION, WINNEBA

PRE-INTERVENTION TEST

RADIOACTIVITY, HALF-LIFE AND NUCLEAR REACTOR CONCEPTS

ANSWER ALL QUESTIONS

TIME: 40MINUTES

1. Most of the mass in an atom is contained in the nucleus. What particles are contained in the nucleus?

   a) Protons and Electrons.
   c) Neutrons and Electrons.
   b) Protons and Neutrons.
   d) Protons, Neutrons and Electrons.

2. What is the relative mass and charge of a Proton?

   a) A Proton has mass 1/2000 and a charge of +1.
   b) A Proton has mass 1/2000 and it has no charge.
   c) A Proton has mass 1 and a charge of -1.
   d) A Proton has mass 1 and a charge of +1.

3. What is the relative Mass and Charge of an Electron?

   a) An Electron has mass 1/2000 and a charge of -1.
   b) An Electron has mass 1/2000 and a charge of +1.
   c) An Electron has mass 1 and it has no charge.
   d) An Electron has mass 1 and a charge of -1.

4. Which of the statements below best describes an alpha particle?

   a) A Proton

   b) An Electron

   c) A Helium Nucleus.

   d) A Molecule.

5. Where does radioactivity come from?

   a) From stable isotopes

   b) From all of the Elements.

   c) From unstable radioactive isotopes which undergo nuclear decay, giving out high energy particles.

   d) From atoms.

6. A radiation source is used to control the thickness of a continuous sheet of metal. When the detector detects too much radiation, the metal has become too thin and so the rollers automatically open out until the correct thickness is reached. The opposite will happen when the metal is too thick. What type of source would be most suitable for this?

   a) Alpha with a half-life of several hours

   b) Gamma with a half-life of several hours

   c) Beta with a half-life of several years

   d) Gamma with a half-life of several years

7. Cancers can be treated using radiation. It has to be directed carefully to kill the cancer cells without damaging too many normal cells. What type of radiation would be ideal for this?

a) High dose of Alpha
c) High dose of Gamma.
b) Low dose of Beta
d) Low dose of Electrons.

8. All isotopes that are taken into the body must be of a type that easily passes back out. What type of radiation would be suitable for this?

a) Gamma with a half-life of several days
b) Gamma with a half-life of a few hours
c) Beta with a half-life of a few hours
d) Alpha with a half-life of several days

9. Which of the following statements is NOT true about half-life?

a) It is important to measure the background count first and then subtract this from every reading taken from the sample
b) To calculate half-life, draw a graph where the background count rate is still part of the readings taken from the sample
c) When the activity of a sample falls quickly, it has a short half-life
d) When the activity of a sample falls slowly, it has a long half-life

10. Background radiation comes from many sources. Which of the following sources produces the least of our background radiation?

a) Food
c) Nuclear Industry
b) Cosmic Rays
d) Medical X-ray

11. Which of the following could not be used to detect ionising radiation?

a) A Joule meter
c) An Ionisation Chamber
b) Photographic Film
d) A Cloud Chamber

12. A radioactive sample has a count rate of 800 counts per minute. One hour later, the count rate has fallen to 100 counts per minute. What is the half-life of the sample?

a) 30 minutes
c) 15 minutes.
b) 20 minutes
d) 12 minutes.

13. The half-life of Uranium-238 is 4.5 billion years. A sample of rock contains Uranium and Lead in the ratio 75:525. How old is the rock?

a) 4.5 billion years
c) 13.5 billion years.
b) 9 billion years
d) 18 billion years.

14. The decaying of an unstable nucleus is entirely random. What can be done to make a decay happen or speed up the decaying process of a source?

a) Increase the temperature of a source
b) Increase the pressure on a source

c) A source is completely unaffected by physical conditions or chemical bonding

d) React a source with a chemical

15. Which of the following would most likely cause cancer?

a) Not enough exposure to all types of radiation

b) Protecting yourself against the harmful effects of radiation

c) Low doses of radiation, which only cause minor damage to a cell

d) High doses of radiation, which will kill cells completely

16. Which of the following does the extent of the radiation effects, NOT depend on?

a) The height of the person

b) How much exposure the person has had to the radiation

c) The energy of the radiation emitted

d) The penetration of the radiation emitted

17. There are several precautions which should be taken to safely use radioactive materials in the laboratory. Which of the following is NOT one of them?

a) Stare directly at the source to protect your eyes from background radiation

b) Never make skin contact with a source

c) Always hold a source with tongs, at arm's length and pointing away from the body

d) Store the source in a lead box and immediately replace when the experiment is over

18. Which of the following is NOT a source of background radiation?

a) Radiation from naturally occurring unstable isotopes

b) Radiation from a Source being measured

c) Radiation from Space

d) Radiation from Human Activity

19. Background radiation comes from many sources. Which of the following sources produces most of our background radiation?

a) Nuclear Industry

b) Medical X-rays

c) Radon and Thoron gas

d) Rocks and Building materials.

20. Industrial nuclear workers need to take extra precautions when working with radioactive material. Which of the following is NOT true?

a) Remotely controlled robot arms are used in highly radioactive areas

b) It is safe to handle a source because they have been trained how to stop radiation entering their bodies

c) Full protective suits are worn to stop tiny radioactive particles from being inhaled or lodging on the skin

d) Lead lined suits, lead and concrete barriers, and thick lead windows are used to reduce exposure to gamma rays

APPENDIX 2

UNIVERSITY OF EDUCATION, WINNEBA

POST-INTERVENTION TEST

RADIOACTIVITY, HALF-LIFE AND NUCLEAR REACTOR CONCEPTS

ANSWER ALL QUESTIONS

TIME: 40MINUTES

1. Electrons orbit around the Nucleus. Which of the following statements is true about electrons?
   a) They are very small and positively charged, but occupy a lot of space giving the atom its overall size
   b) They are very big and positively charged, occupying a lot of space giving the atom its overall size
   c) They are very big and negatively charged, occupying a lot of space giving the atom its overall size
   d) They are very small and negatively charged, but occupy a lot of space giving the atom its overall size

2. What is the relative Mass and Charge of a Neutron?
   a) A Neutron has mass 1/2000 and a charge of -1
   b) A Neutron has mass 1/2000 and it has no charge
   c) A Neutron has mass 1 and it has no charge
   d) A Neutron has mass 1 and a charge of +1

The element Radon has the symbol:

222

Rn

86

3. What is its Mass Number?

a) 222 c) 136

b) 86 d) 308

4. What is its Atomic Number?

a) 222 c) 136

b) 86 d) 308

5. How many Neutrons does it have in its Nucleus?

a) 222 c) 136

b) 86 d) 308

6. Different elements have different numbers of Protons. Atoms of the same element and therefore Proton Number, but which have a different number of Neutrons are called what?

a) Particles c) Isotopes

b) Elements d) Molecules

7. In order to find a leak in an underground water pipe, a radioactive tracer is added to the water. Which type of radiation would be most suitable for this?

   a) Gamma with a half-life of several hours

   b) Beta with a half-life of several minutes

   c) Gamma with a half-life of several years

   d) Beta with a half-life of several years

8. Which of the following statement is NOT true about nuclear fuel?

   a) Uranium is the common fuel used in nuclear power stations

   b) Radioactive decay always gives out energy in the form of heat

   c) Using uranium, a chain reaction can be set up where each nucleus splitting causes another fusion, generating lots of heat

   d) Using uranium, a chain reaction can be set up where each nucleus splitting causes another fission, generating lots of heat

9. In order to find out if a person's thyroid gland is working correctly, an iodine-131 tracer is used. What properties does this type of tracer have?

   a) Emits Gamma and has a half-life of a few days

   b) Emits Gamma and has a half-life of a few hours

   c) Emits Beta and has a half-life of a few minutes

   d) Emits Beta and has a half-life of a few years

10. What is the time taken for half the radioactive atoms in a sample to decay known as?

 a) Rate of Decay
 b) Half-life
 c) Activity
 d) Decay constant

11. Which of the following detects radiation by detecting an electrical discharge caused by ionisation?

 a) Photographic Film
 b) Volt meter
 c) Thermometer
 d) Geiger Muller Tube

12. A radioactive isotope has a half-life of 1 day. What fraction of it remains after 3 days?

 a) 1/2
 b) 1/4
 c) 1/8
 d) 1/16

13. Carbon-14 has a half-life of 5,700 years, and makes up about 1/10,000,000 of the carbon in the air. A bone is found to contain 1 part in 15,000,000 Carbon-14. How old is the bone?

 a) 2,800 years old
 b) 5,600 years old
 c) 8,400 years old.
 d) 11,200 years old

14. Where does radiation come from?

 a) An electron
 b) An atom

c) An unstable nucleus which decay   d) A stable nucleus

15. When a nucleus decays it often changes into a new element, but what type of radiation will it emit?

    a) Any type of radiation

    b) Alpha or Beta and Gamma

    c) Alpha only

    d) Gamma only

16. Which of the following types of radiation can enter living cells and cause ionisation, thus damaging or destroying the cell?

    a) Gamma   c) Beta and Gamma

    b) Alpha and Beta   d) Alpha, Beta and Gamma

17. A very high dose of radiation will normally kill cells completely. If this happens, what is the most likely outcome?

    a) Cancer   c) Asthma

    b) Radiation sickness   d) Nothing

18. Inside the body an alpha source is most dangerous because it will ionise all cells in localised area. What source or sources are most dangerous from outside the body?

    a) Beta and Gamma

b) Alpha and Beta

c) Beta

d) Alpha

19. Radiation from space is known as cosmic rays. Where do most of these come from?

a) The Sun

b) The Moon

c) The Planets

d) Passing Comets

20. In the nuclear industry, what is fired at a nucleus to make it unstable?

a) Neutrons

b) Protons

c) Electrons.

d) Atoms

APPENDIX 3

PRE-INTERVENTION TEST ANSWERS

1. B
2. D
3. A
4. C
5. C
6. D
7. C
8. B
9. B
10. C
11. A
12. B
13. B
14. B
15. C
16. A
17. A
18. B
19. C
20. B

APPENDIX 4

POST-INTERVENTION TEST ANSWERS

1. D
2. C
3. A
4. B
5. C
6. C
7. A
8. C
9. B
10. B
11. D
12. C
13. A
14. C
15. B
16. D
17. B
18. A
19. A
20. A