Research Article

THE EFFECT OF COMPUTER STIMULATION ON STUDENT ACHIEVEMENT AND RETENTION IN CHEMISTRY

[1,][*]Oluchi Emedolu Udodi, [1]Chinaza Chinaecherem Onuegbu, [1]Igboegwu Ekene, and [2]Adiel Nwaigwe

[1]Department of Education/Chemistry, Faculty of Science Education, University of Nigeria, Nsukka, Nigeria
[2]Department of Computer science, Faculty of Science, University of Nigeria, Nsukka, Nigeria

Abstract

This study was carried out to determine the effect of computer simulation on students' achievement and retention in Chemistry, four research questions were formulated to guide the study. The researchers reviewed some related literature. The study adopted a quasi experimental research design, one hundred and fifty (150) SS2 Chemistry students selected from four (4) schools were used. The reliability of the instrument was also tested. Mean and standard deviation were used to answer research questions while From the findings, it was observed that the use of computer simulation in teaching Chemistry had a significant effect on students' achievement and retention among others. Conclusion, recommendations were made based on findings.

Keywords: Computer stimulation, Student achievement, Retention, Chemistry.

INTRODUCTION

The science of today is the technology of tomorrow. Science is a way of life; it is a process that takes from confusion to understanding in a manner that is precise, predictive and reliable, a transformation for those lucky enough to experience it. Science is an organized body of knowledge, based on facts and tested truths arranged in an orderly system (Emendu, 2014). Richard (2010) defined science as the study of the physical and natural world, a phenomenon using a systematic observation and experimentation. Chemistry as one of the major branches of science, is the mother of all sciences. Mohammed Bella and Twandu (2010) described Chemistry as the oracle of modern science. Chemistry is the branch of science which deals with matter, its composition, properties, its reaction, interaction and uses (Ababio, 2018). It is also the branch of science that has enabled the scientists to discover the usefulness of matter. It is concern with the atom and particularly with the properties of chemical bond. It can also be seen as the study of matter and energy and interaction between them (Ugo, 2019). Research findings have shown that computer could be used in the classrooms to improve students' acquisition of basic skills. Computer is a special multi-purpose device that is capable of receiving instructions, storing, processing and giving a desired result at an incredible high speed. Bakac *et al.* (2010) said that computer can be used as an instructional material or technique that can assist teachers to make instructions more effective, flexible and enjoyable. Computer provides equivalent opportunities for all learners to interact with the learning process while taking into account the individual differences among learners with characteristics that appeal to more than one sense at a time. Simulations are activities or materials that present real life situations, past events or organization in such a way that students will learn and understand more about them. It is a model of the real world, in which the participants have specific roles to play, make decisions and solve problems according to specified condition.

Simulation according to the encyclopedia of education is an operating model, reproduction or imitation of physical or socialize phenomena consisting of a set of interrelated factor's or variables which function in essentially the same manner as the actual or hypothetical system (Encyclopedia of Education, vol.4). Computer simulations are therefore computer-generated versions of real-world objects. Computer simulations provide near-authentic environment, context and situation for task-based learning (Chen *et al.,* 2013). Computer simulations enable learners to view events, processes and activities, that otherwise may not have been available to them through interactive engagement. Although at first, computer simulations were mainly used in applied field, such as aviation and medic imaging, but these technologies have now edged their way into science classrooms (Kaheru *et al.,* 2011). Academic achievement describes academic outcomes that indicate the extent to which a student has achieved their learning goals. Achievement maybe defined as the act of achieving or successful performance. It is the level of performance attained by a learner in a task (Karma, 2012). According to Akinteye (2014) it is a task that someone has carried out successfully, especially using his effort and skills. In this study, academic achievement means learning outcome which has to do with the knowledge attained from teaching process. Therefore, achievement is excellent in all academic disciplines, in class as well as co-curricular activities. Retention is referred to the act of absorbing, holding or continuing to hold or have facts of things learned. Horn by (2013) defined retention as "keep, continue or have or hold or keep in place". Ezeamenyi (2014) asserted that failure to provide enough applications to real life activity and social usage, poor teaching techniques are strong limiting factors to students' retention. Iji (2010) asserts that retention is measured in collaboration with achievement.

Objective of the Study

This study is to investigate the effect of computer simulation on secondary school students' achievement and knowledge retention in Chemistry. Specifically this study seeks to:

Corresponding Author: Oluchi Emedolu Udodi,
Department of Education/Chemistry, Faculty of Science Education, University of Nigeria, Nsukka, Nigeria.

1. Determine the mean achievement scores of secondary school students taught Chemistry with computer simulation and those taught without computer simulation.
2. Determine the mean scores in retention test of secondary school students taught Chemistry with computer simulation and without computer simulation.
3. Ascertain the mean achievement scores of secondary school male and female students taught with computer simulation.
4. Ascertain the mean scores in retention test of secondary school male and female students taught with computer simulation.

Research Questions

1. What is the mean achievement scores of secondary school students taught Chemistry with computer simulation and those taught without computer simulation?
2. What is the mean scores in retention test of secondary school students taught Chemistry with computer simulation and those taught without computer simulation?
3. What is the mean achievement scores of secondary school male and female students taught Chemistry with computer simulation?
4. What is the mean scores in retention test of secondary school male and female students taught Chemistry with computer simulation?

Conceptual Framework

Concept of Chemistry

Chemistry is a part of physical sciences and it is the study of the composition of matter and the way different substances interact. It is a branch of science which deals with matter, its composition, its reaction, interaction and uses (Ababio, 2018). Chemistry is also a branch of science that has enabled the scientist to discover the usefulness of matter. Chemistry is sometimes called the central science because it bridges other natural sciences like physics, geology, and biology (Myers, 2013). According to Myers (2013), the genesis of Chemistry can be traced to certain practices known as alchemy, which has been practiced for several millennia in various parts of the world particularly the Middle East. Chemistry is concerned with the atom and particularly with the properties of chemical bonds. It is also concern with interaction between atoms or (group of atoms) and various form of energy (eg photochemical reaction), changes in phases of matter, separation of mixture, properties of polymers and so on (Uduchukwu, 2018). It can also be seen as the study of matter and energy and interactions between them (Ugo, 2019).

Concept of Computer

Computer (Encyclopedia, 2016) is a device or machine which performs processes calculations and operation based on instructions provided by a software or hardware program. It is designed to execute application and provides a variety of solutions by combining integrated hardware and software components. computer is used to aid in calculation, graphical displays, animations, simulations and gaming etc.

Concept of Simulation

Simulations have been given different meanings by different authors; however in a broad sense, simulations are imitation of systems. Simulations are computational models of real or hypothesized situations or natural phenomena that allow users to explore the implications of manipulating or modifying parameters within them (Clark, *et al.,* 2009). Plass *et al.* (2009) proposed that a simulation differs from a static visualization (example, a diagram in a textbook) because it is dynamic. It also differs from a dynamic visualization (an animation) because it allows user interaction.

Types of Simulation

1. *Life Simulation:* This shows human behavior in real example is draining of soldiers in war games.
2. *Virtual Simulation: Simulation* occurs in a computer controlled setting. For example a pilot flying air craft but is controlled from the control room.
3. *Construction Simulation:* this does not involve human or equipment but proper sequencing of events. In this research, life simulation will be used. Since humans (students) are involved.

Simulation is an educational tool where students learn through the application of theory and decision making to a simulated real-world business scenario.

Concept of Computer Simulation

A computer simulation is an attempt to model a real-life or hypothetical situation on a computer so that it can be studied to see how the system works. By changing variables in the simulation, predictions may be made about the behavior of the system. It is a tool to virtually investigate the behavior of the system under study. Computer simulation has become useful part of modeling, many natural systems in physics, Chemistry and biology and human systems in economics and social sciences (example computational sociology) as well as in engineering to gain insight into the operation of those systems. A good example of the usefulness of using computers to simulate can be found in the field of network traffic simulation. In such simulation, the modern simulation will change each simulation according to the set of initial parameters assumed for the environment. Several software packages exist for running computer based simulation modeling (example: Monte Carlo simulation, Stochastic modeling, multi-method modeling) that makes all the modeling almost effortless. Model usage of the term "computer simulation "may encompass virtually any computer based representation.

Concept of Students Achievement

Definition of academic achievement varies among scholars. Achievement may be defined as the act of achieving or successful performance. Achievement is the level of performance attend by a learner in a task (Nwobodo, 2012). Achievement is excellent in all academic disciplines in class as well as co-curricular activities. Achievement may be define as the mastering of major concept and principles, important facts and propositions, skills strategic knowledge and integration of knowledge (Niemi, 2010). Achievement is the competence of a person in relation to a domain of knowledge. Students' achievement measures the amount of academic content, a student learnt in a determined amount of time (Vanissa, 2011). Students' achievement will increase when quality instruction is used to teach instruction standard. It is believed that in

Chemistry the paramount thing in teaching and learning is students' achievement and that makes them functional in the society as such student achievement in Chemistry should be given most priority. The whole process of education centers around two key concepts "Teaching and learning". Therefore, any loophole in the process of teaching is bound to affect learning and consequently student achievement.

Concept of Retention

Retention is the noun form of the verb "retain". It is defined according to Rix (2010) as the act of retaining, absorbing and holding. In the context of this work, retention, refers to the act of absorbing, holding or continuing to hold or have fact of things learned. Hornby A.S. (2018), defined retention as the continued possession used or control of something. It can be seem as the fact of keeping something in ones memory. Knowledge retention is a progress test, feedback oriented education assessment tool for evaluation of development and sustainability of cognitive knowledge during a learning process (Mayer, 2011). Adeniyi, (2017) described retention as a form of reaction which has been presented in the past.

Theoretical Framework

This aspect guides the researchers to determine what thing one will measure and what scientific relationship one will look for. Computer simulation strategy gives the fundamental idea of the cognitive field theorists example Piaget, Gagne, Brunner, Ausubiel. These theorists views learning as an interaction between the cognitive structure and the new or incoming information and this interaction results in meaningful learning. Effective instruction requires the teacher to step outside the realms of his experience into the world of learners (Okonkwo, 2012). It is the learner who must be engage for learning to occur. The learner is the one who must make the commitment to learn. For learning to be meaningful (authentic), it must be individually constructed. This meaningful learning which cognitive theorists also advocate, teaching and learning Chemistry should go beyond stereotype laboratory classroom actively and involves the learners environment and practices.

Computer Simulation Approaches

The definition of learning varies among various and different learning theories. For instance, learning means to bring change in the behavior of the organism. Nwobodo (2012) defined learning as change in human disposition or capacity which persist over a period of time and which is not simply ascribable to the process of growth. Despite the seeming varied definition of learning as a process, there are some attributes that are common to some of them and this common attributes tends to unite them. The issue of change in the behaviour or capacity is central of all definition, it does not include change due to growth (maturity), illness, fatigue, or use of intoxicants. Secondly, the change must be due experience, study, training or practice. Another common and uniting observable but manifest in the activity of the individual. Lastly, learning result in some changes of enduring nature. The major difference is how the changes takes place. There are some groups of learning theories which are:

The Stimulus Response Associationists Theories
The Constructivists Learning Theories

The Stimulus Response Associationists Theories are concerned with observable or overt behavioural changes in organism and how this behavioural changes could be controlled and so the approaches of learning is also referred to as "behaviourism". They posits that learning occur due to formation and association between stimulus and response. The constructivist learning theories looks at the way a learner learns. The constructivist believes that the learner learns best when he or she is actively engaged. The students is viewed as one who act on object and event within his or her environment and in the process gains understanding and drives meaning of those objectives and events (constructivists theory). According to Benaim (2013), the constructivists assume that cognitive skills are most fully potentiated through active engagement.

Empirical Framework

The review of the empirical studies is based on the following: studies on simulation and studies on gender and students' achievement and retention. To establish a context, the researches initially examined the relevant literatures on the effectiveness of computer simulation in learning outcomes. Many papers were analyzed and summarized providing useful guidance for this study through systematic reviews. Okoye (2010) investigated the effect of teaching methods (Simulation and lecture) on academic achievement and attitudes of senior secondary school students on Geography. The design of the study was quasi experimental, non-equivalent control group. Data was collected from sample of 22 S.S.2 Geography students from eight secondary schools in Anambra state. The study was guided by eight research questions and twelve hypothesis while mean and ANCOVA were used for data analysis. It was reported that students taught with simulation teaching strategy, had a higher significant academic achievement in memory questions, problem solving questions and retention test than the students taught with lecture method. The above empirical findings/studies appears to show that students' academic achievement and retention can be improved when innovative teaching methods such as computer simulation is employed when teaching. Thus to further establish the efficiency of computer simulation as regards to achievement and retention there is need to conduct the research in Ogidi education zone in Anambra state.

Studies on and Student's Achievement and Retention

Ekwe (2013) carried out study on the effect of simulation teaching methods on student's achievement in biology. The study was conducted in Nsukka Education Zone of Enugu state. Three hundred (300) Senior Secondary Students S.S.2 were involved in the study. Biology achievement test instrument developed by the researcher and validated by experts was used for data collection. The data collected were analyzed using mean and standard deviation to answer the research questions while T. test was used to test the hypothesis. The findings of the study showed that there was no significant difference in male and female students' achievement in biology when exposed to the same method of teaching. The relevance of the highlighted work to the present study is that it helped the research to identify the interaction effect of simulation method on gender as it regards achievement in biology, nevertheless the reviewed work did not take cognizance of the effect of simulation on students retention while the present study does, the difference created a gap which the present study wishes to fill.

MATERIALS AND METHODS

The design of this study was quasi experimental research design which involves pre-test, post-test, non-randomized control group. It was not possible to randomize the students for this research; hence intact classes were used in the school. This study was carried out in Ogidi Educational zone of Anambra state. Ogidi Educational zone is made up of three Local Government Areas which are Idemili South, Idemili North and Oyi L.G.As.

Population of the Study

The population of the study comprises of all Senior Secondary Two (SS2) Chemistry students in Idemili North Local Government Area. The local government is numbering 3300 students (1800 females and 1500 males enrolled for 2021/2022 academic session). SS2 Chemistry students were chosen based on the fact that the topic taught was part of the SS2 scheme of work.

Sample and Sampling Technique

From the (19) government owned secondary in Idemili north, the researchers stratified random sampling was used to select (4) co-education school. Two co-education schools were randomly assigned as the control group and two co-education as the experimental group. The sample comprises of 150 SS2 students (40 students each for control group and 35 students each for experimental group in the 4 schools). These four schools shared homogenous environmental conditions. The control groups were taught without computer simulation, while the experimental groups were taught using computer simulation.

Instrument for Data Collection

The instrument used for data collection was Chemistry Achievement Test (CAT) which consisted of 50 multiple choice items. The CAT was constructed based on test blue print. The CAT covered the objectives and content areas of periodic table in SS2 scheme of work.

Method of Data Analysis

Data collected was analyzed using mean, standard deviation and z-test. Mean and standard deviation was used to answer research questions.

RESULTS AND DISCUSSION

Data collected was analyzed using mean, standard deviation and z-test. Mean and standard deviation was used to answer research questions

Result

Research question 1: What is the mean achievement score of secondary school students taught Chemistry with computer simulation and those taught without computer simulation?

Data presented in table 1, showed that the experimental group had a mean pre-test achievement score of 6.6 and a mean post-test of achievement 8.6. on the other hand, the control group

had a mean pre-test achievement score of 5.7 and a mean post-test achievement score of 6.. it was observed from the table that the mean achievement score of the experimental group is higher than the mean achievement score of the control group. This means that the group that was taught using computer simulation (experimental group) achieved more than, the group that was taught using lecture method (control group) in Chemistry.

Table 1. The table below shows the Mean and Standard deviation of pre-test and post-test on achievement score of students in the experimental and control group

Groups	N	Pre-test achievement Mean	S.D	Post-test achievement SD	Mean
Experimental	70	6.6	4.21	4.41	8.6
Control	80	5.7	3.44	4.64	6.6

Research Question 2: What is the mean score of the retention of secondary school students taught Chemistry with Computer Simulation and those taught without Computer Simulation?

Table 2. Mean and standard deviation of mean score in retention test of students in the experimental and control group

Groups	N	Mean	S.D
Experimental	70	8.4	4.44
Control	80	7.1	3.96

From the data presented in table 2, the mean score of knowledge retention test of student taught with computer simulation (experimental group) is 8.4 with standard deviation of 4.44 while the mean score of those taught without computer simulation (control group) is 7.1 with standard deviation of 3.96. Therefore those taught computer simulation has a higher mean score.

Research Question 3: What is the mean achievement score of secondary school male and female students taught Chemistry with computer simulation?

Table 3. The mean and standard deviation of pre-test and post-test achievement scores of males and females in the experimental group

Group	Gender	N	Pre-test achievement Mean	S.D	Post-test achievement Mean	S.D
Experimental	Males	35	6.7	4.47	9.1	4.46
	Females	35	6.5	3.94	8.1	4.30

Data presented in table 3 showed that in experimental group, the male students have a pre-test mean score of achievement of 6.7 and a post-test mean score of achievement of 9.1. on the other hand, the female students have a pre-test mean score of 6.5 and a post-test mean score achievement of 8.1. Therefore, the male students have a higher mean score than that of the females in achievement.

Research Question 4: What is the mean retention score of secondary school male and female students taught Chemistry with Computer simulation?

Table 4. The table below shows that the mean and standard deviation of mean retention score of students as regards to gender in experimental group

Group	Gender	N	Mean	S.D
Experimental	Male	35	8.5	4.78
	Female	35	8.3	4.07

From the above table 4, the mean score knowledge retention test of male students taught with computer simulation is 8.5 with standard deviation of 4.78 while the female mean score is 8.3 with standard deviation of 4.07. Therefore, the male students have a higher retention mean score than the female student.

Discussion of Findings

Based on the data presented and analyzed, the following major findings were made. Students taught Chemistry with Computer simulation performed better than their counter parts taught with lecture method. Students taught Chemistry with computer simulation have higher scores in retention test than those taught Chemistry with lecture method. Male students in the experimental group performed better than the female students in the same group. Male students in the experimental group have more retention than female students in the group.

Conclusion

The results in our findings show that students in experimental group (computer simulation) had higher mean achievement scores, compared with control group (lecture method). This means that the students taught with computer simulation strategies achieved better than those taught with lecture method strategies. These findings appeared to be consistent with those of Kotoka and Kriek (2014) that students taught electromagnetism using computer simulation performed better than those taught with lecture method. The findings of this study reveals that the students in The experimental group had higher mean retention scores than those in the control group. This could be as result that computer simulation had effectively enhanced the memory of the experimental group more than the control group. The higher mean retention score by the treatment group (experimental) could be as a result of the computer simulation was able to have enhanced the brain cells of the experimental group. Chemistry being an actively-oriented subject should be taught experimentally, some experiment can be demonstrated and viewed in a classroom by displaying videos as opined by Lunce (2008). Students' tends to remember what they see more than what they hear. Hence, computer simulation strategy appeared to have facilitated the development of retention in Chemistry than the conventional instructional approach (lecture method). The result in our findings showed that male students achieved and retained highly than the female. It equally reveals that there is no significant difference in both male and female students' academical achievements and retention. These findings were in agreement with the findings of (Ezeudu and Okeke, 2013; Egara, 2010; Udousoro, 2011) that there is no significant difference in academic achievement of students in Chemistry due to gender.

The following recommendations were made based on the findings of the study:

1. Chemistry teachers should endeavor to introduce fun and interesting activities in their Chemistry lessons, in order to attract and motivate students to learn Chemistry. This will also enhance the students' achievement and retention in the subject.
2. Since simulation has been found to be an effective strategy for enhancing achievement and retention, government in conjuction with other professional association should organize workshop, seminars, conferences, and in-service training on regular basis to train teachers on the use of innovative, problem-solving and activity based teaching strategies especially computer simulations.
3. Teachers should use computer simulation in teaching Chemistry topics, as it expresses theoretical concepts to real life situations.
4. Females should be particularly assisted in retaining their knowledge and improving on their achievement in Chemistry.
5. The government should utilize the service of various bodies like the Science Teachers Association of Nigeria (STAN), Nigeria Union of Teachers (NUT), Chemical Society of Nigeria (CSN) and others to organize seminars, workshop and conferences to inform, and train Chemistry teachers and other Science teachers on the use of computer simulation in teaching and learning.

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