UNIVERSITY OF CAPE COAST

MULTIMEDIA USAGE AND ACADEMIC PERFORMANCE OF STUDENTS IN PHYSICS: THE CASE OF ADISADEL COLLEGE, CAPE COAST, GHANA

ROLLAND KWEKU FIAKOFI

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BY

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

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DECLARATION

Candidate's Declaration

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

Candidate's Signature……………………… Date………………………

Name: Rolland Kweku Fiakofi

Supervisor's Declaration

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

Supervisor's Signature…………………………………… Date……………

Name: Dr. Paul Nyagorme

ABSTRACT

The study sought to assess the use of multimedia and academic performance of students in physics in Adisadel College in the Central Region of Ghana. The purpose of the research was to compare if there is significant statistical difference between the uses of computers in teaching as compare to the traditional lecture method of teaching. The mixed methodology was employed. Scores on Achievement Test 1 and Achievement Test 2 were used for pre – test and post – test where both groups were compared. Interview schedule was used to collect data from the teachers. There were also documentary analyses where the various multimedia tools were compared to the international standard which should be equivalent to four to five students per computer (ratio). The results of this investigation indicated that students can easily understand various concepts in physics and solve varied forms of problem given to them if they are taught using computers and also the use of computers has a positive impact on students' academic performance and achievement. Therefore the use of computers and technology should be used to teach various concepts and topics in physics. More use of computers and technology by physics teachers should be employed to research into the various concepts and topics in physics so as to come out with best technological methods of teaching physics.

Teachers and various curriculum designers should be educated on the benefits of using technology and computers in teaching and learning. Physics teachers should be trained efficiently by GES with software for teaching. Technology integration units should be established in regional and district education offices to relay any training and technical assistant for physics Teachers.

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DEDICATION

To my Family

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ACRONYMS

CTML	Cognitive Theory of Multimedia Learning
	Examination
GES	Ghana Education Service
ICT	Information Communication Technology
IQ	Intelligent Quotient
MAT	Multimedia Assisted Teaching
	Organization
OTA	Office Technology Assessment
PhET	Physics Education Technology
PPT	Power Point
PTA	Parent and Teachers Association
U.S	United States
UNECA	United Nations Economic Commission for Africa
UNESCO	United Nations Educational, Scientific and Cultural
WAEC	West Africa Examination Council
WASSCE	West Africa Senior Secondary Certificate

CHAPTER ONE

INTRODUCTION

Background to the Study

Over the years, educationists seem to be promoting the use of technologies and application to improve student achievement. Some of the technologies that gain prominence are projectors, computers, mobile phones, tablets, pen drives (Carlson, 2002). Many institutions have mobile carts that are equipped with the technology that is required for any tutor to display information.

One of the teaching technologies included in the learning-teaching process is a series of multimedia applications developed due to advances in information technologies. Considering the present technology available, it is essential that the educational system enforces the use of information technologies. The vivid growth of the internet highlights the relevance of web-based learning environments and has greased the wheels for facilitators to more greatly benefit from multimedia applications. Yui, Liu and Wai (2005) emphasize some of the most important features of web-based learning environments, including less need for a multitude of tools; accessibility by all media, independence of time and space limitations; and nationwide support for communication and cooperation.

In particular, physics lessons are taught in an indigenous manner within the classroom setting because of the nature of physics topics and depending on the students' habits. Therefore, teaching it has become tedious and difficult to comprehend. To be successful in a physics course, students should possess a good cognitive understanding ability, interpretation skills, mathematics knowledge and imagination. (Erdemir, 2011; Lyons, 2004; Trumper, 2006). As a result, the physics teaching is perceived to be difficult in some countries.

The primary reason why such a perception is potentially true is that the subject may be taught in a way that fails to match with the nature of physics and the students' perceptions, thereby disregarding the need to implement and mentally combine optically and oral knowledge. Secondly, the ineffective application of planned techniques can be shown as the reason for the problem or perception. The combination of these two setbacks has brought about students failure in physics education (Gok & Silay, 2008; Trumper, 2006). Visual teaching methods that include the use of Power point presentations can be used to overcome this perception and increase students' success rate.

Universally, multimedia is now the order of the day in our educational system which serves as a tool for effective teaching and learning. It is highly providing richer environments for learning in a vast variety of formats. Multimedia is increasingly being used in many developed countries in computer-based narrated animation that explains how a causal system works and one rationale for this trend is the assumption that multimedia has characteristics that can aid learning, particularly the learning of abstract subject matter. This phenomenon according to Adegoke (2010) is gradually being observed in developing countries too. However, observations have shown that the use of computer in developing countries, for example Nigeria, as teaching and learning aid is being restricted to privately owned institutions and public schools where children of the affluent attend.

Multi-media can be categorized as an entity in which text, pictures, sound, animation, video or a combination of these media are used for students to access information and can make learning simpler (Mayer, 2001). This is also situated in Paivio's dual coding theory (Paivio, 1991) who explained that both hemispheres of the brain are used actively in learning environments in which both visual and textual information items are used. Multimedia software was developed from the principles of cognitive theory of multimedia learning (CTML) (Yui, Liu & Wai 2005).

Cognitive load theory and cognitive theory of multimedia learning provides information about learning from words and visuals. These theories suggested that, there are two distinct channels in the human information processing system. According to Issa, Schuller, Santacaterina, Shapiro, Wang, Mayer and Da-Rosa (2011), one of the processes information presented in a visual format and the other processes information presented in an auditory or verbal format. Issa et al. (2011) elaborate the cognitive learning process in their study as sensory memory that can get unlimited information through verbal and pictorial stimuli, but only limited amount of these stimuli can be processed at any given time. The selected information is transferred to the working memory. There, the information is organised and this takes a significant amount of time.

Multimedia study materials like still and animated graphics, video and audio integrated in a structured manner, compared to indigenous textbooks, are confirmed to be much more efficient tools in adopting new knowledge (Sadaghiani, 2012; Stelzer, Gladding, Mestre & Brookes, 2009).

The use of multiple external representations in a multimedia learning environment has been shown to be an effective way to support learning and increase comprehension (Schnotz & Lowe, 2003) which directly relates to the cognitive theory of multimedia learning (CTML), where we can process more than one representation at the same time (Mayer, 2001). Multiple representations are useful in physics education as they foster students' understanding of physics problems, building a bridge between verbal and mathematical representations, and helping students to develop images that give meaning to mathematical symbols (Van Heuvelen & Zou, 2001).

Simulations used in Physics teaching are computer programs that have an implicit model of behaviour of a physical system which allows the students to explore and to visualise graphic representation (Concari, Giorgi, Camara & Giacosa, 2006). Using computer simulations to learn is closely related to a specific form of constructivist learning, namely scientific discovery learning (van Joolingen, de Jong, Lazonder, Savelsbergh & Manlove, 2005).

The students can change the parameters to the desired ones and observe the effect of those changes by interacting with the system. Although simulations is seen as the fastest and the best tool, it cannot substitute real laboratory experiences but can be used hand in hand with the intention of increasing the understanding of certain concepts. Simulations designed properly and used in the right contexts can be more effective educational tools than real laboratory equipment in developing student facility with real equipment and in fostering student conceptual understanding (Finkelstein, Adams, Keller, Kohl, Perkins, K. K., Podolefsky, & LeMaster, 2005). The Physics Education Technology Project (PhET) of the Colorado University offers a substantial number of ideas and activities designed by physics teachers around the world to be used together with PhET interactive simulations of physics phenomena (Perkins, Adams, Finkelstein, Dubson, LeMaster, Reid, & Wieman, 2006).

Statement of the Problem

Students of physics in the senior high schools face a lot of difficulties in understanding the basic concepts in physics (WAEC Report, 2014). As a result of this difficulties faced by these students, they perform poorly in examinations thereby affecting their performance in physics. The teaching methods for physics at the Senior High Schools face a critical stage of their development. The traditional methods of teaching physics, which is dominated by explicit lecturing function of teachers, has clearly manifested its weaknesses. In the past decades, researchers in physics education had studied the effectiveness of such practice on three different but important aspects of learning which are conceptual understanding, transfer of information, and basic beliefs about physics (Perkins, Adams, Finkelstein, Dubson, LeMaster, Reid, & Wieman, 2006).

Information and communication technologies supported in teaching and learning physics offers an alternative to the solutions used in the traditional approach. The largest source which is the internet offers over 5000 multimedia learning materials for physics. However, this opportunity has not been fully utilized by Ghanaian teachers; hence many students fail physics (WAEC Report, 2014).

Purpose of the Study

This study mainly focuses on using multimedia assisted educational technology to teach students in Adisadel College, Cape Coast in the Central Region of Ghana. In effect the study evaluate the impact of the multimedia usage on students' achievements in physics.

The objectives of the study are:

1. To assess the availability of multimedia in the selected school.
2. To determine the teachers attitude in using multimedia to teach.
3. To evaluate the effectiveness of using multimedia on students' academic performance before treatment.
4. To evaluate the effectiveness of using multimedia on students' academic achievement after treatment.

Hypotheses

The following hypotheses were tested:

H01: There is no significant difference between the availability of multimedia in the selected school compared to the standards required for multimedia tool usage.

H02: There is no significant difference between teacher's attitude and use of multimedia to teach.

H03: The use of multimedia has no significant effect on student's academic performance before treatment.

H04: The use of multimedia has no significant effect on student academic achievement after treatment.

Significance of the Study

This study was chosen because it may provide important and very useful information for curriculum developers to design physics teaching methods that will include the integration of multimedia to enhance meaningful understanding of physics concepts, the Ministry of Education, and ICT teachers about the possible use of ICT's in teaching and learning physics. Findings and general outcomes of this piece of research can help change the teacher's behaviour towards the use of ICT's in teaching physics.

Delimitation of the Study

Only senior high school form three students were used for the study, the study was also delimited to only students of Adisadel College Cape Coast.

Limitations of the Study

Not all students were chosen for the study and this can affect the generalizability of the findings also since quantitative and qualitative methodologies are based on different assumptions, it is possible that different techniques could produce different results.

Organisation of the Study

The remaining chapters of this study are as follows. Chapter (2) two discusses literature related to the study. Chapter (3) three describes the methods used in the study, that is research instrument, research design, sample, population, data collection and analysis of data.

In chapter (4) four, the findings are presented and discussed in relation to the literature. Finally, chapter five gives the summary, conclusion, recommendations and areas for further research.

CHAPTER TWO

LITERATUREREVIEW

Theoretical Framework

In this era science and Technology which serves as the backbone of many countries to progress and prosper in all that they do, science education plays a vital role in the developmental process of these nations. In Ghana, science is a compulsory subject up to senior high school level.

Many methods that teachers use to teach have failed to educate learners to think critically, able to solve their own problems and further more to think logically among many students of science, Technology and Engineering. There is therefore the need to shift from the traditional teacher centred ways of teaching to modern scientific and more innovated information and communication technology (ICT) based methods for meaningful and well accepted methods of teaching and learning.

This technologically advanced world have brought about varied challenges for both leaners and their teachers since most of them have no formal training to use these tools in the teaching and learning processes to achieve the maximum and desired goals. Multimedia aided teaching is normally used to support many traditional ways of teaching (Rolfe & Gray, 2011). It has somehow become a very important feature which makes teaching and learning very interesting and acceptable to many and it includes words, sound, and pictures that is designed for meaningful learning (Mayer, 2005a; 2005b; 2005c).

Multimedia can be presented in many different formats and it delivers, clearly stimulates confusing contents which are unclear and doubting to meaningful and authentic ways of learning understanding of most complex concepts. Multimedia aided teaching is useful especially when students have low motivation and low prior knowledge (Singh, 2003). “Multimedia is characterized by the presence of text, pictures, sound, animation, and video; some or all of which are organized into a coherent program” (Phillips, 1997). According to Bagui (1998) data communication is possible through multiple channels and if information is presented through more than one channels, it will improve learning.

Multimedia usage in teaching and learning stimulates most sensory receptors of the various audiences at a time, most teachers are able to control their flow of concepts being taught easily. In Ghana using multimedia to teach has fallen short due to so many reasons which may include but not limited to their expensive nature, lack of computer literate teachers and other technical staff and infrastructure. Also teachers’ attitude toward their use cannot be left out completely. There are so many merits in using multimedia in the teaching and learning business in the classroom, Gilakjani (2012) asserted that its use “increases students’ interest level, enhances their understanding, and increases their memorizing ability.”It also addresses different individual differences in learning especially the varied learning styles displayed by most learners.

Even though the use of multimedia have some demerits, it is very obvious that the merits outweigh the very few demerits. Multimedia also brings about cognitive development and also instils constructism in the learners. Singh (2003) cited the studies of Kulik, which indicated the effectiveness of MAT over the traditional lecture methods. Studies of Kulik, Bangert, and Williams (1983), indicated that learning occurs in less time by MAT as compared with the traditional method of instruction. Similarly, MAT addresses different styles and approaches to learning and helps students construct their own knowledge (Riding & Grimley, 1999). Jarosievitz (n.d) in his research work titled “ICT in Physics Teaching for Secondary Schools and Colleges” mentioned that MAT is more attractive and interesting and recommended that science classes should be made more multimedia-based to enhance students’ motivation and understanding.

PowerPoint (PPT) presentation increases the interest level of the students. It has been reported in different studies that MAT improves students’ attitude towards science (Mantei, 2000). The students are better able to learn and retain the material when the lectures are presented through PPT, as indicated by Mantei (2000), and Szabo and Hastings (2000).Also, Collis (n.d) concluded that multimedia is effective in teaching when used as a supplement. Similarly, Lee and Keckley (2006) reported positive effect of multimedia lessons on students’ performance.

Learners are motivated by MAT to play an active role in the teaching and learning process. Attitude is a learned predisposition to respond positively or negatively towards an event, situation, and an object or people. Gardner (1975) described attitude as a learned predisposition to evaluate situations, objects, actions, or people in a favourable or unfavourable way. Blalock, Lichtenstein, Owen, Pruski, Marshall, and Toepperwein (2008) have classified attitude towards science into four major areas, i.e., (a) attitude towards science; (b) nature of science; (c) scientific career interests; and (d) scientific attitude. According to Bennett (2003), students' attitude towards science is developed as the result of experiences in different learning environments in the field of science education. The attitudes therefore have an effect on the way they take part in science-related activities. A positive attitude towards science will definitely illicit a positive achievements towards science. Many studies show a positive correlation between attitude towards science and achievement in science (Rana, 2002; Papanastasiou & Zembylas, 2004; Eccles, 2007). Many people chose careers in science due to the Positive attitude towards science which motivates them to study science (Rosink, 2012). The way science is taught is to be properly leaned so as to see how the various teaching approaches affect the learners' willingness to be positively motivated in the learning of science.

An important part of science education as mentioned by Gardner (1975), Joyce and Farenga (2000), and Osborne, Simon, and Collins (2003) is the development of attitude towards science. Different researchers reported decline in elementary level pupils attitude towards science as asserted by Weinburgh (1995) and Rani (2000). These decline can be attributed to many factors such as quantity of instruction, students' motivation, quality of instruction, classroom environment, and medium of instruction. According to Walberg (1984), students' attitude towards science is affected by the quality of instruction, classroom environment, and time involved with different media like video and television.

One factor that affects students' success in science subjects by students is their attitude (Gagne, 1979). Ogunleye (1999) maintained that many students develop negative attitude due to teachers inability to motivate and place the desire or goals in them. There is a positive correlation between the way students perfom towards science subjects as stated in the works of Hough and Piper (1982) and Alao (1990).

As attitude is the best predictor to estimate students' academic success as maintained by Hendrickson (1997), teaching-learning activities must be planned, organized and implemented so that students may develop a more positive attitude (Pintrich, 1996). To plan, organize, and implement such activities MAT gives the best advantage to achieve those goals. According to Soomro, Qaisrani, and Uqaili (2011), students' attitude towards science affects their learning of science subject(s) and their positive or negative attitude has an impact on their academic achievement and future career. In fact, positive attitude towards science leads students to a positive commitment to science and influences their lifelong interest and learning in science (Nurulazam, Rohandi& Jusoh, 2010). Scientific attitude in students is developed by Science education. Parker and Gerber (2000) and Ali and Awan (2013) noticed that students' achievement and their attitude towards science play an important role in the selection of professional studies in future.

Data gathered from students attitude from previous researches indicates that their attitude towards the subject help in designing instructional programs, curriculum, and teaching strategies that will help them understand the various complex and confusing themes in the various subject areas.

The European Commission (2007) pointed out that there is an alarming decline in the attitude of students towards science and recommended that improvements in science education should be brought through new forms of pedagogies and approaches. Scientific attitude, attitude towards science, and scientific literacy are very important to understand environmental, medical, social, and economical issues of scientifically and technologically advanced societies in a globalized world. This has paramount significance for the prosperity of a society. The present study is an attempt to explore the effectiveness of innovations in the teaching and learning process.

The introduction of computer studies is not only as a new subject, but to aid teaching and learning as a whole. The study in turn provides an action research on trends associated with the use of Information and Communication Technology (ICT) in the area of teacher training and education in Ghana. According to Ghana's Education Reforms launched in June 2007,the report gave a recommendation that the use of ICT in teaching and learning did not only fall short of technological resources, hence the shortage of adequate human resource personnel who are well vested in the different areas of ICT use.

In the under developed countries, the use of Information and Communication Technology (ICT) to transform education is widely debated and on the national agenda in most countries of which Ghana cannot be left out, (Tilya, 2008). ICT as a tool cannot be left out in our society of much knowledge (Peeraer & Van Petegem, 2011). ICTs therefore is seen as a tool that provides several chances for most institutions and educational facilities to enhance the use of Technology so as to supplement and add meaning to the teaching and learning process.

Even though several bodies of research to determine the adoption of ICTs in education normally comes from the underdeveloped countries, the developed countries are working hand in hand in the universal society of information as to solve the ICT integration challenges in education (Tilya, 2008).

Africa's sub-Sahara region ministers in 2006 adopted a ten year schedule to make science and technology teaching and learning pass through a reform at every level of their educational system.

During the meeting they suggested that most methods of teaching should have a linkage between science and technology and the learners' styles and their immediate learning environment. The education sector is therefore mandated to note various ways to approach the educational systems to integrate ICT in their systems so as to harness the full potentials and advantages they add to our learning domains. At another stage, the sub Saharan governments placed emphasizes on ways to maximize and add value to the educational sector through the use of ICTs (United Nations Economic Commission for Africa, 2006). An instance in 2006, 28 of the sub-Saharan nations came out with national ICT agenda to impede the realisation of national development goals.

In recent times, Ghana's call for the integration of ICTs in education was drawn to governments attention not far ago (GhanaICT4AD Policy, 2003). This made Ghana a novel area for research to integrate ICTs in teaching and learning. ICT integration into the educational system of Ghana was gainfully started as part of its reform was started in the year 2007 as a portion of the government's initiation to boost the quality of education in the various educational levels of the country.

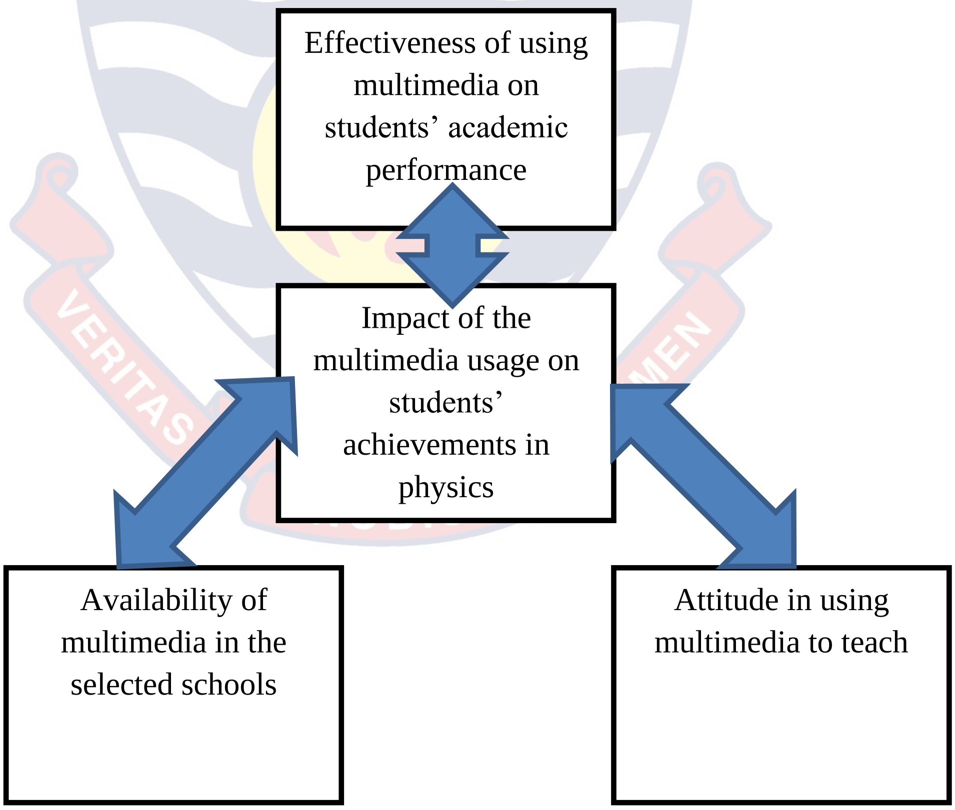
A principal part of the 2007 reform on education in Ghana was to make sure all pupils of pre tertiary schools in Ghana have basic knowledge on the use of ICT not forgotten internet literacy and use in their learning process and also usage in everyday dwellings to make them become technology inclined beings in the near future (CRDD, 2007a,).

Ghana's efforts in taking part in the most recent international ICT development index shows that the country is ranked considering different themes are between 100th and 140th out of 154 countries surveyed (International Telecommunication Union, 2009). This revelation about Ghana's ICT development index reveals that the country lacks behind the integration of teacher education. Important questions such as "What can teachers do with ICTs to promote integration of technology in curriculum or to extend instructional methods?" and "What can teachers do with ICTs to improve students' outcomes?" still remain. A situational analysis regarding ICT usage in different contexts and challenges that the various institutions in Ghana face should be explored and researched deeply into as a necessarily and foremost step to fully adapt ICTs in teaching and learning in the Ghanaian curriculum.

An important area to be looked at seriously is the creation of awareness to stakeholders and decision makers on situations existing within the institutions relating to readiness of teachers' availability of ICT facilities and skilled human resources that will lead to attain the ICT integration goals.

Conceptual Framework

A conceptual framework shows the way ideas are organised to achieve research objectives. From the conceptual framework, effectiveness of using multimedia on students academic performance has a positive link to the impact of multimedia usage on students' performance , again the availability of these multimedia in schools and the attitude of teachers using multimedia to teach could lead to a positive students performancein physics.



Source:The Reseacher 2018

Figure 1: Conceptual Framework

Empirical Review

ICT and Educational Change

Even though a lot of countries are young in using new technologies, its use in the teaching and learning cannot be overlooked (Carnoy & Rhoten, 2002). The nature of education can seriously be transformed by integrating ICTs in education, how and where learning is done and the part learners and their teachers play in the learning process (Tilya, 2008).

ICT has a lot of advantages, according to (Naidoo, 2003), three key points will benefit use of ICT in teaching and learning.

These are;

1. ICT can result in improved learning;
2. ICT offers the greatest support to learners from disadvantaged backgrounds; and
3. It impacts the society in which the learners reside. Despite its potentials, a number of critiques on the use of ICT in education have emerged.

Tempering the expectations of the use of ICT in education can be attributed to two main points;

Firstly, the slow nature of the uptake of ICT in education despite huge investments took place to improve access to technology use and skills improvement of learners and their teachers.

Secondly, the lack of educational revolutions in education (Selwyn, 2007).

The potential of ICT in education cannot be optimized if there is no shift in the educational paradigm is argued by UNESCO (2004).

There is a rhetorical paradox in national ICT policy: on the one hand, ICT is conveyed as having beneficial effects on the educational system and contributing to successful competition in the global market; on the other hand, the driving force behind the use of ICT in educational practice should take its point of departure in pedagogy (Bryderup & Kowalski, 2002). In practice, this inherent paradox too often leads to pedagogical issues being subjugated to matters of technique. Researchers, such as Kirkup and Kirkwood (2005), state in their studies that there exist in abundance computers and technological infrastructure in the level of higher education schools, but they also indicate that these technologies have been learnt by teachers so as to incorporate them in teaching and learning without much stress as compared to those that will change teaching and learning practices radically (Kirkup & Kirkwood, 2005).

Factors Promoting/Constraining the Development of ICT Use in Education

Many researches have shown that for a rapid integration of ICT into teaching and learning will need an adequate ICT policy. To be more precise, an ICT integration strategy for a country's educational sector is a key to change the teaching and learning environments so as to open new chances. ICT based policy is needed to ensure its usage by many in the assimilation of information and to transform it into useful knowledge (Tilya, 2008).

Without the existence of clear plans and ideas placed down by decision makers will make the integration of ICT very difficult in our curriculum (UNESCO, 2007). Countries and institutions have clear visions, strategic plans, commitment, and implementation capability regarding ICT use in education as asserted by Latchem and Jung (2010). According to Kozma

(2008), strategic policies can provide a rationale, a set of goals, and a vision for how education systems might best introduce and integrate ICT. Pick and Azari (2008) remark that the results for a single nation seeking improved ICT depends on political will and leadership that appreciates how multidimensional factors need to be combined for development. In the context of globalization as an economic process, researchers identify a deterministic conception of ICT (Bryderup & Kowalski, 2002; Sawchuk, 2008; Shin & Harman, 2009; Tondeur, van Braak&Valcke, 2007).

However, researchers describe a gap between rhetoric in government policy and reality of education practice (Cheng, 2009; Kozma, 2008; Selwyn, 1999; Tondeur et al., 2007). The studies emphasize that without de-centralized supportive measures, national policies will not easily result in changes in instructional practices. Tondeur et al. (2007) discusses a way forward as stressing the responsibilities of local educational institutions to translate the national ICT guidelines in an ICT plan as part of an overall school policy.

Three preconditions that can lead to a successful beginning of new technologies into any educational system are listed below:

i. An appreciation by the government of the financial, resource, and operational requirements and the resulting consequences.

ii. A commitment by government to give time and take responsibility for decision making and implementation strategies.

iii. A commitment to a policy of an integrated support service encompassing teacher and technician training, curriculum, and assessment, together with software and hardware provision (Walker, 1989).

Walker's assertion strengthens Naidoo's (2003) findings saying that "attempts to integrate ICT into the education system entail the leadership of the government and the education ministry, working together with other relevant ministries." According to literature, there must be a vision which is very clear by leadership to the government on the various ways government wishes to use ICT in education.

The vision therefore needs to be introduced with national policies, effectively communicated and then supported at the various educational levels.

Availability of ICT Infrastructure

Small amounts of resources found in the various schools are key problems to implement and use technology (Mumtaz, 2000). For example, lack of computers and software in classrooms is a major problem that can inhibit teacher's use of ICTs in teaching and learning. According to Murphy, Anzalone, Bosch, & Moulton (2002), only a very small number of Africa's population have computers for use and 4% has access to the internet.

The problem of immediate access to technologies for teachers is a major factor that inhibits technology integration in most countries in sub-Sahara Africa (Aguti & Fraser, 2006).

Resources have been stressed out by other researchers as a paramount part of the implementation and innovation process. According to these researchers, adequate resources are the number of ICT tools that are available at the moment and are readily accessible to teachers so they can use it freely in their planning and teaching processes (Benson & Palaskas, 2006; Snoeyink & Ertmer, 2002).

Teacher Preparedness and Willingness

The success of implementation processes is likened to, "the people who will ultimately use the innovation must possess sufficient knowledge and skills to do the job" (Ely, 1999). This is especially the case when the innovation involves the use of a certain tool or a technique. Without enough preparation to use the tool or technique, the innovation will die out soon.

Lack of enthusiasm by teachers to use ICTs in teaching and learning be the absent of technological knowledge or the lack of its kind that affects the planning process of teachers (Webb and Cox, 2004). This idea has recently been developed by Mishra and Koehler (2006) and Harris, Mishra, and Koehler (2009), who propose that "there is a tendency for teachers not to synergize their content and pedagogical knowledge with their technological knowledge, and that this can result in mundane ICT implementation in the classroom." Alongside the need to develop teachers' knowledge and skills, their attitudes towards ICT integration also need to be understood. Attitude by teachers to use computers as learning tools is a paramount factor that predicts their use of ICTs effectively in education (Christensen & Knezek, 2008).

Professional Development and Training

Attention on how ICT is to be integrated in teacher education and professional development has received so much attention. According to Baylor and Ritchie (2002), "training has an important influence on how well ICT is embraced in the classroom."

A review of the recent teacher education research around ICT shows numerous examples of teacher education programs that have implemented instructional technology in ways that encourage integration (Goktas, Yıldırım,

& Yıldırım, 2008; Kay, 2006). The provision of teachers and teacher candidates with real life problems that sought to be solved using technological processes have been involved since in technological training. Therefore literatures make it very clear that there is more to be done to teacher preparation than training on the ICT tools that needs to be embraced on the complex set of interrelationships between artefacts, users, tools, and practices.

Resistance to Change

So many researches have shown over the years that the resisting factors that frustrate diffusion and implementation efforts. Notable among them are the assertions of Zaltman and Duncan (1977). These authors define resistance as "any conduct that serves to maintain the status quo in the face of pressure to alter the status quo." Much study has also shown that schools are resistance to Technological change. This is because of the resistance of schools to change, many of them do not make time to teachers to manage and acquaint themselves with technological and ICT novelty, also lack of much time allocation to teachers on the time table that demarcates the various times for teaching a specific topic do not allow time for the usage of ICT to teach (Mumtaz, 2000).

Vygotsky's Zone of Proximal Development

Both computer-assisted instruction and traditional teaching allow teachers to level and structure the content so that it is within the child's zone of proximal development. In this theory of learning, Vygotsky describes the optimal learning situation as one in which the student is able to understand the material with help (Powell & Kalina, 2009). This assistance could come from a computer program, a peer or a teacher. If the lower achieving students are struggling with problem solving, for example, the teacher can provide a framework for them to use with a partner or on the computer. On the other hand, a higher achieving student could be presented with more complex problems to solve in class or given the opportunity to work through more difficult problems on the computer.

Motivation to Learn

Another crucial aspect of educating children is inspiring them to learn. Hannula (2006) defines motivation as the potential to affect behaviour by controlling circumstances in a way to affect the student's emotions. He states that students need autonomy, a feeling of competence, and a sense of social connectedness. Maslow's theory of motivation states that once a child's basic needs are met, he is ready to strive to reach his fullest potential through learning that which sparks his interest (Hackman & Johnson, 1991).

In addition, Carl Rogers created an educational framework which relies heavily on student interest and progress (Szlarski, 2011). Setting learning goals is also very motivating to students (Hannula, 2006). Salanova, Llorens, and Schaufeli (2011) conducted research on teachers and college students to examine the connection between efficacy beliefs, effect and engagement. They found in both groups that efficacy beliefs influence engagement which in turn gives the individual a positive effect. Enthusiasm, in their results, showed the strongest impact on engagement in the activity. Most importantly, however, they found that a "gain spiral" exists so that when efficacy beliefs increase due to engagement, positive effect also increases. The key, therefore, is to determine how to help elementary students gain this confidence that they can learn mathematics and develop a positive attitude toward learning so that their engagement also increases. Both computer-aided instruction and traditional teaching can provide conditions for the child to be highly involved in the learning process and provide immediate feedback regarding his progress.

Computer programs are motivating in that they present levels to master and teachers can help motivate students by setting attainable goals for mastery in the traditional classroom. The question that remains, then, is which is more effective with today's learners?

Meeting the Needs of Today's Learners

Students in classrooms today are quite different and have different learning needs than they did even 20 years ago. Twenge (2009), in her article, "Generational Changes and Their Impact in the Classroom: Teaching Generation Me," identified several predominant characteristics of modern learners. She used a method she calls "cross-temporal meta-analysis" in which she examined the statistical results from a variety of psychological questionnaires across various periods of time to discover generational differences. The results show that Generation Me students have high expectations for themselves, exude a sense of entitlement, and exhibit more mental health problems than previous generations.

Most applicable to instructional practice is her assertion that today's students score higher on standard IQ tests, but have very little stamina for long-term concentration. Other studies show similar characteristics of this generation of students. Gorra (2010) stated that these "Digital Natives" view technology as an essential part of their everyday life. These authors surveyed college undergraduate students over a period of four years to identify trends in the technology preferences of these students. Their findings showed that 98% of these students carry some kind of communication device daily and most have devices for listening to music, viewing videos, and accessing the Internet. These students report that they appreciate options in modes of instruction, such as downloading lectures, content or other multi-media sources.

Schools are trying to determine what changes are needed to best meet the needs of this modern learner, and the U.S. Department of Education is encouraging professional development in the use of technology (Frye & Dornisch, 2008). Consequently, more and more teachers are implementing technology in all subject areas. Frye and Dornisch (2008) studied the consequences of increasing the use of technology in high school classes. They discovered that students perceive teachers who use technology as part of their instruction as more competent and knowledgeable, especially in the areas of mathematics and science. This again reflects the characteristics of this technologically geared generation because using technology involves more student interaction with the content and more active involvement.

Recommendations for reaching this type of learner, therefore, include more interactive learning, shorter instructional periods, and the incorporation of multi-media (Twenge, 2009). Both traditional classroom teaching and computer-aided instruction can accomplish this goal.

Teaching with Computers in the Classroom

The Role of Teachers in a Computer-Rich Environment

Mode of interaction between teachers and learners is transformed due to the emergence of ICTs into the teaching and learning process (Means, 1994). The skilful nature of many learners to operate new technologies for instance personal computers and technology instantaneously make a razing effect in the classroom. It has become baseless for a teacher to try to remain on top of issues which is characteristic of the behaviourist due to the many potential students have in the manipulation of ICTs. The learners normally play active role in the use of technologies in the constructivist classroom rather than the behaviourist who may see the use of technology in the classroom as disaster.

Learners therefore are their own responsibility in the constructivist classroom, therefore they try every means to use and understand the varied range of technological tools to aid their learning process. The unfriendly nature of technology use in the classroom to the behaviourist agenda rather accidentally promotes and also endorses the constructivist agenda of technology use in teaching and learning process a radical extent. ICTs instantly create a condition in the learning environments in a way that the teacher ceases to become an expert, rather learner creativity not just anticipated but certainly essential. Celestial navigation on the computer and the ability to use software needs creativity as opposed to impassiveness, obedience, mindless respect for authority, and dependence on the superior knowledge of the teacher.

However the reputation and power that the teacher possess cannot be challenged by technology introduction in teaching and learning if the teacher is adequately supple to become accustomed to methods of teaching that the learners are more self-governing and modest. This is both a trial and a chance. Even though the new trained teachers are more inclined to more independent and centrifugal teaching methods of some kind, which might be due to the fact that they themselves might already have been trained or exposed to this teaching methods at the time of their schooling, the teachers of old may be threatened because they were not initially conditioned in their training days to be very active and use radically the constructivists ways and means of teaching and learning.

The predicaments in which the traditional behaviourist teacher finds themselves in various teaching scenarios have been asserted by Fontaine as: "Teachers may be forgiven if they cling to old models of teaching that have served them so well in the past. All of their formal instruction and role models were driven by traditional teaching practices. Breaking away from traditional approaches to instruction means taking risks and venturing in to the unknown. But this is precisely what is needed at the present time" (Fontaine, 2000, p. 53).

In the traditional behavioural classroom, the teacher of its kind as the sole reservoir of knowledge has the guts to command the type of learning that should take place during the teaching and learning process that they have preference over and to make them compulsory with the power given to them by their various institutions and the general society. The use of varied and new technologies in the classroom and the initiation of constructivist teaching and learning methods oblige the traditional behaviourist teacher to move from their traditional and ritual way of teaching and adapt to new ways to enhance their teaching. This will in effect have a positive change in the way learners perceive teaching and learning and may make them understand difficult principles and theories in a fun way, Siegel (1995).

A lot of the traditional teachers are worried with the prerequisite to the versions of technology use because their teaching and learning strategies and their manner of communication with their students are based basically on the traditionalist teacher education. This crop of teachers frankly finds it very difficult to familiarize to the new constructivist methods that exist in the classroom of which much technology based teaching is done (Burke, 1998).The emergence of technology in the classroom for students has also transformed the teaching and learning environment.

As technology is being integrated into the classroom for the learners has modernize the classroom atmosphere. The traditionalist use of technology in the classroom have a habit of reserving the teacher, an extension of the teacher's authority, control and prestige. The traditional behaviouristic teacher may as a result use an overhead projector to project slides or transparencies imprinted with text or images. The use of technology this way just endorses the supremacy of the behaviourist traditional teacher methods of teaching because the teacher never ceases to be the main and central power house and reservoir of knowledge and education. The moment we democratize technology use in the teaching and learning business, the teacher ceases to be sole focus of attention, the approved purveyor of information, or the guardian of pedagogic protocols.

The teacher becomes a facilitator as compared to a dependable expert in the classroom where technology is similarly available to every learner. The changing aspects of constructivism are figuratively seen in the true bodily activities undertaken by the teacher in the classroom of the constructivists. The teacher is no longer a “talking head” who dispenses information and instruction from a privileged position abovethe learner in such a classroom. In the constructivist classroom, the teacher is no longer even able to talk down to learners because he or she has moved onto the same level as learners, the teacher has moved downand towards the learners in order to answer their questions, observe their progress, and suggest possible new lines of inquiry, activity and investigation.

As the teacher moves from one learner to another in situations like this, he or she responds to calls for help, comment or guidance by responding to the uniqueness of the learners’ needs. Such a teacher no longer needs to embody the dignity and prestige of the institution or the power and authority of the society that finances, maintains and sanctions the institution. The tonethat the teacher adopts when interacting with learners is thus correspondingly different in quality from that which a traditional behaviourist teacher might adopt. The behaviourist teacher is far more likely to offer suggestions, guidelines, support and even further questions, problems and complications rather than commands, solutions, definitions and obiter dicta(Stepich, 1996, quoted in Batane, 2004).

What happens if teachers incorporate technology in teaching and learning instead of moralistic monologues have been approved by Dede (1998), cited in Batane, 2004, p. 390.

A technology inclined classroom help teachers to move about the classroom and observe keenly learners from over their shoulders rather than from the prestigious position at the centre of the front of the room. The school of the constructivist teacher is far more to be expected to use strategies of Socratic discourse by requesting important questions and by examining for an answer already understood with the student but to bring together the facts that he or she already retains. The constructivist instructor also put forward where assets might originate, but does not customarily present them in a convenient and pre-digested layout. In every approach, the learner in the constructivist classroom is stimulated to be responsible, to take initiative, to explore, to extend boundaries, and to discover solutions.

In the behaviourist classroom, on the other hand, the learner is habituated to being a passive observer of how the teacher works througha problem and arrives at a situation which the learner is then invited to replicate. Reproduction, replication, centripetally, solitariness, memorisation and received dogma are all hallmarks of a behaviourist classroom. Experimentation, hypothesis, initiative, centrifugalise, trial and error, self-motivated inquiry, collaboration and teamwork are all hallmarks of the constructivist classroom.

As a teacher in the National Geographic Kids Network Project said: "I no longer spend most of my time standing in front of my class lecturing or having students reading from a textbook. I have become a;

1. Facilitator,
2. Stage Director,
3. Resource Manager,
4. Master Student,
5. Discussion Leader,

6. Observer, and
7. An Evaluator.

For me this change has been refreshing and enlightening and long overdue. There are no longer textbooks or tests with right or wrong answers. They have become collaborators and teachers. They have become;

1. Scientists,
2. Making Predictions,
3. Developing Hypothesis and
4. Analysing Data.

They spend their money buying school pencils, folders, and banners to send home to their pen pals" (Bracey, 1994, quoted by Batane, 2004, p. 391). The school of taught that trust in the usefulness as a way of training children are of the view that every learner may healthily gain from the usage of technology in the classroom if and only if teachers use accepted tactics for introducing technology into their classroom environs. As technology unlocks many forms of innovative potentials for teaching and learning, the inability of technology use in its proper manner will constantly prove unsuccessful.

There should be a careful contextualization of classroom technology in the theoretical and practical sense: it needs to be an essential part of a didactic philosophy that has been well researched and sensitively applied. As much as promising as it will be for any technology it may not benefit neither the learners nor their teachers unless its merits and demerits are obviously understood and incorporated in its classroom applications.

The revolutionary technology such as the personal computer should be integrated in such a way into the classroom context that it will benefit each and every learner and not just a gifted learner (Fosnot, 1996, quoted in Batane, 2004).

Many teaching methods have been revolutionized due to the incorporation of computer technology in the teaching and learning process as asserted by the Office Technology Assessment (OTA) Report (1995). Most of the classroom environments availably become constructivist settings if all learners have a good access to computer for educational purposes.

The availability of computers to learners automatically regionalizes teaching and learning in a way that is reliable with the concrete philosophies of constructivist teaching but not with the reason of educational philosophies as seen in context. That classroom as a whole becomes demoted from teacher's historical position as the sole repositories of knowledge where he only dictates his sole wisdom to the learners from time to time in a traditional behaviouristic manner inclined.

Computer technologies place a conforming responsibility to many learners to become more active, to take more responsibility for their learning, and become independent experts in their own right on the means of education. There exists many forms of constructivist philosophies of education in the classroom but the way computers are designed transforms the classroom in where computers are available for use for constructivist purposes. The computer itself is a major source independently use for educational purposes, the schoolroom stuffed with the abundance of many computers is spontaneously the setting where the locus of attention and power is widely integrated rather than centralized.

The teacher does not lose dignity, authority or prestige in the computer-rich classroom. It is true that there is no place in such classrooms for teachers who cannot accept the decentralization of activity and responsibility that accompanies the widespread use of computers for education. It is true also that modern teachers need to be experts both in their subject specialties as well as in the software programs that their learners use. "Nowadays, the teachers must be specialist in rigorous subject matter and be adept with modern technologies" (Donley & Donley, 1996, p. 6). This new "burden" on teachers simply reflects changing patterns of imparting and processing information in the larger society in which we live.

The point that up to date teachers are wished to have a working wisdom to use computers in the classroom and also use software makes it difficult to make them distinctive. Those applying for new jobs in the world these days are also requested to have a working knowledge of computers as a pre requisite and advantage before they are employed into their new ventures.

A lot of learners in our schools these days come with many fascinating knowledge of computers that many teachers do not even have. The traditional behaviouristic and authoritarian methods of teaching have been dealt coup de grace with the technology that is used in the form of computers. The position of the teacher in the technology rich setting is also of equal importance; it seems simply different. Whether this first-hand role is friendly or not to the teacher depends solely on the nature of the teacher.

Teachers who enjoy encouraging learner independence, creativity, initiative and self-actualization will welcome the opportunities that the technological classroom provides. What is most certain is that teachers who are creative, pragmatic, imaginative and enthusiastic will find themselves very much at home in the modern technological classroom. The challenges presented by the computer-rich classroom are very great indeed, and they test the abilities of even the most gifted teachers. But the kind of teacher skills and aptitudes that ensure success in a classroom of this kind are very different from the skills, aptitudes and attitudes that maintained traditional behaviourist teaching. It is little wonder that many older teachers find it almost impossible to adapt creatively to the challenges of the computer classroom while younger teachers and recent graduates of education colleges find little to surprise them in such classrooms.

This does not mean that teachers have become dispensable. They are just as necessary as ever they were. But the skills they need to make the teaching successful in the technological classroom are vastly different from the skills needed in traditional authoritarian teaching situations. The onusis on teachers to make technology-based educational a success. Without skilled choreography on the part of teachers, learners might easily lapse into old habits of futility and passivity technology or no technology (Hanson-Smith, 1997).

Summary of Literature Gap and Its Implication to the Study

Most authors have written about the integration of technology in teaching which made teaching interesting and acceptable but fail to apply these technologies in individual subject areas of which physics teaching is no exception.

Inability to use multimedia in teaching by these teachers indicated that the expensive nature of these multimedia tools is a resounding factor, lack of technical training and computer illiteracy are also factors affecting multimedia use in teaching physics.

Again, varied advantages on Multimedia Assisted Teaching (MAT) outlined by the various authors but a very few researchers worked on the use of multimedia in teaching physics in our Ghanaian context. This research therefore will help Ghanaian physics teachers to be equipped with the various multimedia tools that should be used to assist the teaching and learning of varied complex concepts that evolve in teaching and learning physics.

This study also forms the basis of an attempt to explore the effectiveness of multimedia use in teaching of various concepts in physics. In addition , the study in turn will provide trends that will be associated with the use of ICT 's especially multimedia tools in the area of physics teaching and education in Ghana.

CHAPTER THREE

RESEARCH METHODS

This chapter explains the methodology used in carrying out the research. This chapter also gives a description of the research design, target population, sources of data. It further explains the study's sample size, sampling techniques used, research instruments and procedures followed in data collection, processing and analysis as well as data presentation.

Research Design

Pre-test/post-test control group design was used for this study. In this design, the randomly selected sample was divided into at least two groups called the experimental group and the control group. Both groups were tested before treatment. The experimental group was given unusual or new treatment, whereas the control group was treated traditionally or given no treatment. After treatment, both groups were post-tested. From the post-test results of both groups, the effectiveness of the unusual treatment was determined. All sources of internal invalidity were controlled in this design. Scores on Achievement Test 1 and Achievement Test 2, were used for pre-test and post-test comparison of both groups.

Students' achievement Tests were used to judge students achievements in physics. Interview schedule was also used as an instrument to collect data from the teachers. There is also a documentary analysis where the various multimedia tools were surveyed from the selected school and then compared to the international standards.

Population

The population of the study comprises of both senior high school form three physics students who were in their final year preparing to write their WASSCE exams. The final year students were chosen for the study because they have done various topics under physics and are ready to write their final year WASSCE exams. Since they have studied various topics under physics for three years, it is believed that they can identify various difficulties and problems they had during their three years of study. Also, all physics teachers in the school were also administered a questionnaire for the survey.

Research Instruments

Data for this study were collected using an achievement Tests based on pre-test and a post - test and an interview schedule.

Pre-test

A pre-test was designed to investigate the equivalence of the experimental and control groups. This was administered to the students in both the experimental and control group prior to the experiment. If the means of the performances of the two groups do not differ significantly, it can be assumed that the two groups are comparable. Students from each group were given 60 minutes to complete the pre-test.

Post-test

A post-test was designed and administered at the end of the experiment to students in both the experimental and control groups. If the mean performance of the experimental group is significantly different from the mean performance of the control group, it can be assumed that the performance of learners must have been influenced by the use of computers using multimedia. Students from each group were given 60 minutes to complete the post-test.

Interview Schedule

An interview schedule is an instrument that can be used to gather in-depth information from an individual. It is used to obtain in-depth information about a participant's thoughts, knowledge, reasoning, motivations, attitudes, perceptions, experiences and feelings about a topic (Johnson & Christensen, 2000).

An interview has the following advantages (Bailey, 1994).

i. The interview is flexible and applicable to many different types of problems.

ii. It is flexible in the sense that the interviewer may change the mode of questioning if the occasion demands. If the responses given by the subject are unclear, questions can be rephrased.

iii. It is useful in collecting personal information, experiences, attitudes, perceptions or beliefs by probing for additional information.

iv. It promotes motivation and openness. Almost all interviews attempt to develop rapport between the interviewer and the respondent (interviewee). Once interviewees accept the interview as a non-threatening situation, they are more likely to be open and frank. This openness adds to the validity of the interview.

In the present study, a semi-structured interview schedule, consisting of five open-ended questions, was designed and conducted after completion of the experiment. The participants in the interview were physics teachers in

Adisadel College, selected using purposeful sampling. Each interview lasted about 10 - 15 minutes.

The purpose of the interview was to investigate the influence of the use of multimedia on students' performance in physics.

Reliability

In this study, the reliability and validity of the instruments (and data collected) were considered. The description of quality instruments used to collect data typically deals with these two related concepts, reliability and validity.

Reliability means consistency of the research instruments used to measure particular variables. Obtaining the same results when the instruments are administered again in a stable condition guarantees reliable instruments (De Vos. 2002). According to Makgato (2003), researchers evaluate the reliability of instruments from different perspectives, but the basic question that cuts across various perspectives (and techniques) is always the same: To what extent can we say that the data are reliable? To ascertain how reliable the measuring instruments that were used in this study, reliability coefficients (Cronbach's alpha) were calculated with coefficient 0.7.

Validity

The term validity refers to the extent to which an instrument measures what it intends to measure. According to Ary, Jacobs and Razavieh (1990), Validity addresses the following two questions (De Vos, 2002)

1. What does the research instrument measure?
2. What do the results mean?

The core essence of validity is captured nicely by the word accuracy. From this general perspective, a researcher's data are valid to the extent that results of the measurement process are accurate. The following process was implemented to ensure the validity of the research instruments:

The pre-test and post-test were based on West African Senior High School Certificate Examination (WASSCE) Physics Syllabus questions. The validity of the tests were also established by experienced physics teachers who were also examiners as they reviewed the face validity, content, clarity, construct validity, correctness and standard of questions with regard to the students level. Pilot testing is very helpful as it makes a researcher aware of any possible unforeseen problems that may emerge during the main investigation (Ntsohi, 2005). Based on the opinions and comments obtained from the teachers and lecturers and the pilot testing, the instruments were amended. Therefore, after the wide consulting of experts, incorporating their opinions and comments as well as pilot testing, it may be concluded that the instruments portray the desired level of construct validity.

Data Collection and Procedure

Achievement Tests was given to the students and their scores recorded. The results of the pre-test and post-test of the experimental and controlled groups before and after treatment was also compared. Interview was also used to collect some information on the physics teachers on themes that correspond with the use of multimedia in teaching physics.

Data Analysis

The data was analysed using both inferential and descriptive statistics. Data analysis for the scores from the achievement Tests and the survey results was completed using the Statistical Package for the Social Sciences (SPSS) software. The data was cleansed coded and entered into the SPSS software, and frequencies, percentages, mean and standard deviations determined for the survey data collected from the teachers .The t-value and mean of both the control and experimental groups were compared before and after treatment.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

In chapter four, the research method and design employed for this study is discussed. A pre-test , a post-test and an interview schedule were used. The results of the survey investigation is presented, analysed and interpreted. (See Appendix A, B and C respectively for the pre- test, post- test and interview schedule)

Table 1: Pre-Test Scores for the Experimental and Control Groups

STUDENTS	**Experimental group (Scores out of 60)**	**STUDENTS**	**Control group (Scores out of 60)**
1	44	1	42
2	40	2	35
3	42	3	42
4	35	4	43
5	42	5	51
6	43	6	48
7	51	7	41
8	48	8	43
9	41	9	42
10	43	10	47
11	42	11	40
12	47	12	35
13	40	13	46
14	35	14	46
15	46	15	45
16	45	16	46
17	46	17	45
18	45	18	45
19	45	19	35
20	35	20	39
21	39	21	50
22	50	22	42
23	42	23	42
24	42	24	42
25	42	25	43
26	43	26	38
27	39	27	45
28	43	28	40
29	41	29	33
30	39	30	35

Table 1 presents the pre-test scores of students in the experimental and control groups.

The questions given to students to be answered in terms of the pre-test and post- test were marked based on the marking scheme and marks awarded accordingly. From this, the scores of students and descriptive statistics were calculated and a null hypothesis was tested.

Table 2: Descriptive Statistics of the Experimental groups for the Pre-test

EXPERIMENAL GROUP	N	Minimum	Maximum	Mean	Std. Deviation
	30	35.00	51.00	42.5000	3.93700
Valid N (listwise)	30				

Table 3: Descriptive Statistics of the Control groups for the Pre-test

CONTROL GROUP	N	Minimum	Maximum	Mean	Std. Deviation
	30	33.00	51.00	42.2000	4.55919
Valid N (listwise)	30				

Pre-Test Hypothesis Testing

The following null hypothesis was tested in terms of the results of the pre-test as well as the post-test:

Ho: There is no significant difference between the mean scores of students in the experimental and control groups.

In both cases the null hypothesis was tested at the 0.05 level of significance. That is, the null hypothesis is rejected if $c_{calculated} \geq c_{ritical}$ and accepted if $c_{alculated} < c_{ritical}$. Student's t-test for independent groups was used to compare the two mean scores of the groups.

The Student's t-test was used because the samples were small. Best (1977) points out that when small samples are involved, the Student t-test proves to be an appropriate test to determine the significance of the difference between the means of two independent groups.

Table 4: Students T- Test Result for the Group Comparison (Pre- Test)

		N	Mean	Std. Deviation	Std. Error Mean
Control group	1.00	2	3.0000	1.41421	1.00000
Experimental group	2.00	3	7.0000	3.60555	2.08167

Table 5: Levenes Test for Equality of Variances

		F	sig	T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									lower	upper
EXPERIMENTALGROUP	Equal variances assumed	2.4	.23	1.43	3	.247	-4.00	2.78	-12.87	4.87
	Equal variances not assumed			-1.73	2.73	.19	-4.00	2.30	-11.76	3.76

An independent sample t test was conducted to compare the means of the experimental and the control groups of the pre-test. The results indicated that p-value 0.25 is greater than the 0.05 statistically significant value which is the cut-off point. Therefore it can be concluded that there is no statistically significant difference between the pre-test scores of the experimental and the control groups.

(M=3.00, SD= 1.41) for the control group and the experimental group (M=7.00, SD= 3.61); $t(3) = -1.43; p=0.25$. The magnitude of the difference in the means was 0.405 which depicts a large effect.

Table 6: Post Test Results for the Control and the Experimental Groups

CONTROL GROUP	SCORES	EXPERIMENTAL GROUP	SCORES
1	40	1	30
2	30	2	50
3	24	3	45
4	30	4	50
5	45	5	30
6	30	6	50
7	35	7	48
8	40	8	50
9	43	9	52
10	41	10	55
11	41	11	55
12	43	12	52
13	41	13	48
14	30	14	44
15	30	15	55
16	40	16	40
17	28	17	42
18	38	18	55
19	20	19	45
20	41	20	38
21	42	21	49
22	38	22	49
23	44	23	48
24	39	24	49
25	38	25	47
26	30	26	45
27	30	27	55
28	42	28	55
29	39	29	48
30	38	30	47

Table 7: Paired Sample T Test on the Post Test Results for the Control and Experimental Groups

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	CONT. GROUP	6.8000	30	3.08947	.56406
	EXP. GROUP	8.0333	30	3.37826	.61678

From the paired sample statistics, the means of the control group and that of the experimental group is compared. From the table seven above, the mean for the experimental group was higher with a value of 8.0 as compared to a value of 6.8 as the mean for the control group.

Table 8: Paired Sample Correlation on the Post Test Results for the Control and Experimental Groups

	N	Correlation	Sig.
CONTROL GROUP & EXPERIMENTAL GROUP	30	-.003	.989

Table 9: Paired Sample T Test for the Pre-Test and Post Test Data for theExperimental and Control Groups

	Paired Differences					t	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
CONTROL GROUP & EXPERIMENTAL GROUP	-1.23333	4.58396	.83691	-2.94501	.47834	-1.474	29	.151

A paired sample t test was calculated for the Pre-Test and post test data for the experimental and control groups. The p-value obtained from the analysis was 0.151 which is more than cut off point of 0.05.

It can be concluded therefore that there is no statistically significant difference between the pre test scores and that of the post test scores after the intervention was given.

To summarize a paired sample t –test was conducted to evaluate the impact of the intervention programme on student's achievement scores on some selected concepts in physics. There was no statistically significant increase in the students' achievement from the pre-test (M=6.8, SD=3.0) to the post test (M=8.0, SD=3.3), t(29)=-1.47, p>0.05=0.151.The eta squared statistics was 0.0805 indicated a large effect size.

Analysis of the Interview Results

Interview schedule for physics teachers based on the research questions and themes associated with the use of multimedia in teaching physics.

1. What multimedia tools are available in your school?

Some physics teachers were ask to identify some multimedia tools in the school and the following are some of the responses from the teachers:

Teacher A "We have a computer Laboratory with very few computers of which majority of them normally break down. We do not have hardware experts to repair the computers when they are broken down, more over we are not even allowed to use these computers for teaching our subjects except for teachers for ICT who teach our students basic ICT concepts as part of the GES curriculum.

In addition to these we have a microphone, speakers, televisions but they are not used for teaching and learning purposes for physics and other subject areas. I personally will be happy if the schools in conjunction with GES, PTA and other stake holders procure more multimedia tools that can be used in teaching and learning processes in isolation to the ones in ICT department for only ICT proficiency only. I will also suggest that training should be given in hardware repairs of these multimedia tools so that fast repairs can be done on the gadgets when they are broken up. "

Teacher B "We also have projectors / telejectors in our school. Unfortunately, the only projector we have is not used in teaching concepts in physics; rather it is used to show movies to entertain students, we seriously need more projectors/telejectors to support learning using multimedia to this effect the teachers can prepare vividly constructivist lessons which students will really appreciate and enjoyed to the highest degree. "

2. Should technology be compulsorily used in teaching physics?

   Teacher C; Yes ,with different technological tools integrated in our academics, the goal of constructivist learning will be achieved, this is not far from its importance from literature, "Teaching and learning physics supported by information and communication technologies offers an alternative to the solutions used in the traditional approach. The Internet, as the largest source, offers over 5000 multimedia learning materials for physics. The most widely used are video materials in the form of computer-generated simulations and animations and interactive research experiments. Multimedia study materials like still and animated graphics, video and audio integrated in a structured manner, compared to traditional textbooks, are confirmed to be much more efficient tools in adopting new knowledge (Sadaghiani, 2012; Stelzer, Gladding, Mestre & Brookes, 2009).

The use of multiple external representations in a multimedia learning environment has been shown to be an effective way to support learning and increase comprehension (Schnotz & Lowe, 2003), which directly relates to the cognitive theory of multimedia learning (CTML), where we can process more than one representation at the same time (Mayer, 2001). Multiple representations are useful in physics education as they foster students' understanding of physics problems, building a bridge between verbal and mathematical representations, and helping students to develop images that give meaning to mathematical symbols (Van Heuvelen & Zou, 2001). The simulations used in Physics teaching are computer programs that have an implicit model of behaviour of a physical system. This allows the students to explore and to visualise graphic representation (Concari, Giorgi, Camara & Giacosa, 2006). Learning with computer simulations is closely related to a specific form of constructivist learning, namely scientific discovery learning (van Joolingen, de Jong, Lazonder, Savelsbergh & Manlove, 2005).

The students can interact with the system by changing the parameters to the desired ones and observe the effect of those changes. Although simulations may be seen as the fastest and the best tool, they cannot substitute real laboratory experiences but can be used hand in hand with the intention of increasing the understanding of certain concepts. Properly designed simulations used in the right contexts can be more effective educational tools than real laboratory equipment, both in developing student facility with real equipment and in fostering student conceptual understanding (Finklestein, et al ,2005).

3. What are some of the achievement of multimedia on students' achievements?

Teachers "A,B,C" answers to this question can be summarized below which correspond to the assertions of Jonassen (1991a, p. 32) thirteen assertions about assessment and other matters in the constructivist classroom:

i. Technology can and will force the issue of constructivism
ii. Assessment will have to become outcome-based and student-centred
iii. Assessment techniques will have to reflect instructional outcomes
iv. "Grades" must be contracted wherever grades are required
v. There must be non-graded options and portfolio assessment
vi. Self-evaluation and peer-evaluation should be carefully and thoughtfully balanced with teacher assessment

vii. Performance standards that are easy to apply in practice need to be developed

viii. A grading system must be developed which provides meaningful feedback

ix. Technology can be used to facilitate communication with parents

x. Videotapes of learners working should be included as part of their portfolio

xi. The focus should be on originality and appropriate performance rather than on regurgitation

xii. It is important to evaluate how the learner goes about constructing his or her own knowledge rather than to focus exclusively on the end-product

xiii. Assessment is context dependent (Jonassen, 1991a, p. 32).

Table 10: Documentary Analysis

Multimedia Tools	Quantity
Televisions	3
Projectors	4
Computers	40
Storage Devices	5
Tablets	0
Modem	6
Printers	5

Documentary Analysis

The total population of Adisadel College is around one thousand five hundred (1500) students. The student to multimedia ratio is calculated as the total number of users divided by the available multimedia tool. According to (Tabs, 2002,p.5) the standard ratio should be equivalent to “4- to 5-students-per-computer ratio that many experts consider reasonable for effective use of computers in schools” This implies that the students in Adisadel College ratio to the various multimedia Tools are as follows;

Table 11: Ratio of Students Multimedia Use

Multimedia Tools	Quantity(N)	Ratio (1500/N)
Televisions	3	500
Projectors	4	375
Tablets	0	1500
Computers	40	37.5
Storage Devices	5	300
Modem	6	250
Printers	5	300

In the table 11, it is clear that student to each multimedia use in Adisadel College is far beyond the accepted standard of the experts. Hence there is an inadequate multimedia tool to support teaching and learning physics in Adisadel College.

CHARPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Overview

The purpose of this study was to investigate whether the use of computers in the teaching and learning of some physics concepts influences students' understanding of the various concepts of topics in Physics as reflected in their achievement, motivation, attitude, problem-solving skills. This chapter summarizes the findings, draws conclusions and makes recommendations.

Summary of the Findings

The findings from the pre-test showed that the mean performance of the experimental group wasn't significantly different from the mean performance of the control group. This indicated that the two groups could be comparable before the experiment started in terms of their understanding of concepts as measured by a performance test.

The findings from the post-test showed that the mean performance of the experimental group was significantly higher than the mean performance of the control group. This indicated that the use of computers had a positive impact on students' understanding of Physics concepts. Also the interviews analysis showed that the use of computers can positively influence students' learning (understanding) of concepts in terms of problem-solving. To add to the above the documentary analysis shows there are inadequate multimedia tools in teaching physics.

Conclusions

The main purpose of this research was to compare whether there is a significant statistical difference between the use of computers in teaching and understanding of various physics concepts as compared to the normal traditional lecture method of teaching.

The results of this investigation indicated that the use of computers had a positive impact on students' achievement, which are similar to the findings reported in the literature. Students can easily understand various concepts in physics and solve varied forms of problem given to them if they are taught using computers.

Students can be encouraged to explore the nature and properties of physics concepts on their own, work in a group, discuss concepts and verify their findings using computers.

The provision of computers and varied forms of Technology will help students to learn physics topics and concepts through constructivist methods better than the traditional way of teaching and learning.

Recommendations

More use of computers and technology by physics teachers should be employed to research into the various concepts and topics in physics so as to come out with best technological methods of teaching physics.

Teachers and various curriculum designers should be educated on the benefits of using technology and computers in teaching and learning so as to help better understanding of students.

Physics teachers should be trained efficiently by GES with the various ways and software that could be used to teach the various concepts so as to enhance their methods of teaching which

in the long run affects students' performance.

Technology integration units should be established in our regional and district education offices to relay any training and technical assistant teachers and students will need to effectively use computers and technology in teaching and learning based from the responses from the interview question three by teachers A, B, C.

Suggestions for further Research

This study should be repeated with the following modifications.

1. The potential gap between what teachers think and what teachers actually do in using multimedia in the classroom.
2. A larger and inter-regional based sample including Junior High School students should be tested.
3. Investigations could be done on teachers perspectives on the use of multimedia in other subjects such as chemistry and biology.

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APPENDICES

APPENDIX A

PRE-TEST

MATTER AND MOTION

1. A car takes off from rest and covers a distance of 80m on a straight road in 10s.calculate the

   Magnitude of its acceleration.

   a. 1.25 ms^{-2}
   b. 1.60 ms^{-2}
   c. 4.00ms^{-2}
   d. 200 ms^{-2}

2. What type of motion does the skin of a 'talking' drum perform when it is struck with a drum stick?

   a. Random
   b. Rotational
   c. Translational
   d. Vibratory

3. A attached to a string is moving in a circular path. If the speed is doubled, the tension in the string will be.

   a. Doubled
   b. Halved
   c. Four times as great
   d. One fourth as much

4. Roads are banked in order to
   a. Reduce friction
   b. Slow down the speed of the car
   c. Facilitate smooth negotiation of curves
   d. Reduce the momentum of a car.
5. A body orbits a circular path at 2.5rad/s .If it covers 50m in 4s, calculate the circumference of the path. [π =3.142]
   a. 15.7m
   b. 16.0m
   c. 31.4m
   d. 50.0m
6. A body in circular motion experiences a force which is
   a. Directed towards a fixed point
   b. Proportional to the radius of the circular path
   c. Proportional to the velocity
   d. Proportional to the square of the radius of the path
7. A body makes 5 complete revolutions in 4.0s. Calculate its angular speed .
   a. 0.8 $\pi rads^{-1}$
   b. 2.5 $\pi rads^{-1}$
   c. 4.0 $\pi rads^{-1}$
   d. 5.0 $\pi rads^{-1}$

8. A ball bearing is projected vertically upwards from the ground with a velocity of 15m/s. Calculate the time taken by the ball to return to the ground (g = 10ms^{-2})
   a. 1.5s
   b. 3.0s
   c. 5.0s
   d. 7.5s
9. At the instant of its release , a freely falling body has
   a. Zero velocity and zero acceleration
   b. Zero velocity and constant acceleration
   c. Maximum velocity and zero acceleration
   d. Maximum velocity and constant acceleration
10. A body is projected vertically upwards with a speed of 10m/s from a point 2m above the ground. Calculate the total time taken for the body to reach the ground. [g =10m/s^2]
   a. 1.00s
   b. 2.00s
   c. 2.18s
   d. 3.00s
11. A bob of a simple pendulum has a mass of 0.02kg.Determine the weight of the bob [g =10m/s^{-2}]
   a. 0.02N
   b. 0.20N
   c. 20.00N
   d. 200.0N

12. The period of oscillation of a particle executing simple harmonic motion is 41 seconds. If the amplitude of oscillation is 3.0m, calculate the maximum speed of the particle.

    a. 1.5m/s
    b. 3.0m/s
    c. 4.5m/s
    d. 6.0m/s

LIGHT ENERGY, WAVE MOTION AND HEAT ENERGY

13. The image of an object is located 6cm behind a convex mirror. If its magnification is 0.6, Calculate the focal length of the mirror.

    a. 3.75 cm
    b. 6.60 cm
    c. 10.0 cm
    d. 15.0 cm

14. The real image of an object, formed by a converging lens of focal length 15cm ,is three times the size of the object. Calculate the object distance.

    a. 60 cm
    b. 30 cm
    c. 20 cm
    d. 15 cm

15. A concave mirror can be used to produce a parallel beam of light if a lighted bulb is placed.

    a. Between its focus and the pole
    b. At its focus

c. At its center of curvature

d. Between its focus and center of curvature

16. A simple microscope forms an image 10cm from an eye close to the lens. If the object is 6cm from the eye, calculate the focal length of the lens.

    a. 4.5 cm

    b. 3.75 cm

    c. 1.50 cm

    d. 16.00 cm

17. A converging lens produce an image four times as its focal length. calculate its focal length

    a. 100 cm

    b. 33 cm

    c. 29 cm

    d. 20 cm

18. An object is placed in front of two plane mirrors inclined at 60^0 to each other. Determine the number of images formed formed.

    a. 2

    b. 3

    c. 5

    d. 7

19. At what distance from a simple microscope must an object be placed so that an image 5 times the size of the object is produced 20cm from the lens?

    a. 2.0 cm

b. 3.3 cm

c. 4.0 cm

d. 5.0 cm

20. What part of the camera corresponds to the iris of the eye?

a. Shutter

b. Film

c. Lens

d. Diaphragm

21. Which of the following characteristics of an image formed by a diverging lens is correct?

a. Erect and virtual

b. Inverted and virtual

c. Inverted and real

d. Erect and real

22. The separation of white light into its component colours using a glass prism is known as

a. Dispersion

b. Diffraction

c. Reflection

d. Refraction

23. Which of the following types of waves is an electromagnetic ?

a. Infra-red radiation

b. Sound wave

c. Seismic waves

d. Electron wave

24. Which of the following phenomena of light can be explained only by wave model?
    a. Interference
    b. Refraction
    c. Reflection
    d. Photoemission

ELECTRICITY AND MAGNETISM

25. A microphone converts sound energy into
    a. Light
    b. Mechanical energy
    c. Heat energy
    d. Electrical energy
26. A wire of length 100cm has a resistance of 10Ω. If its cross sectional area is 0.005cm^2, determine its resistivity.
    a. 0.0005Ωcm
    b. 0.0015Ωcm
    c. 0.0016Ωcm
    d. 0.0700Ωcm
27. A tin – lead alloy is in making fuses because of its
    a. Low resistivity
    b. High resistivity
    c. Low expansivity
    d. Low melting point

28. A voltmeter is a device that
    a. Draws high current
    b. Has a very low resistance
    c. Has a very high resistance
    d. Is able to measure both voltage and current
29. A current of 10A passes through a conductor for 10s, calculate the charge flowing through the conductor .
    a. 100.00
    b. 10.00
    c. 1.00
    d. 0.1
30. An ammeter can be adapted to measure potential difference by using a
    a. Shunt
    b. Multiplier
    c. Rheostat
    d. Resistance box
31. Calculate the terminal potential difference across a 200 resistor connected to a battery of emf 15V and internal resistance of 5Ω.
    a. 60.0V
    b. 15.0V
    c. 12.0V
    d. 6.3V
32. Which of the following is not a conductor of electricity?
    a. Human body
    b. Glass

c. Silver

d. Earth

33. A lamp is rated 240V 60W , calculate the resistance of its filament.

a. 240Ω

b. 360Ω

c. 960Ω

d. 1440Ω

34. The function of the manganese (IV) oxide in a Leclanche cell is to

a. Decrease the emf of the cell

b. Prevent local action in the cell

c. Prevent polarization in the cell

d. Increase the density of the the electrolyte

35. Which of the following is stored by a dry Leclanche cell?

a. Chemical energy

b. Nuclear energy

c. Solar energy

d. Electrical energy

36. Which of the following particles conduct electricity through salty water?

a. Atom

b. Molecules

c. Electrons

d. Neutrons

ATOMIC PHYSICS

37. Which of the following is correct about cathode rays? They are fast moving
    a. Atoms
    b. Ions
    c. Neutrons
    d. Electrons
38. The minimum energy required to remove an electron from an atom is known as
    a. Excitation energy
    b. Ionization energy
    c. Binding energy
    d. Photon energy.
39. The process of increasing the energy of an atom by inelastic collision with an electron is called
    a. Ionization
    b. Thermionic emission
    c. Excitation
    d. X – ray emission
40. There is always an certainty involved in any attempt to measure the position and momentum of an electron . This statement is known as the?
    a. Broglie's law
    b. Heisenberg uncertainty principle
    c. Franck – Hert experimental law

d. Wave – particle paradox

41. Bohr's theory provides evidence for the

a. Structure of the atom

b. Positive charge of an electron

c. Existence of energy levels in the atom

d. Positive charge on a proton

42. Which of the following is not an evidence of the particle nature of matter ?

a. Diffusion

b. Brownian motion

c. Diffraction

d. Crystal structure

43. The process by which when a metal is heated to high temperature , gives off electrons from its surface is known as

a. Photoelectric emission

b. Thermionic emission

c. Radioactive emission

d. Field emission

44. From Einstein's mass – energy equation , Energy , E is proportional to the

a. Change in nuclear charge

b. Mass defect

c. Mass of reactants

d. Mass of the products

45. The duality of matter implies that matter

    a. Exists as a particle of dual composition

    b. Has momentum and energy

    c. Has both wave and particle properties

    d. Is made up of dual materials

46. In which of the following devices is the principle of photoelectric effect not applicable?

    a. Closed circuit television camera

    b. Burglar alarm

    c. Solar cells

    d. Periscope

47. The following occurrences are used to explain the particle nature of matter except .

    a. Thermionic emission

    b. Diffraction

    c. Absorption of light

    d. Radiation of energy from heated bodies

48. Production of x- rays in an x- ray tube begins with

    a. Photoelectric emission

    b. Collision of electrons

    c. Thermionic emission

    d. Fi

    e. eld emission of electrons

NUCLEAR PHYSICS AND ELECTRONICS

49. When an atom is in the ground state it is said to be
    a. Grounded
    b. Excited
    c. Stable
    d. Ionized
50. Which of the following particles / rays does not originate from the nucleus of an atom?
    a. Alpha particles
    b. Beta particles
    c. Neutrons
    d. X – rays
51. The phenomenon of radioactivity was first discovered by
    a. Marie curie
    b. J.J Thompson
    c. Henri Becquerel
    d. Neil’s Bohr
52. Which of the following is used in a nuclear reactor to slow down fast moving neutrons?
    a. Carbon dioxide gas
    b. Liquid sodium metal
    c. Concrete shield
    d. Boron rods

53. Which of the following have the greatest penetrating power?

    a. Beta rays
    b. Alpha rays
    c. Gamma ray
    d. Electrons

54. The minimum energy required to remove an electron from an atom is known as

    a. Excitation energy
    b. Ionization energy
    c. Binding energy
    d. Photon energy

55. Which of the following is usually used to cause fission in an atomic reactor?

    a. Alpha particles
    b. Beta particles
    c. Electrons
    d. Neutrons

56. A high – speed electron emitted from a nucleus radioactive decay is called a/ an

    a. Alpha particle
    b. Beta particle
    c. Gamma ray
    d. X- ray

57. The energy required to separate the nucleons of an atom completely is the
    a. Work function
    b. Binding energy
    c. Ionization potential
    d. Excitation energy
58. If a radioactive atom emits a beta , its mass number
    a. Increases by two
    b. Increases by one
    c. Remains the same
    d. Decreases by one
59. The splitting up of an atomic nucleus into two fragments of nearly equal sizes is known as
    a. Nuclear fusion
    b. Nuclear fission
    c. Half – life
    d. Radioactive decay
60. Which of the following emissions do not emanate from the nucleus of an atom?
    a. Alpha particles
    b. Beta particles
    c. Gamma rays
    d. X - rays

APPENDIX B

POST TEST

MATTER AND MOTION

1. A pendulum bob executing simple harmonic motion has 2cm and 12Hz as amplitude and frequency respectively. Calculate the period of the motion.
   a. 2.00s
   b. 0.83s
   c. 0.08s
   d. 0.06s
2. The bob of simple pendulum takes 0.25s to swing from its equilibrium position to one extreme end. Calculate its period.
   a. 0.25s
   b. 0.50s
   c. 0.75s
   d. 1.00s
3. A swinging pendulum between the rest position and its maximum displacement possesses
   a. Kinetic energy only
   b. Potential energy only
   c. Gravitational energy only
   d. Both kinetic and potential energy
4. The period of a body in simple harmonic motion is 0.0025 seconds .calculate its frequency .
   a. 0.0025Hz

b. 250.0Hz

c. 400.0Hz

d. 500.0Hz

5. A 150kg body is at rest .calculate the constant force needed to impact a velocity of $8ms^{-1}$ to it in 5s.

   a. 600.0N

   b. 300.0N

   c. 240.0N

   d. 180.0N

6. A ball of mass 5.0kg hits a smooth vertical wall normally with a speed of 2m/s. determine the magnitude of the resulting impulse .

   a. 20.0kgm/s

   b. 10.0kgm/s

   c. 5.0kgm/s

   d. 2.5kgm/s

7. A body of mass 1kg is whirled round in a horizontal circle of radius 2m at a speed of 10m/s. calculate the centripetal force on the body.

   a. 5N

   b. 20N

   c. 50N

   d. 100N

8. Which of the following has the highest surface tension

   a. Cold water

   b. Soapy water

   c. Warm water

d. Oily water

9. The force between the molecules of a liquid in contact with that with that of a solid is
   a. Adhesive
   b. Cohesive
   c. Magnetic
   d. Repulsive
10. The force of attraction between like molecules of a substance is called
   a. Adhesion
   b. Tension
   c. Cohesion
   d. Friction
11. Which of the following substances is most viscous at room temperature?
   a. Water
   b. Alcohol
   c. Petrol
   d. Palm oil
12. The odour of a leaking gas is perceived at a distance from the source .this is made possible by the process of
   a. Sublimation
   b. Diffusion
   c. Osmosis
   d. Evaporation

LIGHT ENERGY, WAVE MOTION AND HEAT ENERGY

13. The image in a pin – hole camera is always
    a. Diminished
    b. Enlarge
    c. Upright
    d. Inverted
14. An image which cannot be formed on a screen is said to be
    a. Inverted
    b. Real
    c. Virtual
    d. Erect
15. Which of the following statements about the image of an object formed by a plane mirror is not correct?
    a. Same size as the object
    b. Laterally inverted
    c. Virtual and erect
    d. Erect and magnified
16. A piece of cloth appears green in sunlight when held in red light, it will appear
    a. Green
    b. Blue
    c. Red
    d. Black

17. When a ray of light is incident normally on an air – glass interface ,its angle of refraction is [refractive index , n=1.5]

    a. 0^0

    b. 12^0

    c. 42^0

    d. 60^0

18. The change of direction of wave front because of change in velocity of the wave in another medium is called.

    a. Refraction

    b. Reflection

    c. Diffraction

    d. Interference

19. Which of the following is used for controlling the amount of light entering the eye?

    a. Cornea

    b. Pupil

    c. Iris

    d. Optic nerve

20. A fish appears to be 2m below the surface of a pond when viewed directly from above. How far is the fish below the surface of the pond. [refractive index of water =1.33].

    a. 2.66m

    b. 0.66m

    c. 1.67m

    d. 1.50m

21. Which of the following pairs of light rays shows the least separation in the spectrum of white light.
    a. Green and blue
    b. Orange and indigo
    c. Blue and violet
    d. Red and yellow
22. The ability of the eye to focus objects at different distance is called
    a. Power
    b. Accommodation
    c. Normal vision
    d. Persistence vision
23. Longitudinal waves cannot be
    a. Diffracted
    b. Refracted
    c. Polarized
    d. Reflected
24. Which of the following radiations have the highest frequency?
    a. Radio waves
    b. Light waves
    c. X –rays
    d. Infra red rays

ELECTRICITY AND MAGNETISM

25. The time rate at which an electric charges flow in a circuit is measured in
    a. Tesla
    b. Ampere
    c. Volt
    d. Farad
26. A current of 2.0A passes through a conductor for 50s. Determine the quantity of electric charge that flows through it in the given time.
    a. 0.04C
    b. 25.0C
    c. 50.0C
    d. 100.0C
27. A car fuse marked 3A operates optimally on a 12V battery. Calculate the resistance of the fuse.
    a. 36.0Ω
    b. 15.0Ω
    c. 9.0Ω
    d. 4.0Ω
28. Which of the following factors does not affect the electric resistance of a wire?
    a. Length
    b. Mass
    c. Temperature
    d. Cross sectional area

29. Calculate the terminal potential difference across a 200 resistor connected to a battery of emf 15V and internal resistance of 5Ω.

    a. 60.0V
    b. 15.0V
    c. 12.0V
    d. 6.3V

30. A bulb marked 240V , 40W is used for 30 minutes. Calculate the heat generated.

    a. 320 J
    b. 400 J
    c. 10800 J
    d. 72000 J

31. Which of the following items can be used to compare the relative magnitudes of electric charges on two bodies?

    a. Ebonite rod
    b. Gold leaf electroscope
    c. Proof planes
    d. The electrophorus

32. When positively charged rod is brought near a positively charged gold – leaf electroscope, the leaves of the electroscope are observed to

    a. Collapse
    b. Diverge
    c. Remain unaffected
    d. Collapse and then diverge

33. As the plates of a charged variable capacitor are moved closer, together the potential difference between them .

    a. Increases
    b. Decreases
    c. Remain the same
    d. Is doubled

34. The capacitance of a parallel – plate capacitor is increased by making the area of the plates

    a. Small and their separation large
    b. Large and their separation small
    c. And their separation small
    d. And their separation equal

35. Which of the following components is used for storing electric charges?

    a. Inductor
    b. Resistor
    c. Capacitor
    d. Electrometer

36. The two parallel plates in a capacitor are separated by

    a. Salt
    b. Electrolyte
    c. Dielectric
    d. Electric charges

ATOMIC PHYSICS

37. Which of the following gives rise to the line spectrum obtained from atoms?
    a. Kinetic energy of a moving atom
    b. Potential energy of an electron inside an atom
    c. Change of an electron from a higher to lower energy level in the atom
    d. Disturbed proton in the nucleus
38. When light falls on a metallic surface, the number of electrons that may be emitted would depend solely on the
    a. Area of the metallic surface
    b. Frequency of the light
    c. Intensity of the light
    d. Time of exposure of the metallic surface to light
39. In the J.J Thompson model of the atom , electrons are
    a. Uniformly dispersed within positive charges in a spherical space
    b. Centrally located with a cloud of positive charges
    c. In orbits around a central positive charge
    d. Centrally located with positive charges orbiting them.
40. A metal is illuminated with a radiation of energy 6.88eV . If the kinetic energy of the emitted electrons is 1.50eV, calculate the work function of the metal.
    a. 0.22eV
    b. 4.5eV
    c. 5.38eV
    d. 8.38Ev

41. Which of the following are the essential parts of an atomic bomb?

    a. Uranium and neutrons
    b. Radium and polonium
    c. Nitrogen and neutrons
    d. Uranium and α particles

42. In a photocell , light energy is converted to

    a. Electrical energy
    b. Chemical energy
    c. Heat energy
    d. Mechanical energy

43. Electrons passing through crystals are diffracted because they

    a. Are repelled by the atoms in the crystal
    b. Are attracted by the atoms in the crystal
    c. Possesses wave properties
    d. Are particles

44. When the surface of a piece of chalk is scrapped , the tiny particles that flake off are known as

    a. Matter
    b. Molecules
    c. Elements
    d. Atoms

45. The intercept on the frequency axis and slope of the graph of maximum kinetic energy of photoelectrons against frequency of the incident radiation represent respectively

    a. Threshold frequency and Planck's constant

b. Threshold wavelength and work function

c. Threshold wavelength and threshold frequency

d. Work function and threshold frequency

46. The charge to mass ratio of a proton is 9.58 x 10^{7}C/kg, calculate the mass of the proton. [electronic charge e = 1.6 x 10^{-19}C]

a. 1.67x10^{-27}kg

b. 5.92 x 10^{-27}kg

c. 7.98 x 10^{-27}kg

d. 15.30 x 10^{-27}kg

47. Light of energy 5.0eV falls on a metal of work function 3.0eV and electrons are emitted. Determine the stopping potential .[electronic charge e = 1.60 x 10^{-19}C]

a. 1.7V

b. 2.0V

c. 8.0V

d. 15.0V

48. A metal has a work function of 4.375eV, calculate its threshold frequency . [h =6.6 x10^{-34}Js, 1eV = 1.6 x10^{-19}J]

a. 2.01 x 10^{-15}Hz

b. 1.06 x 10^{-15}Hz

c. 6.30 x 10^{-14}Hz

d. 1.30 x 10^{-14}Hz

NUCLEAR PHYSICS AND ELECTRONICS

49. Which of the following is not correct about isotopes of an element? They have
    a. The same neutron number
    b. The same proton number
    c. The same number of electrons
    d. The same chemical properties
50. If a nucleus $^{3}_{1}H$ decays , a nucleus $^{3}_{2}He$ is formed accompanied with the emission of a
    a. Neutron
    b. Proton
    c. Beta particle
    d. Gamma particle
51. Which of the following are emitted from a radioactive substance without altering either the nucleon number or the proton number of the substance?
    a. Gamma rays
    b. Alpha particles
    c. Beta particles
    d. Protons
52. The count rate of an alpha – particle source is 400 per minute, if the half life of the source is 5 days , what would be the count rate per minute after 15 days?
    a. 20
    b. 25

c. 50

d. 200

53. What is the decay constant of a radioactive element whose half life is 3 seconds?

a. $0.132s^{-1}$

b. $0.235s^{-1}$

c. $0.347s^{-1}$

d. $0.693s^{-1}$

54. The nucleon number and the proton number of a neutral atom of an element are 23 and 11 respectively. How many neutrons are present in the atom?

a. 11

b. 12

c. 23

d. 34

55. Which of the following statements is not true of the isotopes of an element? They

a. Are atoms of the same element

b. Have the same chemical properties

c. Have the same atomic number

d. Have the same mass number

56. The half life of a radioactive substance is 14 days .If 48 kg of this substance is stored, after how many days will 1.8 kg of the original substance remain.

a. 84 days

b. 70 days

c. 56 days

d. 40 days

57. In 90 seconds, the mass of a radioactive element reduces to 1/32 of its original value .Determine the half – life of the element.

a. 45s

b. 36s

c. 18s

d. 16s

58. In nuclear reactor , chain reactions result from the release of

a. Electrons

b. Photons

c. Neutrons

d. Atoms

59. Beta particles are fast moving

a. Protons

b. Electrons

c. Neutrons

d. Photons

60. When a radioactive substance undergoes beta decay ,its

a. Mass number decreases by 1

b. Atomic number decrease by 1

c. Mass number increases by 1

d. Atomic number increases by 1

APPENDIX C

INTERVIEW QUESTIONS

UNIVERSITY OF CAPE COAST

The Interview Questions is meant to gather information on the effect of multimedia usage in teaching Physics at Adisadel College, Cape Coast Municipality

Please tick (√) where applicable.

Interview schedule questions for physics teachers based on the research questions and themes associated with the use of multimedia in teaching physics.

1. What multimedia tools are available in your school?
2. Should technology be compulsorily used in teaching physics?
3. What are some of the achievement of multimedia on students' achievements?