UNIVERSITY OF CAPE COAST

SCIENCE TEACHERS' PERCEPTION OF THE USE OF EDUCATIONAL COMPUTER GAMERS IN SELECTED SENIOR HIGH SCHOOLS IN AKWAPIM NORTH DISTRICT

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BY

ABIGAIL LARBI

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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: ……..

Supervisors' Declaration

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

Supervisor's Signature ……. Date …….

Name: ……

ABSTRACT

Information and Communication Technology (ICT) has become a household name for any country that wants to develop education. ICT has received significant attention from successive governments over the past decade at the senior high school level. Teaching and learning have evolved over the years from the traditional instructivism, to the constructivism approach where learners have become active organism with expectations and the teacher becoming a facilitator. The aim of the study was to investigate the use of ICT as a constructivist approach to the teaching and learning of Physics m Swedru senior high school. The study was underpinned by the constructivist theory. The study adopted a quantitative research approach and descriptive research design. There is no approach like this in the main work and simple random sampling techniques were used in this research The sample size was 206 students who were randomly selected and 8 science teachers who were purposely selected. Questionnaire was used as a research instrument for data collection. Descriptive statistical tools were used in analysing the data. The study revealed that the use of ICT in the teaching and learning of Physics were perceived to develop diverse learning, critical thinking and active student participation which improve student's performance in the subject. It was recommended that, the Government should adopt ICT as a constructivist approach to the teaching and learning of Physics in junior high schools by providing the necessary logistics and infrastructure so that they can use ICT resources to enhance teaching and learning.

DEDICATION

To my daughter Persis Nettey.

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CHAPTER ONE

INTRODUCTION

Background to the Study

The introduction of information and communication technology in education has changed the traditional learning concept and provided the verification of learning independent from time and place. It is known that web-based educational software provides motivation to learners and contributes to meaningful learning (Eady & Lockyer, 2013). According to Eady and Lockyer (2013), teaching methods and instructional techniques in the classrooms have been changing and this is influenced by technological advancements. Digital technologies have penetrated almost every aspect of our lives. In the digital age the potential of educational technologies in schools cannot be ignored considering the new possibilities like teaching with educational computer games (Alvarez, Brown & Nussbaum, 2011; Melhuish & Falloon, 2010). Technology is ever present in our generation and making full use of these educational computer games for teaching and learning is becoming more necessary to engage and to teach essential skills to our students (Thierer, 2015). Most notably among these technologies are computers, laptops, cellphones, televisions, and even cars are considered technologically "smart" nowadays (Dominguez, Saenz-de-Navarrete, de-Marcos, Fernandez-Sanz, Pages & Martinez-Herraiz, 2013).

While all these technologies are ever present in our daily lives, the role of computers in education cannot be overstated (Ahiatrogah & Barfi, 2016; Mafouz

& Ihmeideh, 2009). Computers provide users the opportunity of visual interactivity (Tobarra, Robles-Gomez, Ros, Hernandez & Caminero, 2014) and as a learning tool (Dominguez et al., 2013; Connolly, Boyle, MacArthur, Hainey & Boyle, 2012). Prominent among computer being used as visual interactive and learning tool is game based learning and its application in science education. While the debate on the definition of what a game is will linger among scholars (Salen & Zimmerman, 2004, cited in Plass, Homer & Kinzer, 2015), Plass et al., (2015) is of the view that the design process of games for learning involves balancing the need to cover the subject matter with the desire to prioritize game play" (p. 259). Pass et al. (2015) reiterate that some of the concepts that are important in the context of games, such as motivation, have aspects relating to different theoretical foundations-cognitive, affective, motivational and sociocultural. They further concluded by arguing that "for games to achieve their potential for learning, all these perspectives have to be taken into account, with specific emphases depending upon the intention and design of the learning game" (Plass et al., 2015, p. 258).

Educational computer games offer much potential to make the scientific inquiry process more engaging by providing a rich and interactive environment that challenges students to solve a complex problem in a meaningful context (An, 2015). He further stressed that educational computer games enable students to gather information and evidence from multiple sources using authentic tools. Liaw, Hatala and Huang (2010) reported that the fast spread of the computer games in education and other relevant technologies parallel to the rise in internet

access options and has altered the nature of education thoroughly. Due to the evidence of motivational qualities of educational computer games, educators and trainers alike seek to use them for instruction (Tobias, Fletcher & Wind, 2014). Zhang and Aikmain (2007) reiterated this view and added that because of the usefulness of computer games, most academic institutions are using it as part of their teaching delivery in most developing countries.

Computer games are well suited to the teaching and learning of science subjects because they enable students to learn by doing and develop transferable knowledge (An & Bonk, 2009). Research conducted in the United States of America reported that while 97% of teachers used digital games created for educational use, 80% of learners would be more productive if learning was gamer like (Dichev & Dicheva, 2017). This study further reported that 70% of teachers saw increase in student engagement when using educational video games. Shaffer, Squire, Halverson and Gee (2005) are of the view that the use of computer games in teaching science allows students to practice newly learned skills in a variety of situations. Unlike traditional content-focused standards, the computer games for learning science are written as performance expectations that depict what students should be able to do beyond what they should know to show proficiency in the science subject (An, 2015).

Educational possibilities for enhanced learning with computer games clearly exist, and there are growing view that, guided effectively by teachers, they offer the potential for a new and exciting era in education (Kozma, 2008). Computer games offer new capabilities and opportunities for learning, mainly in

terms of their flexibility, mobile capabilities, and ease of use (Hu & Garimella, 2014).

The integration of technology, especially educational computer games in teaching and learning is rapidly becoming one of the most important and widely necessity in most education policy in the developed world (Thierer, 2015). Ghana as a developing country undoubtedly falls within this category (Agyei, 2013). Integrating educational computer games in classroom instruction ensures greater motivation, increases self-esteem and confidence, enhances good questioning skills, promotes initiative and independent learning (Ministry of Education, 2002). The use of educational computer games in the classroom also improves presentation of information or outputs, develops problem solving capabilities, promotes better information handling skills, increases focus time on task, improves social and communication skills for both teachers and students (GES, 2002).

The Government of Ghana has developed a policy on ICT usage in education. However, the success of the project as a result of the policy has implications. Simply having computers in schools will not guarantee their effective use by teachers for classroom instruction, instead, teachers must have the competence and the right attitude towards technology Tchombe (2008) reported that it is not just acquiring the knowledge of ICT that is important but also teachers need to understand how to use ICT pedagogically in their lesson delivery. Tchombe (2008) further asserted that computer games for teaching and learning, if used appropriately, can stimulate the development of higher cognitive

skills of students, deepen learning and contribute to the acquisition of skills needed for lifelong learning and for working in today's job market.

As an effort to facilitate imagination and creativity among students, conscious efforts are being made by the Ghanaian government to spread the use of ICT in school teaching and learning (GES 2002; Republic of Ghana, 2003). Computer games play a vital role in achieving imagination and creativity in classroom activity (Motamedi & Bakhtiary, 2014) and undoubtedly when it comes to teaching science subjects (Marino, Israel, Beecher & Basham, 2013). Yet, there is paucity of data when it comes to integration of computer games into classroom instruction in Ghana, especially in Akwapim North District of Ghana.

It is against this background that the study seeks to examine science teachers' perceptions towards the use of educational computer games in selected Senior High Schools (SHSs) in Akwapim North District of Ghana.

Statement of the Problem

There is a movement to leverage computer games as a part of the learning process, since educational computer games are changing education curricula in most developed countries and are more than a form of entertainment (Shaffer et al., 2005). Through educational computer games, students learning can be enhanced by experiences in vast virtual worlds (Shaffer et al., 2005). These worlds, according to Shaffer et al. (2005) "can allow students to interact as a community because they make it possible to develop situated understanding" (p. 106). This means that students are able to actually experience and experiment

with things that they are learning rather than simply being told as facts or equations.

A study by EDUCAUSE suggests that in as much as educational games are important for educational purpose; instructors need be aware of computer games that could be helpful to them in class learning experience (Hitch & Duncan, 2005). Educational games should have tactical and strategy features to enhance the level of understanding and engagement with the material (Hitch & Duncan, 2005). A study of a computer game relating to numerical analysis in an engineering curriculum found that "students experienced significantly more intellectual intensity, intrinsic motivation, positive affect and overall student engagement when completing homework" (Coller & Shernoff, 2009). The current generation is exceedingly comfortable with technology and electronic entertainment. One study noted that the average American youngster now spends one-third of each day with some form of electronic media (Escobar- Chaves & Anderson, 2008).

Computer game utilization has become common practice for vast majority of teachers and has been integrated into teaching and learning (Schmidt & Vanderwater, 2008). Although, the appropriate use of educational computer games can stimulate the development of higher cognitive skills, deepen learning and contribute to the acquisition of skills needed for learning (Andersen, 2012), it is vital to note that computer-based games are there to complement instructors. While the Government of Ghana has been trying to provide teachers and students with Information Communication and Technology (ICT) (Barfi & Ahiatrogah,

2016), little has been said about the effectiveness of integrating computer games into teaching and learning. Questions could also be asked about teachers' competencies in using these resources, support services at schools, training services for teachers, just to mention a few. While, these are not the main concerns of the researcher, these concerns play a pivotal role in teachers' decisions in integrating computer games into teaching. Although, there is evidence on the role that educational computer games play in teaching and learning outcomes, especially in science subjects (Coller & Shernoff, 2009, Tchombe, 2008), the paucity of data available on educational computer games in Ghana raises questions whether science teachers in Ghanaian Senior High School are aware of the role of educational computer games not to talk about its integration into teaching and learning. Is it the non-availability of the educational games or the science teachers do not have the needed knowledge levels to integrate computer games in their teaching?

While it is reported that some teachers often remain resistant to technology integration as technology tends to disrupt traditional classroom practices (Collins & Halverson, 2015), knowledge and practice of using educational games in classroom activities cannot be overstated. Gaining an appreciation of teachers' perception and attitude concerning related use of educational computer games in the classroom provided useful insight into the future of technology acceptance, integration and usage in teaching and learning of Science subjects in Senior High Schools (SHSs) in Ghana. Hence, this researcher seeks to examine science teachers' perception related to the use of educational

computer games in selected SHSs in Akwapim North District in the Eastern Region of Ghana.

Purpose of the Study

The purpose of this study seeks to examine science teachers' perception related to the use of educational computer games in selected SHSs in Akwapim North District in the Eastern Region of Ghana. Klein and Freitag (2006) conducted a study to determine the effect of an instructional computer game on motivation and performance. The results indicate that playing a relevant instructional game significantly increases students' motivation in terms of gaining attention and instilling confidence and satisfaction on students.

Objectives of the Study

This study seeks to investigate science teachers' perception towards the use of educational computer games in selected Senior High Schools in Akwapim North District. The specific objectives of the study are to:

1. Determine the extent of computer education games being used in the teaching and learning of science in Akwapim north district senior high schools.
2. Determine the extent senior high school's science teachers perceive technology as useful to help them teach science subject.
3. Determine senior high school's science teachers' perceptions on the use of educational computer games for teaching science.

4. Determine the perceived barriers towards the integration of educational computer games for teaching science.
5. Determine the perception of science teachers toward the use of educational games for teaching and learning based on science resource centre.
6. Determine the perception of science teachers toward the use of educational games for teaching and learning based on their knowledge of educational scientific software.

Research Questions

The following questions were formulated to guide the study:

1. To what extent are computer educational games being used in the teaching and learning of science in Akwapim north district senior high schools?
2. To what extent do senior high school's science teachers perceive technology as useful to help them teach science subject?
3. What are senior high school's science teachers' perceptions on the use of educational computer games for teaching science?
4. What are the perceived barriers towards the integration of educational computer games for teaching science?
5. What is the perception of science teachers toward the use of educational games for teaching and learning based on science resource centre?
6. What is the perception of science teachers toward the use of educational games for teaching and learning based on their knowledge of educational scientific software?

Significance of the Study

The essence of any research is to address the void in our minds and add new knowledge to the existing ones. It is expected that the results of this study will help policy-makers or curriculum developers in Ghana to integrate educational computer games to improve the current methods of teaching science subject in SHSs.

The study was of great significance to computer programmers in Ghana and school administrations of secondary schools in the sense that, this study gave an insight of what is expected of them in planning for the students and teachers in the future, if they want to turn out trained teachers for the 21st century classroom and labour market.

This study may also help to raise awareness among policymakers, Directors of Education, Head teachers and teachers, about the barriers of using educational computer games in teaching science subjects. A thorough understanding of barriers, informed the educators, in deciding how to address them, with the hope that they can be minimized if not eliminated entirely.

Delimitation

This study was delimited to only selected senior high schools in Akwapim North District in the Eastern Region of Ghana. However, educational computer games are a multidimensional concept. For this reason, the researcher focused on issues relating to extent of usage, perception and perceived barriers towards the

integration of computer educational in teaching and learning. The researcher teaches in that district and knows the condition in the district well.

Limitations

The findings of this study could not be generalized to all SHSs in Ghana because of the purposive sampling technique used in selecting the science teachers and schools. Also, the response rate of the respondents, vacations when schools are close, teachers might be difficult to reach to respond to the questionnaire and teacher's unwillingness to participate in the study could affect the level of ICT use in the school. These variables cannot be controlled and therefore they could affect the final results of the study. Measures were however taken to minimize the effects of these on the final results of the study.

Definition of Terms

ICT: Information and Communication Technology, which means computers, mobile or cellular phones, digital cameras, satellite navigations systems, electronic instruments and data recorders, radio, television, computer networks, and almost anything which handles and communicates information electronically (Milken, 1999).

Online gaming: Are games that are played online via the Internet (Kuss, 2013).

Educational Computer Games: Educational computer games are software that helps students to learn the lesson subjects and to develop their problem-solving

skills by using their desire and enthusiasm to play using the computer (Cankaya & Karamate, 2009).

Game Based Learning: This is a type of game play with defined learning outcomes (Motamedi & Bakhtiary, 2014; Shaffer, Halverson, Squire & Gee, 2005).

Game Based Instruction: This refers to the borrowing of certain gaming principles and applying them to real-life settings to engage users (Trybus, 2015).

Organization of the Study

This study is organised into five different chapters. Chapter one presented the background to the study, statement of the problem, research objectives and research questions, significance of the study, the delimitation and limitations to the study. The chapter two deals with theoretical framework and the review of literature related to the study. Chapter three talks about the research design, population, sample and sampling technique, research instrument, data collection instrument and data analysis. Chapter four presents results and discussion for the study. Chapter five presents the summary of findings, the conclusions and the recommendations for further study.

CHAPTER TWO

LITERATURE REVIEW

This chapter seeks to review literature under the following headings:

1. Theoretical Framework
2. The Role of Technology in Education
3. Gagne's Condition of Learning and Events of Instruction
4. Computer Based Learning
5. Educational Computer Games
6. Teachers Perception Towards Educational Computer Games
7. Teachers' Perceptions on the Benefits of Educational Computer Games in the Classroom
8. Perceived Barriers Towards the Integration of Educational Computer Games

Theoretical Framework

In order to investigate science teachers' technology use at the SHS level, there is the need to better understand the factors that influence it. Several studies on technology use by teachers have identified a range of factors influencing uptake and implementation. These factors include: skill and previous experience in using technology, time and opportunities to learn, availability of teaching materials, technical support and the role of technology in learning (Forgasz & Prince, 2011). In this study, the researcher adapted the technology

acceptance model (TAM) as the theoretical framework to investigate perceptions of science teachers' technology use and factors influencing their use at the SHS level. One of the well-known models related to technology acceptance and use is the technology acceptance model (TAM), originally proposed by Davis in 1986. TAM has proven to be a theoretical model in helping to explain and predict users' behaviour of information technology (Legris, Ingham & Collerette, 2003).

The TAM model is considered an influential extension of the theory of reasoned action (TRA), according to Ajzen and Fishbein (1980) as it sought to explain why a user accepts or rejects information technology. The TAM model suggests that one's actual use of a technology system is influenced directly or indirectly by the user's behavioral intentions, attitude, perceived usefulness of the system and perceived ease of the system. This theory postulates that an individual's behaviour is a result of their attitudes about the expectation of behaviour and social norms about a particular behaviour (Ajzen & Fishbein, 1980). Attitudes are constructed based on an individual's perceptions about an innovation (Agarwal & Prasad, 1998). Davis (1989) and Davis, Bagozzi and Warshaw (1989) proposed TAM to explain why a user accepts or rejects information technology by adapting TRA. TAM provides a basis with which one traces how external variables influence belief, attitude, and intention to use.

The TAM posits that two factors: perceived usefulness and perceived ease of use are of primary relevance in influencing information technology acceptance behaviour. Following Davis (1989), the posited relationship between perceived usefulness and perceived ease of use is that perceived usefulness

mediates the effect of perceived ease of use on attitudes and intended use. In other words, while perceived usefulness has direct impacts on attitudes and intended use, perceived ease of use also influences attitude and use indirectly through perceived usefulness. In turn, the two factors are the product of a number of variables which are exogenous to the TAM itself. Perceived ease of use is the degree to which an individual believes that learning to use a technology will require little effort.

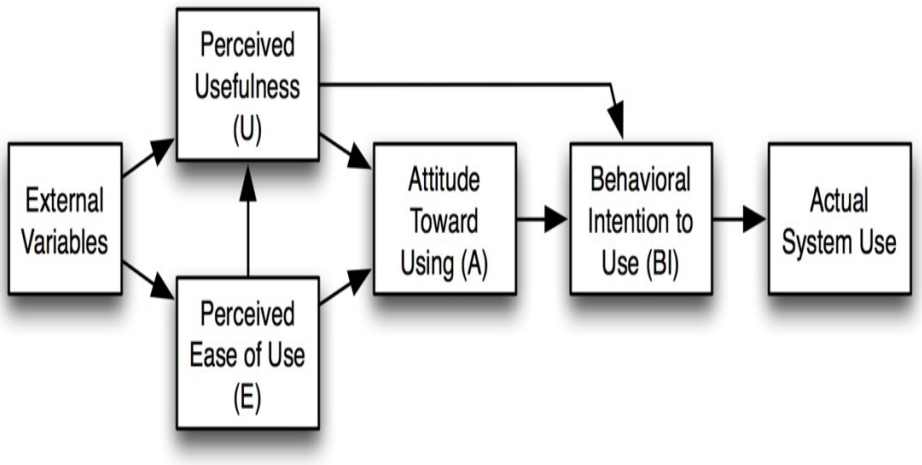

Figure 1: Technology Acceptance Model (TAM) (Davis, 1986, 1989)

Relevance of Technology Acceptance Model to this Study

This aspect deals with the review of the empirical literature on teachers' perceptions towards the use of educational computer games. Zeng, Hall and Jackson Pitts (2012) found that while awareness of educational computer games in the USA is high, with 80% of Faculty in one study reporting they used

educational computer games in learning and teaching remains 'superficial' with only 10% of faculty actively engaging students using the educational computer games. Anecdotally, it seems some educators are happy to engage with educational computer games for personal use – the extent to which they do so is currently the subject of a survey aligned with this research project, the results of which will be published in a forthcoming article.

Mwulimu, Mulauzi and Mwiinga (2018) analysed the use of educational computer games among university of Zambia lecturers in teaching and learning. The authors purposively sampled thirty lecturers for the study. A semi-structured interview guide and focus group discussion were employed to collect data for the study. It was revealed that lecturers, specifically younger ones are aware and are at the frontline of using educational computer games for learning and teaching. Also, Okereke (2014) studied the awareness, competencies and use of educational computer games in teaching by lecturers in higher institutions in South-East of Nigeria. Fifty-eight lectures successfully took part in the study. The results showed that the lecturers are aware of educational computer games. However, they are not interested to use it for learning and teaching.

Criticisms of Technology Acceptance Model

Straub (2009) indicated that the idea that perceived ease of use can be directly mapped on to the concept of self-efficacy is flawed. He further argued that in the original definition, perceived ease of use is a judgment about the qualities of a technology, but self-efficacy is a judgment about the abilities of an

individual. Agarwal, Sambamurthy and Stair (2000) also suggest that the perceived self-efficacy in a particular computer-based task may in turn influence the perceived ease of use.

Straub (2009) reasoned that, although the two factors (perceived ease of use and usefulness) are important, but strictly predicting user behaviour based on these two ignores many other factors, as illustrated by later models. Later research (Venkatesh, 2000) suggests that, indeed, self-efficacy is separate conceptually from perceived ease of use. In addition, one of the most salient criticisms of TAM is the lack of acknowledgement of individual differences (Agarwal & Prasad, 1999). Beliefs and attitudes about technology are influenced by more factors than the perceived ease of use and perceived usefulness of the product. Moreover, the original TAM does not take into account prior experience, age, gender, and many other characteristics that may influence attitudes about technology, which in turn influence intention to use an innovation (Straub, 2009).

The Role of Technology in Education

The rapid spread of electronic communications has the capacity to affect the quality and efficiency of education throughout the world in dramatic ways (Chapman, Garrett & Mahlck, 2004). Chapman et al. (2004) continue to say that, the ease with which teachers and students can gather information over the Internet on virtually any topic has the potential to transform instructional content and pedagogical practice. Educators virtually everywhere have long looked to the emerging technologies of their time to improve the delivery of instruction in the

classroom and to help them reach students (and teachers) in remote locations. In the early days of technology use, the focus was on the delivery of direct instruction through radio, interactive radio and instructional television, for example.

The use of technology in education has impacted on the way that educators present information, the way students learn that information and the overall availability of academic material. This implementation of technology in education is seen at various educational levels as it has provided new and interactive platforms for learning that can be adapted to suit the educational needs of students at any age (Marés, 2012) and promotes collaborative learning (Resta & Laferrié, 2007). Instructional education technologies widely used for classroom purposes in low-income countries include the use of programmed instruction, the distribution of lessons on audiotape, the use of duplication and photocopy machines to prepare learning aids and television broadcasts of lessons at times that coincide with the school teaching schedule. Newer technology-based instructional strategies that incorporate the Internet and the World Wide Web (WWW) are used more to expand communication and increase access to resources.

These newer technologies represent a significant change in the teacher's role in the instructional process. Whereas earlier technologies provided teachers primarily with a tool for continuing to teach in the manner they were already teaching (though presumably more efficiently), technologies such as e-mail and Internet tend to push teachers toward fundamentally different ways of teaching

(Chapman, 2004). Every new technology provides the potential to both transform the education environment and upset the status quo in the classroom (Wartella & Jennings, 2000). On the one hand, tablet computers have been noted to promote student-centered learning practices, which developmental theorists and policymakers support for early childhood education above more didactic teaching styles (Burns, Griffin & Snow, 1999; Clements, Sarama & DiBiase, 2003).

As Means and Olsen (1997) describe, technology promotes student learning through collaborative involvement in authentic challenging, multidisciplinary tasks by providing realistic complex environments for student inquiry, furnishing information and tools to support investigation and linking classrooms for joint investigations. Additionally, student-centered practices focus on motivating and engaging learning activities that relate to children's real lives (Vygotsky, 1978; Wood, Bruner & Ross, 1976). Thus, technology in general and tablets more specifically, could alter classroom practices and have implications for teaching and learning.

On the other hand, there is often resistance by schools and teachers to integrate technology in order to maintain current teaching practices (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur & Sendurur, 2012). Despite increased access to technology in education, studies still report the underuse of technology in the classroom, especially in early childhood education (Blackwell, Lauricella, Wartella, Robb & Schomburg, 2013; Gray, Thomas & Lewis, 2010).

In general, results are inconclusive over whether technology in education advances educational attainment (Cheung & Slavin, 2013), and no

technology thus far has ubiquitously altered the education landscape to change teaching and learning practices on the large scale. As Buckingham (2007) noted, previous promises of a technological revolution in education have failed to produce much change.

According to Kozma (2008), there are three rationales for the introduction of technology into education. The first one is the economic rationale which refers to the role it can play in preparing students as future workers, leaders and in supporting economic development of every nation. The second is the social rationale where technology in education investment aims to increase knowledge sharing, encourages cultural creativity, increase civic participation, make Government services more accessible and finally enhance social cohesion. The third and final rationale is the educational and pedagogic rationale where technology can advance educational reform and improve educational management structures or curriculum developers.

Similarly, Hennessy (2005) broadly concur and identified three reasons for the use of technology in teaching and learning; the development of new skills and ideas for the information age, increased productivity in any business field and the development of quality and effective learning.

Hawkridge (2010) proposes four rationales for the utilization of technology in education. He notes these as social, vocational, pedagogical and catalytically. The social and vocational rationales point to the increased use of technology in all spheres of human activity. The pedagogical and catalytically

rationales relate to the effects of technology on students and school's academic performance.

According to Bigum (2007), using technology in education stems from technological and socially determined points of view. His standpoint is that the school systems within which the computer is used, is driven by computers. He argues that a change occurs within the education system using the computer and that change is as a result of the effect of technology in education worldwide.

Bigum (2007) argues that the social context sees computers in education as neutral technology-technical means of achieving a defined purpose in education. Two contexts emerge and are used in this study; they are the social context and the pedagogical context. The social contexts run along the lines of Hawkridge (1990) social and vocational rationales, whiles the pedagogical context agrees with Hawkridge's pedagogical and catalytical rationales. The pedagogical context also agrees with the views of Bigum (2007).

Scholars and educators indicate that technology integration in education improves teaching (Williams, Linn, Ammon & Gearhart, 2004), facilitates students' learning (Enriquez, 2010), advances higher order thinking (Fox & Henri, 2005), and allows teachers to create more student-centered classroom environment (Teo, Chai, Hung & Lee, 2008). Because of these expected outcomes, many countries have invested huge amounts of money to increase availability of technology in education into the classrooms (Waxman, Evans, Boriack & Kilinc, 2013).

Therefore, technology can respond to the needs of the individual both in everyday life and training environments (Akpinar, 2005; Alkan, 2005; Van Wyk & Louw, 2008). Technology is contributing to the enrichment of courses, when used in the teaching and learning environment both for teachers and students (Chen, 2012; Gunduz, 2010; Demirel & Ark, 2004). At the same time, teachers can create an effective learning environment with the support of technology (Turan, 2010).

There have been concerns by the stakeholders of education in Ghana about the use of technology in education by teachers and students since the 1990's in our schools. The acquisition of knowledge in ICT by the students will help them in their research, assignment and learning. Teachers on the other hand, can even use technology to write lesson notes, prepare materials for teaching and learning. Thus, technologies in education have become a routine tool or device for helping teachers accomplish their professional work successfully (Becker, Ravitz & Wang, 2009).

The availability of technology has changed the nature of teaching and learning. Hence, to judge the extent and how technology may enhance teaching and learning, it is necessary to examine the available research evidence. There are many positives that teachers can derive from the use of technology in the teaching and learning process (Cohen, 2004; Laubsch 2006).

Al-Balawi (2010) undertook a study aimed at identifying the effects of technology on learning during the teaching of a statistics. The study sample comprised of 66 selected students who were divided equally into two groups. An

experimental group consisted of 33 selected students who studied relying on technology-assisted methods, while the control group consisted of students 33 who studied by traditional methods. The findings of the study revealed that there were significant differences in the skills of understanding and application, and the overall post-test results were in favour of the experimental group who were taught using technology.

Rendall (2001) also conducted a study to assess the effectiveness of technology in teaching mathematics for rural public schools' students. The study sample consisted of two groups: experimental and control groups with a total number of 120 students. The eighty students of the control group studied over three semesters using traditional methods, while the experimental group comprising forty students studied using technology-assisted methods. The study indicated that technology-assisted teaching was more effective in raising the arithmetical and logical skills in mathematics compared with the use of the traditional methods.

Similarly, Jabr (2007) investigated the effect of using technology on students' achievement in mathematics compared with traditional methods in addition to identifying the teachers' attitudes towards using technology in teaching. The study findings revealed that there were significant differences between the average achievements amongst students after both methods were applied (ICT and traditional) in favour of the technology method. Likewise, a study by Su (2011) suggested that technology integrated in learning can support students to achieve a greater understanding of a chemistry lesson and improves

their attitude and approach to chemistry learning. However, these studies emphasised the importance of providing effectiveness of technology use in the learning environment with the support of teachers.

Similarly, Hussein's (2000) and Mawata (2008) studied the effect of using technology on the achievement among teachers and their attitudes towards mathematics. The study sample consisted of 163 teachers enrolled in three high schools within Baltimore, USA. The findings indicated that teachers' achievement was high according to their teaching results. Furthermore, the findings indicated the presence of teachers' positive attitudes towards mathematics from the study sample.

Gagne's Condition of Learning and Events of Instruction

The Gagne's (1962) theory of learning stipulates that there are several different types or levels of learning. The significance of these classifications is that each different type requires different types of instruction. Gagne (1962) identifies five major categories or conditions of learning: verbal information, intellectual skills, cognitive strategies, motor skills and attitudes.

In addition, Gagne's (1962) theory outlines nine instructional events and corresponding cognitive processes:

1. Gaining attention: In order for any learning to take place using technology, the user must first capture the attention of the student. A multimedia programme that begins with an animated title screen sequence accompanied by sound effects or music startles the senses with auditory or

visual stimuli. An even better way to capture students' attention is to start each lesson with a thought-provoking question or interesting fact using technology. This will raise the curiosity of students and motivate students to learn (Gagne, 1962).

2. Informing learners of the objective: Before the teaching lesson begins, students should be provided with the list of the learning objectives. This initiates the internal process of expectancy and helps motivate students to complete the lesson. These objectives should form the basis for assessment and possible certification as well at the end of the lesson delivery (Gagne, 1962).

3. Stimulating recall of prior learning: Recalling previous or prior knowledge can facilitate the learning process. These will make it easier for students to encode and store information in long-term memory when there are links to personal experience and knowledge. A simple way to stimulate recall is to ask questions about previous experiences or knowledge, an understanding of previous concepts, or a body of content in the previous lesson taught (Gagne, 1962).

4. Presenting the stimulus: This event of instruction is where the new content is actually presented to the student using the technology. Content should be chunked and organized meaningfully and typically is explained and then demonstrated to the students. To appeal to different learning modalities, a variety of media should be used if possible, including text, graphics, audio narration, and video in the lesson delivery (Gagne, 1962).

5. Providing learning guidance: To help students encode information for their long-term storage, additional guidance should be provided by the teacher along with the presentation of the new content (Gagne, 1962). Guidance strategies include the use of examples, non-examples, case studies, graphical representations, mnemonics and analogies for effective understanding.
6. Eliciting performance: In this event of instruction, the student is required to practice the new skill learnt in the classroom. Eliciting performance provides an opportunity for students to confirm their correct understanding and the repetition further increases the likelihood of retention of the new content (Gagne, 1962).
7. Providing feedback: As students practice new behaviour or skills, it is important to provide specific and immediate feedback of their performance. Unlike questions in a post-test, exercises within tutorials should be used for comprehension and encoding purposes, not for formal scoring (Gagne, 1962). Additional guidance and answers provided at this stage are called formative feedback.
8. Assessing performance: Upon completing instructional modules, students should be given the opportunity to take (or be required to take) a post-test or final assessment. This assessment should be completed without the ability to receive additional coaching, feedback, or hints (Gagne, 1962). Mastery of material, or certification, is typically granted

after achieving a certain score or percent correct. A commonly accepted level of mastery is eighty percent to ninety percent correct responses.

9. Enhancing retention and transfer: Determining whether or not the skills learned from the training programme are ever applied back on the job often remains a mystery to training managers and a source of consternation for instructors. Effective training programme have a performance focus, incorporating design and media that facilitate retention and transfer to the job or to the academic field (Gagne, 1962). The repetition of learned concepts is a tried and true means of aiding retention, although often disliked by students. Creating electronic or online job-aids, references, templates, and wizards are other ways of aiding performance of learners (Gagne, 1962, pg. 1).

According to Gagne, Briggs and Wager (1992), nine instructional events should satisfy or provide the necessary conditions for learning and serve as the basis for designing instruction and selecting appropriate media. Applying Gagne's (1962) nine-step model to any training programme is the single best way to ensure an effective learning program using technology. A multimedia programme that is filled with glitz or that provides unlimited access to Web-based documents is no substitute for sound instructional design. While those types of programme might entertain or be valuable as references, they will not maximize the effectiveness of information processing and learning will not occur.

Computer Based Learning

From a game designers' perspective, a game is the system in which players engage in artificial conflict characterized by rules that result in a quantifiable outcome (Salen & Zimmerman, 2003). Given this kind of definition, it is possible to assert that computer games exist all around us, whether or not we define them as such. According to Alcorn (2003), computer games are a kind of play and other rivals used in class in order to achieve certain goals and have special rules. In order for an application to be a game, it requires to have rules and certain targets to be followed. Moreover, Piaget defined computer game as assimilation of stimuli from outside world and put them into adaptation system (Donmez, 1992). One definition defines a game as "a system in which players engage in an artificial conflict, defined by rules that result in a quantifiable outcome" (Salen & Zimmerman, 2004, p. 80). Hence, any game has a challenging component in terms of the rules and purposes, by raising either a personal challenge or a competitive drive.

Computer games encompass much more than a computer 's Solitaire or Nintendo 's Super Mario Bros. Over the last decade, the genre of computer games has exploded to include numerous platforms and designs. Computer games, whether computer, game console, or handheld-based, are characterized by rules, goals/objectives, outcomes/feedback, conflict/competition/challenge/opposition, interaction, and representation of story (Prenksy, 2001) or more simply, purposeful, goal-oriented, rule-based activity that the players perceive as fun‖ (Klopfer, 2008).

Main Characteristics of Computer Games

According to Johnson, Vilhjalmsson and Marsella (2005) there are certain artificial intelligence functions needed for serious computer games. These are:

1. Gameplay - computer games are so engaging because the primary objective of the game designer is to keep the user engaged (Prensky, 2002). Good computer gameplay does not come from the game graphics but from the continual decision making and action that engages the learner and keeps him or her motivated to continue.
2. Feedback - Sending information back to the user about what action has actually been done, what result has been accomplished is a well-known concept in the science of control and information theory (Norman, 1998). Good computer games provide users with feedback on their actions, so that they know how well they are doing and can seek to improve their performance.
3. Simple interface – Well defined simple interface helps to guide the player during the game (Johnson, 2005) and provide information about the player's location.
4. Challenge - An important aspect of a computer game design is ensuring that users experience a proper level of challenge. The role of challenge in promoting intrinsic motivation is not limited to games but has been noted by motivation researchers as relevant to all learning activity.
5. Fish tanks and sandboxes – Some games provide smaller versions of the real game where gameplay complexity is limited or versions of the game

that have similar gameplay to the real game, but where there is less likelihood for things to go wrong these help users to practice for the challenges of the full game.

6. Story and character identification – For keeping user interest it is important that the player identifies with the story and the main character.
7. Fun and learning orientation - Fun in the learning process creates relaxation and motivation. Relaxation enables learners to take things in more easily; motivation enables them to put forth effort without resentment. Given this, it certainly makes sense that fun and learning should go hand in hand (Johnson, 2005).

Educational Computer Games

Qteefan (2012) observed that educational computer games are individual or group games that have cognitive, social, behavioural, and emotional, dimensions which are related to educational objectives. According to Naim (2011), educational computer games enhance learning through visualisation, experimentation, and creativity of play and often include problems that develop critical thinking. Furthermore, educational computer games are activities that provide students with the opportunity to reinforce the previous knowledge by repeating it in a more comfortable environment (Turner, Johnston, Kebritchi, Evans & Heflich 2018). Educational computer games are software that helps students to learn the lesson subjects and to develop their problem-solving skills by using their desire and enthusiasm to play (Cankaya & Karamate, 2009).

Another essential characteristic of a serious educational computer game is interaction. The educational computer game environment should allow flexible interaction and different methods of interaction for the users. Interaction enhances learning and for the educational computer game designer, it helps to get feedback from the players (Whitton, 2010). Educational computer game has many similar characteristics like any other games. However, educational computer games are particularly designed to teach and its main objective is to involve in learning. Educational computer games are learning tools designed to enhance students learning experience. This means the design process of educational computer games for learning involves balancing the need to cover the subject matter with the desire to prioritize game play (Plass, Perlin & Nordlinger, 2010). According to Trybus (2015), educational computer game-based learning allows students to engage with educational materials in a playful and dynamic way.

Even though most genres of the computer games in some ways are educational, educational computer games are designed with explicit educational purpose (Okur & Aygene, 2018). When educational computer games are adopted in supporting learning in the classroom, the pedagogical aspects of students such as learning style are taken into account.

Teachers' Perception Towards Computer Games

Kangas, Koskineen and Krokfors (2017) examined teachers' experience and perception with computer games, particularly using it for teaching and learning in the classroom. Their survey results revealed that the majority of the

selected teachers had no or limited experiences with using computer games for teaching and were not fully aware of their pedagogical value. The results indicated that teachers valued computers as a motivational tool or a reward for positive behaviour. Gaudelli and Taylor (2011) found that in-service teachers were skeptical about the pedagogical value of computer games for teaching. The teachers participating in the study viewed computer games as motivational tools for teaching and learning. Takeuchi and Vaala (2014) reported that more than half the teachers selected in their study used computer games to motivate and reward students in classroom.

Pastore and Falvo (2010) examined both pre- and in-service teachers' experience and perception with computer games in the classroom environment. Ninety-eight participants, 53 in-service and 45 pre-service teachers, completed the survey. The results of the study revealed that a majority of both pre- and in-service teachers agreed that using computer games for teaching enhances students' learning and motivates students. However, only about half the participants indicated that they used or intended to use computer games in their teaching. Although these findings indicate that positive experience do not always lead to behavioural intention for teachers.

Gerber and Price (2013) examined in-service teachers' experience with computer games for the teaching of science subjects in the classrooms. The participants, ten literacy teachers, were required to complete multiple readings, explore several multi-user virtual environments, and play a commercial off-the shelf video game using computers. Whiles completing at the same time

researching literacy activities directly related to the game they had selected to play using the computer game. The results of the study indicated that the participants saw the value of game-based pedagogy and wanted to use game-based learning with science teaching. However, they believed that the schools where they taught would not be open to game-based pedagogy using computers for teaching and learning.

Maraffi, Sacerdoti and Paris (2017) exposed teachers to a wide variety of games in a graduate-level course on digital game-based learning using computers. The participants played, examined, and discussed various computer games. At the end of the class, all participants were enthusiastic about the potential of using computer games to enhance learning as a result of the analyses and discussions. However, many teachers still continued to feel that integrating games in the formal curriculum was not likely to occur in the near future. Gaudelli and Taylor (2011) investigated teachers' views of serious video games before, during, and after game play in the context of global education. Seven social studies teachers participated in a series of activities, including an initial focus group meeting, both extended and short-play games, blogging, and a focus-group reflection using computer games for the teaching of science. The data from the initial focus group meeting revealed that the participants were generally skeptical about the pedagogical value of computer games, due in part to their lack of familiarity with this type of media. Interestingly, even during and after the video game experience, the teachers remained skeptical about teaching global content through video games using tablet computers. They consistently mentioned

that the use of computer games for teaching and learning should not replace teacher instruction.

Simply having computers in schools will not guarantee their effective use in the classroom. Regardless of the quantity and quality of computers placed in classrooms for teaching and learning, the key to how those tools are used is the teacher; therefore, teachers must have the right attitude and perception towards technology (Kadel, 2005). Attitudes refer to one's positive or negative judgment about a concrete subject. Attitudes are determined by the analysis of the information regarding the result of an action and by the positive or negative evaluation of these results (Ajzen & Fishbein, 2000).

Several studies implied that teachers' beliefs and perception are the one of the most important constructs of using computer games in teaching and learning (Baturay, Gokcearslan & Sahin, 2019; Fu, 2013). Technology anxiety is defined as an attitude that is applicable to technology in various forms (Cocorada & Maican, 2017; Sabzian & Gilakjani, 2013). It is also defined as a negative emotional state by an individual when he/she uses technology or technology equipment for teaching (Boyle, 2016). Technology anxiety influences the use of computer games for teaching.

Studies have established close links and affinities between teacher's perception and their use of computer games for teaching. High teacher's positive attitudes towards computer games usage were associated with a higher level of computer experience (An et al., 2016). Students' confidence in computer games for learning can be explained through the attitude and behaviour of their teachers.

Teachers' behaviour is a critical influence on teachers' confidence and perception towards computer games use in lesson delivery (Awan, 2011). Teacher's perception and knowledge toward technology integration might change as they gain more experiences from and insights in the adoptions processes (Ifenthal & Schweinbenz, 2013).

Perception of teachers towards computer games for teaching and technology skills can be improved by integrating technology into teacher education (Oliver, 2013). Findings have revealed that a significant relationship exist between teacher's perception towards using computer games in teaching and its use in schools (Khatatneh & Teh, 2018). Perception is a major predictor of teachers' future for using computer games in teaching. Licorish, Owen, Daniel and George's (2018) study indicated the importance of appropriate responses to teacher's feelings about using computer games as one of the factors critical to teacher's usage of computer games in teaching and learning in the classroom.

Teachers who have positive perception and are highly enthusiastic about using computer games in the classroom as an important feature of teaching and learning, can motivate their students to practice using the technology (An et al., 2016). Teachers need to be skilled in the use of computer games for teaching and also to be able to critically evaluate strategies for the acquisition and the appropriate application of it in diverse curriculum delivery in the classroom (Robbins, 2014). On the contrary, Ifenthaler and Schweinbenz (2013) found variations in perception across teachers using computer games in their lesson

delivery, where attitudes toward technology in addition to performance expectancy and extrinsic conditions influenced their actual use of the devices.

Blackwell (2014) found that teachers' perception about computer games for teaching are closely aligned with their classroom practices with technology. Blackwell (2014) further found that educators who held more positive perception about the potential of technology to aid student learning also used a variety of technologies more often than their peers with more negative attitudes. Similarly, Hermans, Tondeur, Hermans, van Braak and Valcke (2008) showed that teachers who held more student-centered learning perception used computer games in different ways and more often than teachers with more traditional beliefs.

Research conducted Yung-hsun and Chia-wen (2017) the USA showed that teachers' prior knowledge of digital media and technologies can effectively mediate the use and impact of teachers. This finding points to the importance of taking prior knowledge and experience in using technology in education into account when teacher educators attempt to help teachers develop a knowledge base and skill set in using computer games for teaching.

Computer games meet the actual needs and interests of students, and are becoming the most popular computer activity and provide a new mode of interaction. Some of the advantages of games are that they are attractive, novel, provide a better atmosphere and help keep the learner focused on the task (Akdemir & Akdemir, 2017). Students like all humans, love to learn when it is not forced upon them. Modern computer and video games provide learning opportunities every second or fraction thereof (Chung-Ho & Ching-Hsue, 2013).

Gee (2003) argues that "the real importance of good computer and video games is that they allow people to recreate themselves in new worlds and achieve recreation and deep learning at the same time".

Teachers' Perceptions of the Benefits of Computer Games in the Classroom

The important role that computer games play in the overall personal and intellectual development of the individual cannot be underestimated. The use of computer games in the teaching and learning environment has become an unstoppable force in recent years (Cohen, 2014; Laubsch, 2016). Computers games have impacted on a large section of education delivery, from teaching contents to online learning resources (Bishop, 2007). Bishop further stresses that the use of computer games in classrooms have flourished in tandem with improved student's participation in classroom activities.

It has been fairly well documented that computer games for learning have the potential to encourage students to explore beyond the boundaries of a given material thus allowing for a proactive and exploratory nature that allows the student to become a self-reliant learner (Taradi, Taradi, Radic, & Pokrajac, 2005). Rickard and Oblinger (2004) discussed how gaming provides learners the opportunity to learn by doing, experience situations first-hand, and though role-play. Bransford and colleagues (as cited in Squire, 2002) have found that students perform best when given access to lectures in the context of completing open-ended complex problem-solving tasks. Gaming environments allow both the simulation of experiences that students might have in the real world and also the

creation of compelling experiences that cannot normally be experienced directly (Winn, 2002).

The multiplayer component of computer games for learning allows students to interrelate while interacting with the virtual environment making games more dynamic and interesting. This notion of cooperative play lends another dimension to learning through computer games (Consortium, 2005). Munger (2005) reported that computer games improved student performance in reading comprehension, spelling, science and mathematics.

Scholars and educators indicated that computer games integration improves teaching (Williams, Linn, Ammon & Gearhart, 2004), facilitates students' learning (Enriquez, 2010), advances higher order thinking (Fox & Henri, 2005), and allows teachers to create more student-centered classroom environments (Teo, Chai, Hung & Lee, 2008). Liaw, Hatala, and Huang (2010) report that the fast spread of the computer games and relevant technologies parallel to the rise in internet access options has altered the nature of higher education.

However, the benefits of computer games use in the classroom depend on the success with which it has been integrated (Condie & Munro, 2017). Dawes (2015) asserts that new computer games could support education across the entire curriculum, providing innovative opportunities for effective communication. Computer games in education has undoubted potential, to be influential in changing teaching methodologies.

Research has shown that many students benefit from the use of computer games in the classroom (Frear & Hirschbuhl, 2013). Wishart and Blease (2009) claims that students get immediate feedback or rewards when using educational games in learning with the support of a computer game. According1to Wahyudi (2008), computer games for teaching enables students to learn from1feedback. Yee (2006) argued that computer games for teaching and learning often1provides fast and reliable1feedback to students. Computer games use in teaching enables1students to explore many examples when developing concepts (Forgasz & Prince, 2001).

Papert (2013) assert that the computer game is a tool, allowing for the construction of higher order thinking, facilitating users to take responsibility for their learning when making decisions, while Korte and Housing (2007) refer to its ability to motivate students learning. Yee (2006) lamented that computer games in teaching and learning enables1students to work with real1data which can be1represented in variety1of ways. Cankaya and Karamete (2009) and Baki (2002) argued that the use of games aided instruction helps students to see their performance, control their learning with getting feedbacks, engage the lesson with graphics, sounds, animations and figures.

According to Hawkridge (2010), computer games as pedagogical tools in Computer Assisted learning or Computer Assisted Instructions offer advantages over other methods of teaching and have revolutionized education in advanced countries. He further stated that computer games are useful tools for pupils' drills and practice. The computer game serves as a cognitive tool. It is a software

programme is able to extend or enhance human cognition (Kozma, 2008). They are designed to aid users in task relevant, cognitive components of performance, leaving the performance open-ended hand controlled by the learner (Fouche, 2005).

The impedance of computer games in teaching and learning has prompted Todd (2007) to declare that a real learning revolution in which educators use information technologies to provide learning experiences that are qualitatively different from their predecessors. Despite the advantages that computer games offer in education, Bigum (2017) recommends that computer games should not be seen as the only educational tool, but as one of a number of possible tools which could be used to teach content.

It has even been suggested that using computer games well in the classroom can even prepare students to be more effective citizens in increasing open and democratic societies (John & Sutherland, 2014). Research in West and Central Africa shows that computer games for teaching and learning in school environments can contribute to developing student centered approaches to pedagogy in science (Rocare, 2016). Koile and Singer (2006) argued that the use of computer games in teaching and learning has increase interactions between the instructor and the individual student with the ultimate goal of supporting or enhancing student learning. Computer games for learning movements have created a transformative impact on classroom learning among teachers by offering a context in which students can engage in open and active learning settings based on their preferred learning styles (Cummings & Hill, 2015; Sahin Izmirli &

Kabakçi Yurdakul, 2014). However, incorporating computer games into students' learning also increases the complexity of, and creates additional challenges and anxieties for managing classroom settings in teaching science (Moats, 2015).

Similarly, Fister and McCarty (2008) stated in their study that games enriched students' learning environment and the students benefited from the archival resources and the comments of the teachers with computer games. Moreover, they added that the use of computer games motivated the students better for the lesson. Enriquez (2010) claimed that the use of technology with wireless had many benefits. Enriquez further lamented that computer games provided many benefits for the students such as making significant and sudden evaluation for the students about their learning, helping them maximise their learning, and providing necessary feedback.

Fister and McCarty (2008) drew attention to two points related to the use of computers by students to examine and analyse problems. First, computer games provide the students responsibility for their learning. Second, the students feel excited to be in the class because of the games. Enriquez (2010) determined that the use of computer games provided opportunities both for the students and the teachers to analyse the problems, collect data, take notes, and connect electronic class materials and their hand-written notes.

Studies show that computer games use in the classroom improves the quality of education as opposed to traditional learning methods, while others do not find sufficient empirical evidence to justify such positive claims. In this sense, Nguyen, Barton and Nguyen (2015) show that although the use of computer

games in the educational context enhances the learning experience of students. They further lamented that it does not necessarily lead to improvements in performance. Similar studies coincide with works by Leung and Zhang (2016) and Dhir, Gahwaji and Nyman (2013), who point out that while computer games for teaching use can stimulate motivation towards learning, its real impact is limited.

Falloon (2015) also shows that computer games usage in the classroom can consistently broaden students' learning provided there is a carefully designed itinerary based on collaboration, debate and negotiation, and sufficient role changing when group work is undertaken. Changes in education are not just about the use of the computer games in the classroom for teaching and learning, rather it is the symbolic tool that teachers can use to think about all the pedagogical elements that range from new functions to transitions (Suarez-Guerrero, Lloret-Catala & Mengual-Andrea, 2016). They further lamented that the demand of its use in education is going beyond the mere replacement of the old with the new technology for teaching.

Schrader, Zheng and Young (2006) examined pre-service teachers' perceptions of computer games for teaching, particularly massively multiplayer online games. Their survey results revealed that the majority of the participants had no or limited experiences with social aspects of gaming and gaming communities and were not fully aware of their pedagogical value. The results indicated that the pre-service teachers valued games as a motivational tool or a reward for positive behaviour. This was corroborated by Takeuchi and Vaala

(2014) who reported that more than half the computer game used by teachers in their study used digital games to motivate and reward students.

Educational computer games as a component of computer assisted instructions cannot be overstated (An, Haynes, D'Alba & Chumney, 2016; Proctor & Marks, 2013; Habgood & Ainsworth, 2011). A study conducted by An, Haynes, D'Alba and Chumney (2016) revealed that Seventy-nine percent of the teachers indicated an interest in using educational computer games in their classrooms and concluded that they are reliable. The aim of the study was to better understand science teachers' experiences, attitudes, perceptions, concerns and support needs related to the use of educational computer games in the classroom. The sample size of the study was One hundred and eleven teachers.

This was supported by Proctor and Marks (2013), who analyzed teachers' perceptions, use and access of computer-based games and technology for classroom instruction. Two hundred and fifty-nine award winning educators from the 1996 to 2009 were surveyed concerning educational game use for teaching. The study concluded that seventy-one percent of teachers perceived educational computer games as more useful for classroom instruction.

The study conducted by Dondlinger (2007), on educational video game design has indicated success in the usage of educational game. The purpose of the study was to analyze educational game design, namely those that present design elements conducive to learning. The sample size of the study used a multiple database search using the search terms game design and video or computer or PC and educational or instructional which yielded nearly 100 publications for

consideration of the study. The study concluded that educational computer video games affect learning.

Perceived Barriers Towards the Integration of Educational Computer Games

A challenge is anything that retards the progress or achievement of any set objective or aim. It therefore means that the removal of one or more of these challenges or barriers such as the ones in computer games integration should assist perhaps significantly advance the process of integration of educational games in education. Educational computer games integration in the classroom is the application of technology to assist, enhance, and extend student knowledge (Omwenga, 2014). Using educational computer games in education means more than simply teaching learners how to use computers. Educational computer games in education are a means for improving education and not an end in itself.

A study conducted by OECD in 2009 confirmed that there are a number of barriers or challenges that inhibit teachers use of computer educational games in education. These barriers included an inconsistent number of computers to students, a deficit in maintenance and technical assistance and finally, a lack of computer skills and or knowledge among teachers (OECD, 2009). Jenson (2002) classified these barriers as: limited equipment, inadequate skills, minimal support, time constraints and lack of interest or knowledge by teachers.

In a research report conducted by BECTA (2004), a number of other important barriers were identified as the reasons why teachers do not use

educational computer games to support their teaching. These were: lack of confidence, accessibility, lack of time, fear of change, poor appreciation of the benefits of ICT and age. Ertmer (2009) concurs with Schoepp (2005), asserting that if teachers are aware of and understand such barriers, they can initiate strategies to overcome them within the shortest possible time.

Research has classified these barriers in different ways. Several studies have divided the barriers into two categories: extrinsic and intrinsic. However, what was meant by extrinsic and intrinsic differed among studies. In one such study, Ertmer (2009) referred to extrinsic barriers as first order barriers citing as examples: lack of time, support, resources and training. She referred to intrinsic barriers as second order barriers, citing as examples: attitudes, beliefs, practices and resistance to change.

Jones (2004) reported that the breakdown of a computer educational games causes interruptions and if there is lack of technical assistance, then it is likely that the regular repairs of the computer will not be carried out resulting in teachers not using computers. The effect is that teachers will be discouraged from using computer educational games because of fear of equipment failure since no one would give them technical support in case there is technical problem. BECTA (2004) agreed that "if there is a lack of technical support available in a school, then it is likely that technical maintenance will not be carried out regularly, resulting in a higher risk of technical breakdowns" (p.16). In Ireland, the NCTE census on ICT infrastructure (as cited in ICT strategy group report, 2008-2013) found that about 85.3% of schools reported technical support and maintenance as

a 'high' or 'very high' priority and claimed that it should be an important element of the school ICT environment with proper technical support.

Similarly, Yilmaz (2011), in assessing the technology integration processes in the Turkish education system reported that in providing schools with hardware and internet connections, it is also crucial to provide the schools with technical support with regard to repair and maintenance for the continued use of educational computer games in schools for effective teaching and learning. Therefore, if there is no technical support for teachers, they become frustrated resulting in their unwillingness to use educational computer games in their teaching (Tong & Trinidad, 2010). Even though, lack of technical support discourages teachers from adopting and integrating technology in classrooms, a study by (Korte & Housing, 2007) revealed that schools in Britain and the Netherlands have appreciated the significance of technical support to help teachers to integrate educational computer games into their teaching.

Chapter Summary

Most of the research reviewed for this study dealt with students' perception towards use of educational computer games in teaching and learning. They have also cited a number of benefits when computer technology is used. However, use of computer assisted instructions, particularly educational computer games and tutorials for teaching integrated science at the high school level in African countries, particularly Ghana, is not extensive.

Furthermore, a comparison of traditional teaching methods and computer instructions in teaching secondary school science in Ghana so far is not intensive. Nothing much has been done in Ghana and specifically in use of computer assisted learning in teaching and learning of science subjects. This study thus attempted to fill these existing research gaps by examining science teachers' experiences, attitudes, perceptions and support needs related to the use of computer games in the classroom.

CHAPTER THREE

RESEARCH METHODS

The purpose of this study was to investigate science teachers' perception towards the use of educational computer games in the classroom. This chapter covers the research design, population, sample and sampling procedure, instrumentations, data collection and data analysis.

Research Design

Descriptive survey design was employed in this study. Descriptive survey design, according to Amedahe and Gyimah (2003), makes use of various data collection techniques involving questionnaire. Considering the nature of the research problem and purpose of this study, the most appropriate research methodology used is the descriptive survey design. Descriptive survey design, according to Amedahe and Gyimah (2003), makes use of various data collection techniques involving questionnaire.

Descriptive research is generally concerned with the present status of a phenomenon. According to Gay (1992), descriptive research is concerned with the conditions or relationships that exist, such as determining the nature of prevailing conditions, practices and attitudes; opinions that are held; processes that are going on; or trends that are developed. The purpose of descriptive research is to observe, describe, and document situation as it naturally occurs. It sometimes, serves as a

starting point for hypothesis generation or theory development. It deals with interpreting the relationship among variables and describing their relationships.

The descriptive sample survey answers questions of what, where, when and how and has the advantage of eliciting responses from a wide range of people. It is chosen because in considering the purpose of the study it is the most appropriate design which leads the researcher to make a meaningful conclusion from the study.

Population

According to Cohen, Manion and Morrison (2006) population is a group of elements or variables, humans, objects or event which form specific criteria that are interested to the researchers for generalization of results. Population is also referred to as "the total number of subjects of your research that conform to a clearly defined set of characteristics" (Awanta & Asiedi-Addo, 2008, p. 55). The population for the study was all Senior High Schools Science teachers in Akwapim North District in Ghana. The targeted population was all teachers who teach science in the Akwapim North District.

Study Area

The study area was Akwapem North District in the Eastern Region of Ghana. The Akwapem North District is one of the twenty-one districts of the Eastern Region of southern Ghana. The capital is Akropong. In the 2010 census,

the population was 136,483 (Ghana Statistical Servic, 2010). The metropolis occupies an area of 544 square kilometers and lies between longitude 5.978^0N and 0.91^0 West. The municipal area is located in the south-eastern part of the Eastern Region and is about 58 km from Accra, the capital city of Ghana. The District covers a land area of about 450 square kilometers representing 2.3 percent of the total area of the Eastern Region.

Sample and Sampling Procedure

Varkevisser (2003) explained sampling as the process of selecting a number of study units from a defined population. Leady (1993) defines sampling as the process of choosing from a much larger population, so that selected parts represent the total group. Sampling per say is not a technique or procedure for getting information but it ensured that any technique used helped in getting information from a smaller group, which accurately represented the entire group (Teye, 2012).

The sample for the research was chosen from the Senior High Schools in Akwapem North District. There are 8 circuits in Akwapem North District, but only 5 circuits have Senior High Schools in them. The circuits are Mampong, Larteh, Akropong, Adukrom and Mangoase. Purposive sampling was used to select all the science teachers in the 5 districts since they are the only ones with Senior High Schools and the other three do not have Senior High Schools. Purposive sampling, according to Teddie and Tashaskkori (2003), involves selecting certain units or cases based on specific purposes rather than randomly.

Teddie and Tashaskkori further argued that purposive sampling is used in inductive studies to gather detail and in-depth information or data with small number of participants to represent the target population in order to yield detailed information about the issue. The technique affords easy responses from the respondents. The researcher chose this sampling method because the cases were available and easy to study to get the expected responses (Gall, Borg & Gall, 2006). All the 110 Science teachers in Akwapem North District were selected for the study from the various schools.

Instrumentation

A questionnaire was used as the research instrument to collect data for the study. Questionnaire was used because it allows for simplicity, easiness and quickness of responses (Amin, 2005; Sarantakos, 2008). The questionnaire was made up of four sections: A, B, C, and D. Section 'A' dealt with the respondents' demographic information. Items considered were age, gender, highest level of education and teaching experiences. Section B contained statements on the type of ICTs available for teaching science subjects.

Section C contained statements on the extent science teachers perceived the usefulness of technology use in the classroom. Respondents were required to respond to the usefulness of ICT for teaching and learning in the classroom. The scales were ranked from disagree, neutral, agree and completely agree in a four-point Likert-type scale. Finally, section D contained statements on science

teachers' perception on the use of educational games for teaching science subjects.

Validity and Reliability of the Instruments

The quality of a research instrument or a scientific measurement is determined by both its validity and reliability (Aikenhead, 2005). Validity seeks to determine whether the instrument actually measures what it is intended to be measured but reliability, on the other hand, refers to the gathering of multiple measurements (Gott, 2003). The questionnaires were developed in consultation with the supervisor to enhance content validity of the instrument. The questionnaires were pilot-tested at selected schools in Akwapem South District in the Eastern Region of Ghana that were not selected for this study. The Akwapem South District was chosen because they had some attributes similar to the accessible population of the study. The results were analyzed afterwards to determine the content validity of the instrument and those items that needed revision.

Pilot-testing is important in that it served the purpose of enhancing the content validity and reliability of the instrument and also to improve the question format and the scales. The IBM SPSS Statistics version 21.0 was used to test the reliability which gave a value of 0.70. A careful analysis of the items was done based on the comments passed by respondents concerning the weakness, clarity and ambiguity in all aspects of the questionnaires.

Data Collection Procedure

Before contacting the schools and their respective Science teachers, permission was sought from the District Education Office of Ghana Education Service (GES) in Akropong in the Eastern Region of Ghana. This was done through an introductory letter from the researcher's academic Head of Department. The selected science teachers were contacted individually to explain the purpose of the study to them. The researcher visited the selected schools and distributed the questionnaire to the 110 science teachers and went through or briefed them on the questionnaire. The instruments were hand delivered to all the participants of the study. The data collection was completed within two weeks in the month of April, 2019.

The ethical considerations in research involve outlining the content of research and what would be required of participants, how informed consent was obtained and confidentiality ensured. It concerns protection of respondents' autonomy, maximizing good outcomes while minimizing unnecessary risk to research assistants. In conducting this study, therefore, explanations about its aims was made to the respondents, so as to obtain their informed consent. Anonymity of the respondents were also assured and the data that they provided treated with utmost confidentiality. As such, the respondents participated in the study voluntarily and mention of their names were avoided.

Data Analysis

Data analysis helps to manipulate the data obtained during the study in order to assess and evaluate the findings and arrive at some valid, reasonable, and relevant conclusions (Aikenhead, 2005). The statistical software that was used to analyze the research data obtained was the IBM SPSS Statistics version 21.0. Research questions one, two, and three were analyzed or answered using descriptive statistics (frequencies and percentages). Research questions two, three and four were also answered using descriptive statistics (mean and standard deviation). Research questions five and six were analyzed using the p-test.

Chapter Summary

This chapter described the methodology and procedures that were used to collect the data from the respondents in the study. The descriptive research design was used to allow the researcher to interpret the results in different ways. The population, the sample and sampling procedures, the research instruments as well as the data collection procedures and the data analysis procedures were also described in this chapter. The chapter further discussed the ethics considered in ensuring the humane treatment of the participants in this research.

CHAPTER FOUR

RESULTS AND DISCUSSION

In this chapter, all data gathered for the study are organized, analysed and this is followed by discussion of key issues relating to the findings of the study. Frequency tables are provided to give statistical reflections on key issues in terms of the research questions. The main thrust of the study is to examine science teacher's perception towards the use of educational computer games in selected senior high schools in Akwapim north district. This chapter dealt with the presentation and discussions of analysed data.

Demographic Characteristics of the Respondents

The demographic characteristics considered in the study were age, sex, highest educational level and years of teaching experience. Of the population, male was 54 (54%) and females 46 (46%). Majority of science teachers were between 41 – 45 years (n=24, 24.0%), with minority of them being between the ages of 56 – 60 (n=1, 1.0%) (See Table 1).

Table 1: *Demographic Information of Research Respondents*

Responses	Frequency	Percent
Age		
Under 25 years	7	7.0
26 – 30 years	21	21.0
31 – 35 years	15	15.0
36 – 40 years	17	17.0
41 – 45 years	24	24.0
46 – 50 years	5	5.0
51 – 55 years	10	10.0
56 – 60 years	1	1.0
Sex		
Male	54	54.0
Female	46	46.0
Highest educational level		
Undergraduate degree	78	78.0
Master's degree	22	22.0
Teaching experience		
1 – 5 years	33	33.0
6 – 10 years	23	23.0
11 – 15 years	24	24.0
16 years and above	20	20.0

Source: Field survey, 2019.

Most studies allege that teaching in the senior high schools is a male dominated area while others think otherwise. For instance, it was revealed that there are more male teachers teaching at the senior high schools than their female counterparts (Yusuf, 2012). However, in Western US schools, Breisser (2010) was found that female teachers were more than male teachers. Even though this was not the focus of the research, males were in a greater proportion compared to females with this study sample.

The data in Table 1 revealed that 78 (78.0%) of the respondents possessed undergraduate degree certificate as their highest level of education whilst 22 (22.0%) possessed a Master's degree (Table 1). Majority of the respondents possessing undergraduate degree further supports the Ghana Education Service's requirement to have senior high teachers have at least an undergraduate degree.

In terms of teaching experience, majority of the science teachers (n = 33, 33.0%) had 1 – 5 years of teaching experience with minority (n = 20, 20.0%) falling under 16 and above teaching experience. With 56% of the science teachers possessing at least 5 years of teaching experience indicate that respondents' interactions with teaching curriculum for that period could be vital in instruction delivery. It can imply that the selected science teachers might have experience in using different strategies in their teaching deliveries.

Research Question 1: To what extent are educational computer games being used in the teaching and learning of science subjects in senior high schools?

This question sought to establish the extent of information technologies used by science teachers in the teaching and learning of science.

Table 2: *Information Technologies Resource Distribution in Respondents' Schools and Support Received by Respondents.*

Responses	Frequency	Percent
Science Centre		
Yes	63	63.0
No	37	37.0
Information Resource Centre		
Yes	71	71.7
No	28	28.3
Availability of Support		
Very frequently	2	2.0
Frequently	14	14.1
Occasionally	58	58.6
Rarely	17	17.2
Never	8	8.1
Scientific Educational Software		
Yes	24	24.0
No	76	76.o
Educational computer games respondents use for teaching and learning		

	Science Journal by Google	3	12.5
	Sun Flower	11	45.8
	Day Dream	6	25.0
	Encarta Kids	4	16.7

Table 2 *Cont.*

Listed Educational Software Respondents			
Use for Teaching and Learning			
	Daydream	3	4.0
	Kerbal Space Program	9	12.0
	Big History Projects	6	8.0
	Ptable	5	6.7
	BioGigital	7	9.3
	Science Journal by Google	8	10.7
	NOVA Labs	11	14.7
	Learn Genetics	4	5.3
	PhET Interactive	5	6.7
	None	17	22.6

Source: Field survey, 2019.

The values in Table 2 revealed that 63.0% of the science teachers said that they had science resource centre in their school whilst 37.0% disagreed. This implies that most of the science teachers revealed that they had a science resource centre in their school. It is clear from Table 2 that, majority (71.7%) agreed that

they had information resource centre in their school whilst 28.3% of the respondents disagreed. It can be concluded that majority of the schools had information resource centre. The data in Table 2 shows that 58 (58.6%) of the science teachers reported that they occasionally received help from their IT instructors. Again, 2 (2.0%) revealed that they were very frequently receiving help from their IT instructors whiles 14 (14.1%) frequently received help. Furthermore, 17 (17.2%) of the teachers indicated that they rarely received help from their IT instructors and the remaining 8 (8.1%) of the teachers never received any help from help from their IT instructors. This implies that majority of the science teachers received planned support from their information technology instructors. This is not encouraging at all.

The results in Table 2 shows that as many as 76% of the science teachers responded in the negative that they do not know any scientific software's that are used in the classroom. The remaining 24% responded in the affirmative. A deduction from the above is that, majority of the science teachers do not know any scientific software's that are used in the classroom. The finding of this study supports the work of Schrader (2010), who concluded that most teachers were not fully aware of scientific software's that are used in the classroom. However, the science teachers who had knowledge on the scientific educational computer games used in the classroom were asked to indicate the type of software's they know. Their responses reveal that, 12.5% of the teachers indicated that they know Science Journal by Google as a scientific software's that are used in class, 45.8% mentioned Sun Flower and 25.0% also mentioned Day Dream. The remaining

16.7% indicated that they know of Encarta Kids as scientific software's that are used in the classroom. In sum, virtually all the science teachers had exceedingly low limited knowledge about educational scientific software.

The science teachers were asked to state the educational scientific software they use in their teaching and learning. As shown in Table 2, 4.0% of the teachers indicated that they use Daydream as educational scientific software in their teaching and learning, 12.0% of the teachers use Kerbal Space Program and 6 (8.0%) use Big History Projects. Again, 6.7% of the teachers use Ptable and PhET Interactive educational scientific software in their teaching and learning respectively. Similarly, 9.3% of the teachers revealed that they use BioGigital as educational scientific software in their teaching and learning, 10.7% of the teachers use Science Journal by Google and 4.7% of the teachers also use NOVA Labs in their teaching and learning. Thus, 5.3% use Learn Genetics as educational scientific software in their teaching and learning and the remaining 22.6% did not use any of the educational scientific software in their teaching and learning. This implies that the majority (22.6%) of the science teachers did not use any of the educational scientific software in their teaching and learning. This level of teachers not using educational scientific software in their teaching and learning, obviously, could be that these science teachers have not receive any help on how to use these software's. This outcome is at complete variance to the study by Takeuchi and Vaala (2014), who revealed that science teachers mostly used drill-and practice games and Jeopardy-style educational computer games in their teaching.

The science teachers were further asked how often they use the following applications in the classroom with their students.

Table 3: *Educational Computer Software's Used by Respondents for Teaching and Learning in the Classroom*

Applications	Daily	Weekly	Monthly	Once a year	Never	Not avail.
Sun Flower	22	24	27	11	5	7
Day Dream	9	23	31	11	12	10
Encarta kids	7	11	39	15	14	9
Phet Interactive	13	19	27	18	8	7
Kerbal Space Program	8	17	43	17	7	4
Big History projects	8	15	31	13	11	16
Ptable	18	6	18	16	8	31
BioGigital	26	17	25	12	9	8
NOVA Labs	9	20	26	15	7	17
Learn Genetics	12	28	33	10	6	7
Science Journal by Google	13	16	43	14	8	4

Source: Field survey, 2019.

The results in Table 3 reveals that the educational computer games that are monthly used in the classroom included Sun Flower (27%), Day Dream (31%), Encarta kids (39%), Phet Interactive (27%), Kerbal Space Program (43%), Big History projects (31%), Ptable (18%), BioGigital (25%), NOVA Labs (26%), Learn Genetics (33%) and Science Journal by Google (43%). Furthermore, 23% of the science teachers indicated that they never used educational computer games in their teaching. This implies that majority of the science teachers monthly used Sun Flower, Day dream, Encarta Kids, Kerbal Space Program, Big History, Projects, Ptable, BioGigital, Science Journal Google, NOVA Labs, Learn Genetics, PhET Interactive in their teaching.

Research Question 2: To what extent do senior high school's science teachers perceive technology as useful to help them teach science subject?

Table 4 shows the descriptive statistics about science teachers' perceived usefulness on technology use in the classroom.

Table 4: *Teachers Perceived Usefulness on Technology use in the Classroom*

Item	SA	A	SD	D	M	SD
Educational computer games can be helpful for my students learning	36	44	7	11	1.94	.950
Educational computer games will motivate my students learn science	34	37	14	12	2.04	.999
Educational computer games will help my students develop science knowledge	29	39	17	12	2.12	.981
Educational computer games will help my students develop 21st century	21	47	16	9	1.96	.647

skills						
CONCERNS						
It is too complicated to use educational computer games in classroom	2	54	20	12	2.46	.757
It is difficult to use educational computer games in classroom	12	43	16	28	2.60	1.03
I have no idea how to teach science using educational computer games	10	15	43	30	2.87	1.03
Computer games can be distracting even though they are educational	8	33	26	30	2.80	.975
Educational computer games are not compatible with my teaching style	19	21	37	19	2.42	1.02

Source: Field survey, 2019.

For the item "Educational computer games can be helpful for students learning" (M = 1.94, SD = .950), 37% respondents strongly agreed, 45% agreed, 7% strongly disagreed and 11% disagreed. "Educational computer games will motivate students learn science" (M=2.04, SD= .999), 35% strongly agreed, 38% agreed, 15% strongly disagreed and 12% disagreed. "Educational computer games will help students develop science knowledge and skills" (M=2.12, SD= .981), 30% respondent strongly agreed, 40% agreed, 18% strongly disagreed and 12% disagreed. "Educational computer games will help students develop 21st century skills" (M=1.96, SD=.647), 23% respondent strongly agreed, 50% agreed, 17% strongly disagreed and 10% disagreed. "It is too complicated to use educational computer games in the classroom" (M=2.46, SD= .757), 2% respondent strongly agreed, 61% agreed, 23% strongly disagreed and 14% disagreed. "It is difficult to use educational computer games in the classroom"

(M=2.60, SD= 1.03), 12% respondent strongly agreed, 44% agreed, 16% strongly disagreed and 28% disagreed. "I have no idea how to teach science using educational computer games" (M=2.87, SD=1.03), 10% respondent strongly agreed, 16% agreed, 43% strongly disagreed and 31% disagreed. "Educational computer games can be distracting even though they are educational" (M=2.80, SD= .975), 8% respondent strongly agreed, 34% agreed, 27% strongly disagreed and 31% disagreed. "Educational computer games are not compatible with my teaching style" (M=2.42, SD= 1.02), 20% strongly agreed, 22% agreed, 38% strongly disagreed and 20% disagreed.

Most science teachers (45%) agreed that educational computer games can be helpful for students learning. Approximately 38% agreed that educational computer games will motivate students to learn science. About 40% of the science teachers believed that educational computer games will help students develop science knowledge and skills. Fifty percentage of the science teachers agreed that educational computer games will help students develop 21st century skills. The science teachers perceived usefulness of educational computer games in teaching. Most of the science teachers agreed that the use of educational games is helpful to students learning, educational games motivate students to learn science, educational games help students develop science knowledge and educational games help students develop 21st century skills. The outcome of this study agreed with the study conducted by Gaudelli and Taylor (2011), Pastore and Falvo (2010) and Takeuchi and Vaala (2014), who concluded that most teachers use educational computer games in their teaching to improve students learning.

The selected science teachers raised some concerns related to the use of educational computer games in teaching were measured using four Likert-scale items (table 4). Overall, the science teachers felt that using educational computer games in the classroom was too complicated or difficult and it can be distracting even though they are educational. However, they did not think that educational computer games were compatible with their teaching style and they have idea on how to teach science subject using educational computer games. The findings are consistent with Gerber and Price (2013) study who concluded that they do not used educational computer games because they believed that their students would not open to game-based pedagogy using computers.

Research Question 3: What are senior high school's science teachers' perceptions on the use of educational computer games for teaching science?

The purpose of the research question was to identify science teachers' perception on the use of educational computer games in teaching. The data were analysed and discussed using mean and standard deviation. A mean score of 2.50 and above indicates positive perception of teachers towards the use of ICT facilities and mean score of 2.49 and below shows negative perception of science teachers towards the use of ICT facilities in the schools. The result is presented in Table 5.

Table 5: *Teachers Perceptions on the use of Educational Computer Games*

Statements	Means	St. Dev.
The use of educational games makes life easier	2.36	1.00
The use of educational games helps me with my job	2.23	.910
The use of educational games drives towards laziness	2.64	.933
The use of educational games makes teaching easier	2.19	.953
ICT is not conducive to good teaching because it creates technical problems	2.80	1.06
The use of educational games causes estrangement	2.74	.998
The use of educational games causes problems	2.80	1.06
Educational games reduce time allocated to teaching	2.39	1.03
The use of educational games relaxes students	2.27	.961
The use of educational games improve curiosity	2.78	4.50
The use of educational games helps me improve myself by learning new things	2.43	1.12
The use of educational games helps me improve me get rid of boredom by performing various activities	2.12	1.07
The use of educational games irritates me due to wrong information	2.69	1.08
Use of educational games enables equality in education		
	3.32	1.01

Source: Field survey, 2019.

It is clear from Table 5 that, most of the teachers agreed that (M=2.80; SD=1.06) ICT is not conducive to good teaching because it creates technical problems. Also, it was found that most of the teachers were in disagreement (M=2.74; SD=.998) with the statement that the use of educational computer

games causes estrangement. To the statement "The use of educational computer games causes problems" it was found that most of the teachers disagreed (M=2.80; SD=1.06) to the statement. On the contrary, most of the teachers agreed that (M=2.39; SD=1.03) the use of educational computer games reduces the time allocated to teaching. Again, most of the teachers agreed that (M=2.27; SD=.961) the use of educational computer games relaxes students.

As shown in Table 5, it was found that most of the teachers agreed (M=2.78; SD=4.50) that educational computer games improve curiosity. To the statement "The use of educational computer games helps me improve myself by learning new things" it was found that majority of the teachers agreed (M=2.43; SD=1.12) to the statement. Similarly, it was found that majority of the teachers agreed (M=2.12; SD=1.07) that the use of educational computer games helps them get rid of boredom by performing various activities. On the contrary, majority of the teachers disagreed (M=2.69; SD=1.08) that the use of educational games irritates them due to wrong information it displays. Moreover, most of the teachers agreed (M=3.32; SD=1.01) that the use of educational computer games enables equality in education.

From Table 5, it can be seen that majority of the science teachers have positive perception towards the use of educational computer games for teaching because the mean of means score of (M=2.55; SD=1.26) indicate that a cluster of teachers agreed to the statement while the standard deviation revealed that most of the teacher were having conscientious response to the items. The results indicated

that science teachers in the Akwapem North District have positive perception towards the use of educational computer games for teaching.

These findings are in line with the view of Enriquez (2010) and Perrotta (2013) that teachers have positive perception towards the use of educational computer games in teaching. Again, these results were congruent to the view of Segers and Verhoeven (2012) and Slouti and Barton (2010) who indicated that teachers believe that educational computer games can motivate students in their learning. Balanskat (2006) are of the view that the use educational computer games enabled teachers to save time and to increase productivity in such activities as preparing and updating daily lessons and maintaining records. This current study also affirmed the findings of Lai and Pratt (2014) who concluded that teachers have positive perception towards the use of educational computer games in their classroom delivery and practice.

Research Question 4: What are the perceived barriers towards the integration of educational computer games for teaching science?

In trying to answer this, respondents were asked what was preventing them from integrating educational computer games for teaching science subject. Their responses are presented in Table 6.

Table 6: *Perceived Barriers Hindering Teachers' Integration of Educational Computer Games in Teaching*

Item	MI[1]	I[2]	MI[3]	SI[4]	NI[5]	LI[6]
Insufficient access to technology	39	18	20	9	3	2
Insufficient skills on the part of teachers	22	22	19	10	8	8
Lack of software for use on available computers	30	24	20	7	7	4
Lack of usable data about the desired focus topic	30	30	12	11	6	2
Lack of specific relevant curriculum that include the use of technology	21	32	13	12	5	7
Inadequate time allocated on timetable for teaching science with IT	23	33	18	4	7	4
There are no available science games for teaching in my school	32	21	14	8	9	5
Do not know how to integrate educational games in my teaching	16	28	30	4	4	7

1= Most Important 2= Important; 3= Moderately Important 4= Slightly Important 5= Not Important 6= Least Important.

Source: Field survey, 2019.

The major barriers to hindering the integration of educational computer games into the classroom most importantly included insufficient access to technology (43%), insufficient skills on the part of teachers (25%), lack of software for use on available computers (33%), lack of usable data about the desired focus topic (33%), lack of specific relevant curriculum that include the use of information technology (36%) and inadequate time allocated on timetable for teaching science with information technology (38%). Again, there are no

available science games for teaching in the school (36%) and (33%) revealed moderately important that they do not know how to integrate educational computer games in their teaching. These barriers were similar to the reasons given by Kirriemuir & McFarlane (2004) and Koh, Kin, Wadhwa and Lim (2011) as the major barriers hindering the integration of educational computer games in teaching. Research by Baek (2008) and Rice (2009) also asserted that inflexible curriculum, limited budgets, and lack of adequate hardware resources were obstacles to the use of educational games in classroom practice.

Research Question 5: What is the perception of science teachers toward the use of educational games for teaching and learning based on the availability of science resource centre.

In order to address this, the science teachers were asked about their perception toward the use of educational games for teaching and learning based on science resource centre. The details are represented in Table 7.

Table 7: *Perception of Teachers Towards the use of Educational Games based on Availability of Science Resource Centre*

Items		N	M	SD	t-value	Sig (2-tail)
1.The use of educational games makes life easier	Yes	63	2.31	.96	-.578	.564
	No	34	2.44	1.07	-.559	.578
2.The use of educational games helps me with my job	Yes	63	2.30	.891	.949	.345
	No	34	2.11	.945	.932	.355
3.The use of educational games gives me the opportunity to follow daily events	Yes	63	2.34	.918	.031	.975
	No	35	2.34	1.02	.030	.976
4.The use of educational games drives students towards laziness	Yes	63	2.63	.866	-.112	.911
	No	35	2.65	1.05	-.106	.916
5.The use of educational games makes teaching easier	Yes	62	2.24	.986	.631	.529
	No	35	2.11	.900	.648	.519
6.ICT is not conducive to good teaching because it creates technical problems	Yes	61	2.88	1.03	1.341	.183
	No	35	2.60	.945	1.374	.173
7.The use of educational games causes estrangement	Yes	62	2.91	1.01	2.32	.022
	No	36	2.44	.908	2.39	.019
8.The use of educational games causes problems	Yes	60	2.86	1.04	.705	.483
	No	34	2.70	1.08	.697	.488
9.The use of educational games reduces the time for teaching	Yes	62	2.48	.987	1.16	.246
	No	35	2.22	1.11	1.12	.263
10.The use of educational games relaxes students	Yes	61	2.50	.959	3.35	.001
	No	34	1.85	.821	3.50	.001
11.The use of educational games improve curiosity	Yes	62	3.09	5.57	.912	.364
	No	35	2.22	1.00	1.19	.237
12.The use of educational games makes finding friends easy	Yes	61	2.32	.889	-.918	.361
	No	35	2.51	1.06	-.874	.386
13.The use of educational games helps me improve myself by learning new things	Yes	61	2.45	1.06	.228	.820
	No	37	2.40	1.16	.233	.816
14.The use of educational games helps me get rid of boredom by performing various activities	Yes	62	2.11	1.08	-.219	.827
	No	37	2.16	1.06	-.221	.826
15.The use of educational games irritates me due to wrong information	Yes	62	2.72	1.09	.380	.705
	No	36	2.63	1.09	.379	.706
16.Use of educational games enables equality in education	Yes	62	2.16	.978	-.215	.033
	No	36	2.61	1.02	-.213	.036

Source: Field survey, 2019.

* = Sig. at 0.05

As shown in Table 7, item on "the use of educational computer games makes life easier", the response for 'Yes' was (M=2.317; SD=.964) and 'No' was (M=2.441; SD=1.078). To the statement "The use of educational games helps me with my job" it was found that 'Yes' had (M=2.301; SD=.891) and 'No' had (M=2.117; SD=.945) to the statement. Similarly, it was found that 'Yes' had (M=2.349; SD=.918) and 'No' had a response with (M=2.349; SD=1.027) to the item "the use of educational games gives me the opportunity to follow daily events". Also, 'Yes' had a value of (M=2.634; SD=.866) and 'No' (M=2.657; SD=1.055) to the item "the use of educational computer games drives students towards laziness". Moreover, 'Yes' had (M=2.241; SD=2.114) and 'No' (M=2.114; SD=.900) on the use of educational games makes teaching easier.

It is clear from Table 7 that, the 'Yes' had (M=2.885; SD=1.034) and 'No' had (M=2.600; SD=.945) on the item "ICT is not conducive to good teaching because it creates technical problems". Also, it was found that 'Yes' had (M=2.919; SD=1.013) and 'No' had (M=2.444; SD=.908) with the statement that the use of educational computer games causes estrangement to ourselves. To the statement "the use of educational computer games causes problems" it was found that the 'Yes' had (M=2.866; SD=1.049) and 'No' had (M=2.705; SD=1.087) to the statement. On the use of educational computer games reduces the time allocated to teaching, the 'Yes' had (M=2.483; SD=.987) and 'No' had (M=2.228, SD=1.113). Again, the 'Yes' had (M=2.508; SD=.959) and the 'No' had

(M=1.852; SD=.821) to the item "the use of educational computer games relaxes students".

As shown in Table 7, the teachers who indicated 'Yes' had (M=3.096; SD=5.571) and 'No' had (M=2.228; SD=1.002) to the item "the use of educational computer games improve curiosity. To the statement "the use of educational computer games helps me improve myself by learning new things" it was found that that the 'Yes' had (M=2.459; SD=1.162) and 'No' had (M=2.405; SD=1.066) to the statement. Similarly, it was found that the 'Yes' had (M=2.112; SD=1.088) and 'No' had (M=2.162, SD=1.067) to the item the use of educational computer games helps them get rid of boredom by performing various activities. Also, the teachers indicated 'Yes' with (M=2.725; SD=1.088) and 'No' with (M=2.638; SD=1.099) to the item "the use of educational games irritates them due to wrong information its displays". Moreover, the teachers who indicated 'Yes' had (M=2.161; SD=.978) and 'No' had (M=2.611; SD=1.021) to the statement "the use of educational computer games enables equality in education".

Also, the p-values are not significant (for items 1, 2, 3, 4, 5, 6, 8, 9, 11, 12, 13, 14 and 15), since the alpha value is more than the 0.05. On the contrary, p-values are not significant (for items 7, 10 and 16), since the alpha value is less than the 0.05.

From Table 7, it can be seen that majority of the items (the use of educational games makes life easier, the use of educational games helps me with my job, the use of educational games gives me the opportunity to follow daily events, the use of educational games drives students towards laziness, the use of

educational games reduces the time for teaching, the use of educational games makes finding friends easy, the use of educational games helps me improve myself by learning new things and the use of educational games enables equality in education) had a consistent standard deviation score. On the contrary, items (the use of educational games helps me with my job, the use of educational games makes teaching easier, ICT is not conducive to good teaching because it creates technical problems, the use of educational games causes estrangement to me, the use of educational games relaxes students, the use of educational games improve curiosity, the use of educational games helps me get rid of boredom by performing various activities and the use of educational games irritates me due to wrong information) had an inconsistent standard deviation score. This implies that the science teachers' perception toward the use of educational games for teaching and learning is based on the availability of science resource centre. This could be attributed to the fact that the use of educational games in teaching is based on the availability of the educational game. This study supports the study of Aik-Ling (2018), who concluded that science teachers in Singapore have positive perception towards the use of educational games in teaching based on its availability. However, the study contradicts the study of Kihoza, Zlotnikova, Bada and Kalegele (2016), who revealed that teachers have poor skills and inefficient on the use of computer software's games in teaching.

Research Question 6: What is the perception of science teachers toward the use of educational computer games for teaching and learning based on their knowledge of educational scientific software.

This question sought to establish the perception of science teachers towards the use of educational games for teaching and learning based on their knowledge on educational scientific software. The details are provided in Table 8.

Table 8: Perception of Teachers Towards the use of Educational Computer Games based on Knowledge on Educational Scientific Software

Items		N	M	SD	t-value	Sig (2-tail)
1.The use of educational games makes life easier	Yes	24	2.62	1.01	1.499	.137
	No	73	2.27	.989	1.481	.147
2.The use of educational games helps me with my job	Yes	24	2.20	.931	-.178	.859
	No	73	2.24	.909	-.175	.862
3.The use of educational games gives me the opportunity to follow daily events	Yes	24	2.50	1.06	.904	.368
	No	74	2.29	.917	.838	.408
4.The use of educational games drives students towards laziness	Yes	24	2.70	1.12	.394	.695
	No	74	2.62	.871	.346	.731
5.The use of educational games makes teaching easier	Yes	24	2.08	.964	-.665	.508
	No	73	2.23	1.20	-.678	.502
6.ICT is not conducive to good teaching because it creates technical problems	Yes	24	2.66	1.20	-.641	.523
	No	72	2.81	.937	-.567	.575
7.The use of educational games causes estrangement to me	Yes	24	3.16	.963	2.44	.016
	No	74	2.60	.976	2.46	.018
8.The use of educational games causes problems	Yes	24	2.87	1.15	.354	.724
	No	70	2.78	1.03	.336	.739
9.The use of educational games reduces the time for teaching	Yes	24	2.25	1.03	-.771	.443
	No	73	2.43	1.04	-.774	.444
10.The use of educational games relaxes students	Yes	24	2.62	.923	2.10	.038
	No	71	2.15	.950	2.13	.038
11.The use of educational games improve curiosity	Yes	24	2.20	.883	-.720	.475
	No	73	2.97	5.15	-1.21	.229
12.The use of educational games makes finding friends	Yes	24	2.50	.978	.614	.541
	No	72	2.36	.953	.606	.548

easy						
13.The use of educational games helps me improve myself by learning new things	Yes	24	2.54	1.25	.515	.608
	No	74	2.40	1.08	.479	.635
14.The use of educational games helps me get rid of boredom by performing various activities	Yes	24	2.00	1.02	-.686	.495
	No	75	2.17	1.09	-.711	.481
15.The use of educational games irritates me due to wrong information	Yes	24	2.75	1.18	.289	.773
	No	74	2.67	1.06	.273	.786
16.Use of educational games enables equality in education	Yes	24	2.45	1.17	.732	.466
	No	72	2.28	958	.658	.515

Source: Field survey, 2019.

* = Sig. at 0.05

As shown in Table 8, item on "the use of educational computer games makes life easier" based on their knowledge on educational scientific software, the response for 'Yes' was (M=2.625; SD=1.013) and 'No' was (M=2.274; SD=.989). To the statement "The use of educational games helps me with my job" it was found that 'Yes' had (M=2.2083; SD=.931) and 'No' had (M=2.246; SD=.909) to the statement. Similarly, it was found that 'Yes' had (M=2.500; SD=1.063) and 'No' had a response with (M=2.297; SD=.917) to the item "the use of educational games gives me the opportunity to follow daily events". Also, 'Yes' had a value of (M=2.708; SD=1.122) and 'No' (M=2.621; SD=.871) to the item "the use of educational computer games drives students towards laziness". Moreover, 'Yes' had (M=2.083; SD=.928) and 'No' (M=2.232; SD=.964) on the issue that the use of educational games makes teaching easier.

It is clear from Table 8 that, the 'Yes' had (M=2.666; SD=1.203) and 'No' had (M=2.819; SD=.939) on the item "ICT is not conducive to good teaching because it creates technical problems". Also, it was found that 'Yes' had

(M=3.166; SD=.963) and 'No' had (M=2.608; SD=.976) with the statement that the use of educational computer games causes estrangement to ourselves. To the statement "the use of educational computer games causes problems" it was found that the 'Yes' had (M=2.875; SD=1.153) and 'No' had (M=2.785; SD=1.034) to the statement. On the use of educational computer games reduces the time allocated to teaching, the 'Yes' had (M=2.250; SD=1.032) and 'No' had (M=2.438, SD=1.040). Again, the 'Yes' had (M=2.625; SD=.923) and the 'No' had (M=2.154; SD=.950) to the item "the use of educational computer games relaxes students".

As shown in Table 8, the teachers who indicated 'Yes' had (M=2.208; SD=.883) and 'No' had (M=2.972; SD=5.158) to the item "the use of educational computer games improve curiosity. To the statement "the use of educational computer games helps me improve myself by learning new things" it was found that that the 'Yes' had (M=2.541; SD=1.250) and 'No' had (M=2.405; SD=1.084) to the statement. Similarly, it was found that the 'Yes' had (M=2.000; SD=1.021) and 'No' had (M=2.173, SD=1.095) to the item the use of educational computer games helps them get rid of boredom by performing various activities. Also, the teachers indicated 'Yes' with (M=2.750; SD=1.188) and 'No' with (M=2.675; SD=1.061) to the item "the use of educational games irritates them due to wrong information it displays". Moreover, the teachers who indicated 'Yes' had (M=2.458; SD=1.178) and 'No' had (M=2.283; SD=.958) to the statement "the use of educational computer games enables equality in education".

Also, the p-values are not significance (for items 1, 2, 3, 4, 5, 6, 8, 9, 11, 12, 13, 14, 15 and 16), since the alpha value is more than the 0.05. On the contrary, p-values are not significance (for items 7 and 10), since the alpha value is less than the 0.05.

From Table 8, it can be seen that few of the items (the use of educational games causes estrangement to me, the use of educational games reduces the time for teaching, the use of educational games relaxes students, the use of educational games improve curiosity and the use of educational games helps me get rid of boredom by performing various activities had a consistent standard deviation score. On the contrary, majority of the items (the use of educational games makes life easier, the use of educational games helps me with my job, the use of educational games gives me the opportunity to follow daily events, the use of educational games drives students towards laziness, the use of educational games makes teaching easier, ICT is not conducive to good teaching because it creates technical problems, the use of educational games causes problems, the use of educational games makes finding friends easy, the use of educational games helps me improve myself by learning new things, the use of educational games irritates me due to wrong information and the use of educational games enables equality in education had an inconsistent standard deviation score. This implies that the perception of science teachers towards the use of educational games is not based on teachers' knowledge on the educational scientific software. The finding of this study contradicts the study of Takeuchi and Vaala (2014), who concluded that the use of computer educational games in teaching depends on its availability.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Introduction

This chapter presents a summary of the findings, conclusion and outlines recommendations including areas for further research.

Summary

The study investigated science teachers' perception towards the use of educational computer games in selected senior high schools in Akwapim North District. Purposive sampling technique was used to select the science teachers in the Akwapim North District. In all one hundred and ten science teachers were selected for the study. Self-administered questionnaire was used as an instrument for the study. SPSS version 20.0 was the software's used for the data analysis. Frequency tables mean and standard deviations were also used in presenting the data. Conclusions from relevant related literature were captured along to authenticate the findings of the study. The summary of the findings is presented as follows:

1. Majority of the science teachers monthly used word processing packages, spreadsheets, digital media, scientific application, presentation software, video streaming, interactive CDs, slides, overhead projector, simulation, software programs and tutorials in their teaching.

2. Most of the science teachers agreed that the use of educational games is helpful to students learning, educational games motivate students to learn science, educational games help students develop science knowledge and educational games help students develop 21st century skills.
3. The science teachers felt that using educational computer games in the classroom was too complicated or difficult and it can be distracting even though they are educational.
4. The results indicated that science teachers in the Akwapem North District have positive perception towards the use of educational computer games for teaching.
5. The major barriers to hindering the integration of educational computer games into the classroom most importantly included insufficient access to technology, insufficient skills on the part of teachers, lack of software for use on available computers, lack of usable data about the desired focus topic, lack of specific relevant curriculum that include the use of information technology and inadequate time allocated on timetable for teaching science with information technology.
6. The science teachers' perception toward the use of educational games for teaching and learning is based on the availability of science resource centre. Similarly, the perception of science teachers towards the use of educational games is not based on teachers' knowledge on the educational scientific software.

Conclusions

The following conclusions were drawn based on the research questions that were set:

It can be concluded that most of the science teachers monthly used word processing packages, spreadsheets, digital media, scientific application, presentation software, video streaming, interactive CDs, slides, overhead projector, simulation, software programs and tutorials in their teaching. This implies that most science teachers in Ghanaian senior high schools use information technologies in their teaching and learning.

From the empirical findings of the study, it was established that the use of educational games for teaching have shown that a wide range of opportunities. These opportunities include its ability to support students learning, motivating students in learning science, helping students to developing science knowledge and helping students developing 21st century skills. By this, it can be concluded that the use of educational games is desirable for science teachers since it offers more engagement in the teaching and learning process.

The science teachers felt that using educational computer games in the classroom was too complicated or difficult and it can be distracting even though they are educational. However, they did not think that educational computer games were compatible with their teaching style and they have idea on how to teach science subject using educational computer games.

The major barriers to hindering the integration of educational computer games into the classroom most importantly included insufficient access to

technology, insufficient skills on the part of teachers, lack of software for use on available computers, lack of usable data about the desired focus topic, lack of specific relevant curriculum that include the use of information technology and inadequate time allocated on timetable for teaching science with information technology.

The science teachers' perception toward the use of educational games for teaching and learning is based on the availability of science resource centre. This could be attributed to the fact that the use of educational games in teaching is based on the availability of the educational game. Similarly, the perception of science teachers towards the use of educational games is not based on teachers' knowledge on the educational scientific software. This could be attributed to the fact that the use of educational games in teaching is not based on only teacher's knowledge but rather the resources.

Recommendations

From the summary of the major findings of this study, it is recommended that:

1. The major barriers hindering the integration of educational computer games into the classroom most importantly included insufficient access to technology, insufficient skills on the part of teachers, lack of software for use on available computers. There is the need for various senior high schools to have the required infrastructure and their relevant technologies that support the integration of educational computer games in teaching and

learning. The provision of enough computers, projectors, and other related technologies will enable science teachers effectively use educational computer games in their teaching and learning.

2. It is also recommended that the old students of the various senior high schools should come on board to financially assist the schools so as to make provisions for more computers and their related accessories and also replace obsolete ones.
3. Technical support and skills are necessary for the integration of educational computer games ICT into teaching and learning in senior high schools, therefore it is recommended that science teachers should be given the necessary training on how to integrate educational computer games in their teaching.
4. Furthermore, there should be an ongoing support for science teachers that will help them to deal with the challenges that they are faced with in their endeavour in integrating educational computer games in their teaching.
5. The findings should be shared with science teachers and teacher educators to emphasize the importance of the appropriate use of computer educational games in teaching.

Suggestions for Further Research

It may be necessary for further research to be conducted on the effectiveness on training model of educational computer games usage in teaching and learning science subject.

REFERENCES

Agyei, D. D. (2013). Effects of using interactive spreadsheet as a demonstrative tool to enhance teaching and learning of mathematics concepts. *International Journal of Educational Planning & Administration, 3*(1), 81-99.

Ahiatrogah, P. D. & Barfi, K. A. (2016). The attitude and competence level of basic school teachers in the teaching of ICT in Cape Coast Metropolis. *Proceedings of INCEDI 2016 Conference*, August 29-31, X 2016.

Ahmad, L, & Jaafar, A. (2012). Computer games: Implementation into teaching and learning. *Procedia - Social and Behavioral Sciences 59*, 515-519.

Aikenhead, G. S. (2005). *Logical Reasoning in Science and Technology: Trial Version 2.* Saskatoon S. K. Department of Curriculum Studies, University of Saskatchewan.

Aik-Ling, T. (2018). Journey of science teacher education in Singapore: Past, present and future. *Tan Asia-Pacific Science Education*, 4(1). 1 - 10

Ajzen, L, & Fishbein, M. (2000). *Understanding attitudes and predicting social behavior.* Englewood Cliffs, NJ: Prentice- Hall.

Akdemir, A. S., & Akdemir, O. A. (2017). Learning and teaching: Theories, approaches and models. *Journal of Cihan Sokak, 13*(6), 3-140.

Alvarez, C., Brown, C., & Nussbaum, M. (2011). Comparative study of netbooks and tablets PC for fostering face-to-face collaborative learning. *Computers in Human Behaviour, 27*(2), 834-844.

Amedahe, K., & Gyimah, E. (2003). *Introduction to Educational Research* (CCUCC) 149 - 150.

Amin A. L. (2005). An exploration of pre-service teachers' perceptions of learning to teach while using asynchronous discussion board. *Educational Technology and Society, 12*(2), 86-100.

An, Y. (2015). Games to promote inquiry learning. In J. M. Spector (Ed.), *Encyclopedia of educational technology* (1 -20) Thousand Oaks, CA: SAGE Publication.

An, Y., & Bonk, C. J. (2009). Finding that special place: Designing digital game-based learning environments, *Tech Trends, 53*(3), 43- 48.

An, Y. J., Haynes, L, D'Alba, A., & Chumney, F. (2016). Using educational computer games in the classroom: Science teachers' experiences, attitudes, perceptions, concerns, and support needs. Contemporary Issues in Technology & Teacher Education, 16(4),4-16.

Awan, R. N. (2011). What happens to teachers ICT attitudes and classroom ICT use when teachers are made to play computer games? *International Journal of Information and Education Technology, 1*(4),354-359.

Awanta, E. K., & Asiedu-Addo, S. K. (2008). *Essential statistical research for universities, colleges and research institutions*. Accra: Salt and Light Publishers.

Baek, Y. K. (2008). What hinders teachers in using computer and video games in the classroom? Exploring factors inhibiting the uptake of computer and video games. *Cyberpsychology & Behavior, 11*(6), 665-671.

Balanskat, A., Blamire, R. & Kefala, S. (2006). *The ICT impact report: A review of studies of ICT impact on schools in Europe.* European Schoolnet.

Baturay, M. H., Gokcearslan, S., & Sahin, S. (2017). Associations among teachers' attitudes towards computer-assisted education and TPACK competencies. *Informatics in Education, 16*(1), 1-23.

Beavis, C., Rowan, L., Dezuanni, M., Mcgillivray, C., O'Maria, J., Prestridge, S., Stieler-Hunt, C., Thompson, R., & Zagami, J. (2014). Teachers' beliefs about the possibilities and limitations of digital games in classroom. *E-Learning and Digital Media, 11(*6), 569-582.

Bigum, C. (2007). Teachers and computers: In control or being controlled? *Australian Journal of Education, 41*(3), 247-261.

Blackwell, C. (2014). Teacher practices with mobile technology integrating tablet computers. *Journal of Education Research, 7*(4), 1-25.

Boyle, A. (2016). *Emotional regulation and technology in various educational environments.* Unpublished certificate of advanced study Thesis, Sacred Heart University, Fairfield, CT. Available at: http://digitalcomrnons.sacredheart.eduJedl/12. (Assessed 13 May 2018).

Bragininsky, T., & Bragininsky, B. (1974). *Mainstream psychology*: A critique. New York: Holt, Rinehard and Winston, Inc.

Breisser, D. C. (2006). Learning about and learning from expert teachers. *Educational Research Publication, 35*,463 - 470.

Cankaya, S., & Karamete, A. (2009). The effects of educational computer games on students' attitudes towards mathematics course and educational

computer games. World Conference on Educational Sciences 2009, *Procedia Social and Behavioral Sciences*, 145-149.

Chung-Ho, S., & Ching-Hsue, C. (2013). 3D game-based learning system for improving learning achievement in software engineering curriculum. *The Turkish Online Journal of Educational Technology, 12*(2), 1-12.

Cocorada, E., & Maican, C. L. (2017). Anxiety with and without new technology among Romanian high school students. E*uropean Journal of Interdisciplinary Studies, 3*(3),22-30.

Cohen, I. (2004). *Research methods in education*. London: Croom Helm Ltd.

Cohen, L., Manion, L., & Morrison, K. (2007). *Research methods in education* (6th ed.). London and New York: Routledge.

Coller, B. D., & Shernoff, D. 1. (2009). Video game-based education in mechanical engineering: A look at student engagement. *International Journal of Engineering Education, 25*(2), 308-317.

Collins, A., & Halverson, R. (2015). Rethinking education in the age of technology: *The digital revolution and schooling in America (Technology, Education-Connections* (The TEC Series)) (15t ed.). Retrieved from www.amazon.com.

Connolly, T. M., Boyle, E. A., MacArthur, E., Hainey, T., & Boyle, J. M. (2012). A systematic literature review of empirical evidence on computer games and serious games. *Computers & Education, 59*(2), 661-686.

Creighton, S., & Szyrnkowiak, A. (2013). The effects of cooperative games on classroom interaction frequencies. *Procedia - Social and Behavioral Science, 140,* 155-163.

Cummings, J., & Hill, S. (201S). Enhancing the classroom experience: Instructor use of tablets. *Information Systems Education Journal, 13*(S),62-6S.

Dhir, A., Gahwaji, N. M., & Nyman, G. (2013). The role of the iPad in the hands of the learner. *Journal of Universal Computer Science, 19*(5), 706-727.

Dichev, C., & Dicheva, D. (2017). Gamifying education: what is known, what is believed and what remains uncertain: A critical review. *International Journal of Educational Technology in Higher Education, 14*(9), 11.

Domínguez, A., Saenz-de-Navarrete, J., de-Marcos, L., Fernández-Sanz, L., Pagés, C., & Martínez-Herráiz, J. J. (2013). Gamifying learning experiences: Practical implications and outcomes. *Computers & Education, 63*(1),380-392.

Dondlinger, M. J. (2007). *Educational video game design: A review of the literature*. In J.W Rice (Ed.), Denton, Texas.

Eady, M. J., & Lockyer, L. (2013). *Tools for learning: technology and teaching strategies', learning to teach in the primary school*, Queensland University of Technology, Australia, 71.

Enriquez, A. G. (2010). Enhancing student performance using tablet computers, *College Teaching, 58*(3), 77-84.

Escobar-Chaves, S. L., & Anderson, C. A. (2008). Media and risky behaviors. *The Future of Children,18*(1), 147-180

Falloon, G. (2015). What's the Difference? Learning collaboratively using iPads in conventional classrooms. *Computers & Education, 84*, 62- 77.

Fister, K. R., & McCarty, M. L. (2008). Mathematics instruction and the tablet PC. *International Journal of Mathematical Education in Science and Technology, 39*(3), 285-292.

Fu, J. S. (2013). ICT in education: A critical literature review and its implications. *International Journal of Education and Development Using Information and Communication Technology, 9*(1), 112-125.

Gall, M. D., Borg, R. G., & Gall, 1. P. (2006). E*ducational research: An Introduction* (6th ed.). Longman Publishers, N.Y.

Gaudelli, W., & Taylor, A. (2011). Modding the global classroom? Serious video games and teacher reflection. *Contemporary Issues in Technology and Teacher Education, 11*(1), 70-91.

Gay, L. P. (1992). *Educational RESEARCH: Competencies for analysis and application.* Englewood Cliffs, New Jersey: Charles E. Merrill Publishing Company.

Gee, J. P. (2003). Opportunity to learn: A language-based perspective on assessment. *Assessment in Education, 10*(1), 27-46

Gerber, H. R., & Price, D. P. (2013). Fighting baddies and collecting bananas: Teachers' perceptions of games-based literacy learning. *Educational Media international, 50*(1),51-62.

Ghana Education Service (2002). *Circuit supervisors handbook*. Accra: Ghana Publishing Corporation.

Gott, S. B. (2003). Books make a difference: A study of access to literacy. In *Reading Research Quarterly, 34*, 286-311.

Granic, I., Lobel, A., & Engels, C. M. (2013). The benefits of playing video games. *American Psychological Association, 69*(1), 66-78.

Habgood, M. P., & Ainsworth, S. E. (2011). Motivating children to learn effectively: exploring the value of intrinsic integration in educational games. *Journal of the Learning Sciences, 20*(2), 169-206.

Hawkridge, D. (1990). Computers in third world schools. The example of China. *British Journal of Educational Technology, 21* (1),4-20.

Hennessy, S. (2005). Teacher perspectives on integrating ICT into subject teaching: Commitment, constrains, caution, and change. *Journal of Curriculum Studies, 37*,155-192.

Hermans, R., Tondeur, J., van Braak, J., & Valcke, M. (2008). The impact of primary school teachers' educational beliefs on the classroom use of computers. *Computers & Education, 51*, 1499-1509.

Hitch, L., & Duncan, J. (2005). Games in higher ed.: When Halo 2, Civilization IV, and X Box 360 come to campus. *Educause Evolving Technologies Committee.*

Hu, H., & and Garimella, U. (2014). iPads for STEM Teachers: A case study on perceived usefulness, perceived proficiency, intention to adopt, and integration in K-12 Instruction, *Journal of Educational Technology Development and Exchange, 7*(1), 4 – 12

Ifenthaler, D., & Schweinbenz, V. (2016). Students acceptance of tablets PCs in the classroom. *Journal of Research on Technology in Education, 48*(4), 306-341.

Inan, F. A. & Lowther, D. L. (2010). Factors affecting technology integration in K-12 classrooms: A path model. E*ducational Technology Research and Development, 58*(2), 137-154.

John, P., & Sutherland, R. (2004). Transforming teaching and learning: Embedding ICT into everyday classroom practices. *Journal of Computer Assisted Learning, 20*(6), 413 - 425.

Johnson, M. (2005). Learning and teaching with technology. *British Journal of Educational Technology, 36*(4), 693-705.

Johnson, W. L., Vilhjalmsson, H. H., & Marsella, S. (2005). Serious games for language learning: How much game, how much AI? AIED. 2 – 12.

Kadel, R. (2005). How teacher attitude affect technology. *Learning and Leading with Technology, 39*(5),34 - 47.

Kangas, M., Koskineen, A., & Krokfors, L. (2017). A qualitative literature review of educational games in the classroom: the teacher's pedagogical activities. *Journal Teachers and Teaching, 23*(4). 452- 466.

Khatatney, N. A. K., & Teh, K. S. M. (2018). Attitudes of primary school teachers towards the use of computerized educational games in the teaching of English language. *International Journal of Academic Research in Progressive Education and Development, 7*(4),280-294.

Kihoza, P., Zlotnikova, 1., Bada, J. & Kalegele, K. (2016). Classroom ICT integration in Tanzania: Opportunities and challenges from the perspectives of TP ACK and SAMR models. *International Journal of Education and Development using ICT, 12*(1), 1- 35

Kirriemuir, J. (2002). Video gammg, education and digital learning technologies: Relevance and opportunities. *D-Lib Magazine, 8*(2). Available at: http://www.dlib.org/dlib/february02/kirriemuir/02kirriemuir.html. (Assessed 20th May, 2018).

Kirriermuir, J. & McFarlane, A. (2004). *Report 8: Literature review in games and learning*. Page 1 – 12. Futurelab Series.

Klein, M., & Freitag, M. (2006). An improved method to assess the quality of large eddy simulations in the context of implicit filtering, *Journal of Turbulence, 7.*

Klopfer, E. & Squire, K. (2008). Environmental detectives - The development of an augmented reality platform for environmental simulations. *Educational Technology Research and Development, 56*(2), 203-228.

Koh, E., Kin. Y. G., Wadhwa, B., & Lim, J. (2011). Teacher perceptions of games in Singapore schools. *Simulation & Gaming, 42* (4), 1 – 16.

Koile, K., & Singer, D. (2006a). *Development of a Tablet-PC-based System to Increase Instructor-Student Classroom Interactions and Student Learning,* To appear in The Impact of Pen-based Technology on Education; Vignettes, Evaluations, and Future Directions. Berque, D., Gray, J., and Reed, R. (Eds.). Purdue University Press.

Korte, W. B., & Husing, T. (2007). Benchmarking access and use of lCT in European schools 2006: Results from Head teacher and a classroom surveys in 27 European countries, *e-learning papers, 29*(10), 1-6.

Kozma, R. (2008). World links for development: Accomplishments and challenges. *Monitoring and Evaluation Annual Report*. California, Centre for Technology International.

Kuss, D. J. (2013). Intemet gaming addiction: Current perspectives. *Psychological Resource Behaviour Management, 6,* 125-137.

Lai, K. W., & Pratt, K. (2004). Information communication technology in secondary schools: The role of the computer coordinator, *British Journal of Educational Technology, 35*(4), 461-475.

Laubsch, L. J. (2006). Digital natives as pre-service teachers: What technology preparation is needed? *Journal of Computing in Teacher Education, 25*(3), 87-97.

Leady, N. (1993). *Education research for modern scholars.* Enugu: Fourth Dimension.

Leonard, A. A., Meng-Tzu, C., & Shawn, H. (2010). Assessing twenty-first century skills through a teacher created video game for high school biology students, *Research in Science & Technological Education, 28* (2), 101-114.

Leung, L., & Zhang, R. (2016). Predicting tablet use: A study of gratifications-sought, leisure boredom, and multitasking. *Telematics and Informatics, 33*, 331-341.

Liaw, S. S, Hatala, M., & Huang, H. M. (2010). Investigating acceptance toward mobile learning to assist individual knowledge management: Based on activity theory approach. *Computers & Education, 54*, 446-454

Licorish, S. A., Owen, H. E., Daniel, B., & George, J. L. (2018). Students' perception of Kahoot's influence on teaching and learning. *Research and Practice in Technology Enhanced Learning, 13*(9), 1 - 6.

Lymbery, J. (2017). *Listening to student voices: A phenomenological investigation of the student experience of using technology for learning*. Thesis submitted to the Victoria University of Wellington.

Mahfouz, S. M. & Ihmeideh, F. M. (2009). Attitudes of Jordanian university students towards using online chat discourse with native speakers of English for improving their language proficiency. *Computer Assisted Language Learning, 22*(3),207-227.

Maraffi, S., Sacerdoti, F. M., & Paris, E. (2017). Learning on gaming: A new digital game based learning approach to improve education outcomes, *US-China Education Review, 7*(9),421-432.

Marino, M. T., Israel, M., Beecher, C. C., & Basham, J. D. (2013). Students' and Teachers' Perceptions of Using Video Games to Enhance Science Instruction. *Journal of Science Education and Technology, 22*(5),667-680.

Marshall, T., Champagne-Langabeer, T., Castelli, D., & Hoelscher, D. (2017). Cognitive computing and e-Science in health and life science research:

Artificial intelligence and obesity intervention programs. *Health Information Science System, 5*(1), 13

Mayer, R. E. (2019). Computer games in education. *Annual Review of Psychology, 70,* 531-549.

Melhuish, K. & Falloon, G. (2010). Looking to the future: M-learning with the iPad. *Computers in New Zealand Schools, 22*(3), 1-16.

Milken, T. (1999). Educational technology, policy and practice. *Educational Evaluation and Policy Analysis, 9*(2), 153 - 170.

Motamedi, V., & Bakhtiary, L. (2014). The impact of computer games on creativity and academic achievement. *Sky Journal of Education, 2*(3), 15-19.

Nairn, C. P. (2011). *Computer games use in an educational system*. PhD thesis, University of Nottingham.

Nguyen, L., Barton, S. M., & Nguyen, L. T. (2015). iPads in Higher Education - Hype and Hope. *British Journal of Educational Technology, 46*(1), 190-203.

Okur, M., & Aygenc, E. (2018). Video games as teaching and learning tool for environmental and space design. *Eurasia Journal of Mathematics, Science and Technology Education, 14*(3), 977-985.

Oliver, K. (2013). Preparing teachers for technology integration: Programs, competencies and factors from the literature. *National Teacher Education Journal, 6*(3), 41-60.

Pastore, R. S., & Falvo, D. A. (2010). Video games in the classroom: Pre- and in service teachers' perceptions of games in the K-12 classroom. *International Journal of Instructional Technology and Distance Learning. 7*(12), 49-57.

Perrotta, C. (2013). Do school-level factors influence the educational benefits of digital technology? A critical analysis of teachers' perceptions. *British Journal of Educational Technology, 44*(2),314-327.

Plass, J. L., Homer, B. D., & Kinzer, C. K. (2015). Foundations of game-based learning, *Educational Psychologist, 50*(4), 258-283

Plass, J. L., Perlin, K., & Nordlinger, J. (2010). The games for learning institute: Research on design patterns for effective educational games. *Paper presented at the Game Developers Conference*, San Francisco, CA.

Prensky, M. (2002). The motivation of gameplay, the real twenty-first century learning revolution, *On the Horizon, 10* (1), 5-11.

Prensky, M. (2007). *Digital game-based learning.* St. Paul, MN: Paragon House.

Proctor, M., & Marks, Y. (2013). A survey of exemplar teachers' perceptions, use, and access of computer-based games and technology for classroom instruction. *Computers & Education 62*, 171-180.

Qteefan, G. N. (2012). *The effectiveness of educational computer games on Palestinian fifth graders' achievement in English language in Gaza Governorates.* Unpublished M.A thesis. The Islamic University of Gaza.

Raphael, C., Bachen, C, Lynn, K-M., Mckee, K., & Baldwin-Philippi, J. (2010). Games for civic learning: A conceptual framework and agenda for research and design. *Games and Culture, 5,* 199-235.

Razak, A., & Connolly, T. (2013). Using games for learning, from the students' perspective, *Games and Learning Alliance,3,* 1-11.

Redmond, D. L. (2010). *The effect of video games on family communication and interaction.* Graduate Theses and Dissertations, 116 – 214.

Republic of Ghana, (2003). *The Ghana ICT for Accelerated Development (ICT4AD) policy*. Accra, Ghana: Graphic Communications Group Limited.

Rice, J. W. (2007). New media resistance: barriers to implementation of computer video games in the classroom. *Journal of Educational Multimedia and Hypermedia, 16* (3), 249-261.

Rickard, W., & Oblinger, D. (2004). *Unlocking the potential of gaming technology*. Retrieved December 18, 2003, from email communication.

Rocare, T. M. (2006). Computer block, does it exist in comprehensive school? *British Journal of Educational Technology, 28*(3), 219-221.

Ronimus, M., Eklund, K., Pesu, L., & Lyytinen, H. (2019). Supporting struggling readers with digital game-based learning. *Educational Technology Research and Development, 3*, 639-663.

Sabzian, F., & Gilakjani, A. P. (2013). Teachers' attitudes about computer technology training, professional development, integration, experience,

anxiety and literacy in English language teaching and learning. *International Journal of Applied Science and Technology, 3*(1),67-75.

Santos, A. (2015). *Instructional strategies for game-based learning*. Encyclopedia of instructional Systems and Technology, IGE-Global.

Sarantakos, S. (2012). *Social Research* (4th ed.). Palgrave Macmillan, London.

Segers, E., & Verhoeven, L. (2009). Learning in a sheltered Internet environment: The use of WebQuests. *Learning and Instruction, 19*, 423-432.

Sengupta, P., Sharma, A., & Das, N. (2017). Is there any benefit of integrating computer-assisted learning with conventional teaching format in pharmacology to demonstrate the effects of different drugs on mean arterial blood pressure. *Journal of Biological Medicine, 8*(2), 181-185.

Schrader, P. G., Zheng, D., & Young, M. (2006). Teachers' perceptions of video games: MMOGs and the future of pre-service teacher education. Innovate: *Journal Online Education, 2*(3), 1-10.

Shaffer, D. W., Squire, K. R., Halverson, R., & Gee, 1. P. (2005). Video games and the future of learning. *Phi Delta Kappan, 87*(2), 104-111.

Simkova, M. (2013). Using of computer games in supporting education. Procedia – *Social and Behavioral Sciences, Science Direct, l41*, 1224-1227.

Suárez-Guerrero, C., Lloret-Catalá, C., & Mengual-Andrés, S. (2016). Teachers' perceptions of the digital transformation of the classroom through the use of tablets: A study in Spain. *Comunicar, 49,* 81 - 89

Takeuchi, L M., & Vaala, S. (2014). Level up learning: A national survey on teaching with digital games. Available at:

http://www.joanganzcooneycenter.org/wpcontentluploads/2014/10/jgccleveluplearning_final.pdf. (Assessed 15 July 2019).

Tashakkori, A., & Teddlie, C. (2003b). The past and future of mixed methods research: From data triangulation to mixed model designs. In A. Tashakkori & C. Teddlie (Eds.), *Handbook of mixed methods in social & behavioral research* (pp. 671-702). Thousand Oaks, CA: Sage.

Teo, T., Chai, C. S., Hung, D., & Lee, C. B. (2008). Beliefs about teaching and uses of technology among pre-service; *Asia Pacific Journal of Teacher Education, 36*,165-176.

Teye, A. E. (2012). *Assessment of ICT situation in Senior High School A case study in Manya Krobo district.* Unpublished thesis submitted to institute of distance learning, in partial fulfillment for the degree of Commonwealth Executive Master of Business Administration: Kwame Nkrumah University of Science and Technology.

Thierer, A. (20] 5). The Internet of things and wearable technology: Addressing privacy and security concerns without derailing innovation, *21 Rich J L. & Technology, 6,* 12 - 19

Tobarra, L., Robles-Gomes, A, Ros, S., Hernandez, A., & Caminero, A. (2014). Analyzing the students' behaviour and relevant topics in virtual learning communities. *Computers in Human Behaviour, 31*(1),659-669.

Tobias, S., Fletcher, J. D., & Wind, A. P. (2014). Game-based learning. J. M. Spector et al. (eds.), *Handbook of Research on Educational Communications and Technology, 4,* 485 – 503.

Trybus, J. (2015). Game-Based Learning: What it is, Why it Works, and Where it's Going. New Media Institute. Available at: http://www.newmedia.orglgame-based-learning-what-it-is-why-it-works-and-where-itsgoing.html. (Assessed 20 March 2018).

Turner, P. E., Johnston, E., Kebritchi, M., Evans, S., & Heflich, D. A. (Eds.) (2018). Influence of online computer games on the academic achievement of nontraditional undergraduate students, *Cogent Education, 5*(1), 34.

Ucas, S. (2014). Elementary school teachers views on game-based learning as a teaching method. *5th World Conference on Learning, Teaching and Educational Leadership, WCLTA 2014, Procedia - Social Behavioral Sciences, 186*, 401-409.

Vasileiadou, 1., & Makrina, Z. (2017). Using online computer games in the ELT classroom: A case study. *English Language Teaching, 10*(12), 134-150.

Vlachopoulos, D., & Makri, A. (2017). The effect of games and simulations on higher education: A systematic literature review. *International Journal of Education in Higher Education, 14*(22), 2-19.

Whitton, N. (2010). Game engagement theory and adult learning. *Simulation & Gaming, 42*(5), 596-609.

Yurdakul, 1. K., & Izmirli, S. (2015). Investigation of prospective teachers' information and communication technology integration practices in terms of transformative learning theory. *Educational Sciences: Theory and Practice, 14*(6), 14.

Yung-hsun, c., & Chia-wen, W. (2017). Factors influence the digital media teaching of primary school teachers in a flipped class: A Taiwan case study. *South African Journal of Education, 37*(1), 1-12.

Yusuf, M. O. (2011). An investigation into teachers' self-efficacy in implementing computer education in Nigerian secondary schools. Meridian: *A Middle School Computer Technologies Journal, 8*(2), 4.

Zhang, P., & Aikman, S. (2007). Attitudes in ICT acceptance and use. In *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics),* 4550 LNCS, 1021-1030.

Zhonggen, Y. (2019). A meta-analysis of use of serious games in education over a decade. *International Journal of Computer Games Technology*, *23*, 1 – 6.

Zubković, R., Kolić-Vehovec, 8., Maglica, S. K., Smojver-Ažić, B., & Pahljina-Reinic, S. (2016). Attitudes of students and parents towards lCT with regard to the experience of using the iPad in classroom, *Suvremena Psihologija, 19*(1),37-47.

APPENDIX A

UNIVERSITY OF CAPE COAST

COLLEGE OF DISTANCE EDUCATION

A STUDY TO INVESTIGATE SENIOR HIGH SCHOOL SCIENCE TEACHERS' PERCEPTION ON THE USE OF EDUCATIONAL COMPUTER GAMES FOR TEACHING AND LEARNING

Section A: Demographic Information

1. Age: …….
2. Sex: Male [ ] Female [ ]
3. Highest educational level attained:

   1st Degree [ ] Masters [ ] PHD. [ ]
4. How long have you been teaching? .....Years …… Months
5. Do you have science resource centre? Yes [ ] No [ ]
6. Do you have Information Technology (IT) resource centre?

   Yes [ ] No [ ]
7. How often do you receive help from IT instructors?

   Very frequently [ ]

   Frequently [ ]

   Occasionally [ ]

   Rarely [ ]

   Never [ ]

Section B: ICTs Available for Teaching Science Subjects

8. Do you know any scientific software's that are used in class?

   Yes [ ] No [ ]

9. If yes, please specify

   ……

10. Which of the following educational scientific software do you use for teaching and learning? [You can tick more than 1]

    Daydream [ ]

    Kerbal Space Program [ ]

    Big History Projects [ ]

    Ptable [ ]

    BioGigital [ ]

    Science Journal by Google [ ]

    NOVA Labs [ ]

    Learn Genetics [ ]

    PhET Interactive Simulation [ ]

    Other (specify): ……

SECTION C: Approximately, how often do you use each of these applications in the classroom with your students? Check or tick one in the boxes provided.

	Daily	Weekly	Monthly	Once or twice a year	Never	Not Available

Computers in general						
Word processing packages						
Spreadsheets						
Digital media						
Scientific application						
Presentation software (e.g. PowerPoint)						
Video streaming (e.g. YouTube)						
Interactive whiteboard (e.g. Smart board)						
Search engines for the Internet (e.g. Infoseek, Google)						
Interactive CDs						
Slides						
Overhead projector						
Television						
Simulation/Science software programs						
Radio						
Educational portals						
Drill/Practice programs, Tutorials						

Section D: Science Teachers Perceived Usefulness on Technology Use in the Classroom

Please indicate the extent to which you agree or disagree with the following statements

SN	ITEM	Strongly Agree	Agree	Strongly Disagree	Disagree
1.	Educational computer games can be helpful for my students learning.	[ ]	[ ]	[ ]	[ ]
2.	Educational computer games will motivate my students learn science	[ ]	[ ]	[ ]	[ ]
3.	Educational computer games will help my students develop science knowledge and skills.	[ ]	[ ]	[ ]	[ ]
4.	Educational computer games will help my students develop 21st century skills.	[ ]	[ ]	[ ]	[ ]
CONCERNS		[ ]	[ ]	[ ]	[ ]
1.	It is too complicated to use educational computer games in the classroom	[ ]	[ ]	[ ]	[ ]
2.	It is difficult to use educational computer games in the classroom.	[ ]	[ ]	[ ]	[ ]
3.	I have no idea how to teach science using educational computer games.	[ ]	[ ]	[ ]	[ ]
4.	Computer games can be distracting even though they are educational.	[ ]	[ ]	[ ]	[ ]
5.	Computer games are not compatible with my teaching style.	[ ]	[ ]	[ ]	[ ]

Section E: Teachers Perceptions on the use of Educational Computer Games

Please indicate the extent to which you agree or disagree with the following statements

SN ITEM	Strongly Agree	Agree	Strongly Disagree	Disagree
1. The use of educational games makes life easier	[ ]	[ ]	[ ]	[ ]
2. The use of educational games helps me with my job	[ ]	[ ]	[ ]	[ ]
3. The use of educational games gives me the opportunity to follow daily events	[ ]	[ ]	[ ]	[ ]
4. The use of educational games drives students towards laziness	[ ]	[ ]	[ ]	[ ]
5. The use of educational games makes teaching easier.	[ ]	[ ]	[ ]	[ ]
6. The ICT is not conducive to good teaching because it creates technical problems	[ ]	[ ]	[ ]	[ ]
7. The use of educational games causes estrangement to ourselves	[ ]	[ ]	[ ]	[ ]
8. The use of educational games causes problems	[ ]	[ ]	[ ]	[ ]
9. The use of educational games reduces the time allocated to teaching	[ ]	[ ]	[ ]	[ ]
10. The use of educational games relaxes students	[ ]	[ ]	[ ]	[ ]
11. The use of educational games improve curiosity	[ ]	[ ]	[ ]	[ ]
12. The use of educational games makes finding friends easy.	[ ]	[ ]	[ ]	[ ]
13. The use of educational games helps me improve myself by learning new things	[ ]	[ ]	[ ]	[ ]
14 The use of educational games helps me get rid of boredom by performing various activities	[ ]	[ ]	[ ]	[ ]
15. The use of educational games irritates me due to wrong information	[ ]	[ ]	[ ]	[ ]
16. The use of educational games enables equality in education	[ ]	[ ]	[ ]	[ ]

Section F: Perceived Barriers and Support Needs

Rank each of the following from the most important (1) to least (6). A rank of one (1) would indicate that this challenge is the most important challenge you face in using Information Technologies to enhance teaching of science in your classroom.

…….. Insufficient access to technology.

…….. Insufficient skills on the part of teachers.

…….. Lack of software for use on available computers.

…….. Lack of usable data about the desired focus topic.

…….. Lack of specific relevant curriculum that include the use of information technology.

……. Inadequate time allocated on timetable for teaching science with information technology.

……. There are no available science games for teaching in my school.

…….. Do not know how to integrate educational games in my teaching.