

Effect of Simulation on Students' Achievement in Senior Secondary School Chemistry in Enugu East Local Government Area of Enugu State, Nigeria.

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Abstract

The study investigated the effect of simulation on students' achievement in senior secondary school chemistry in Enugu East Local Government Area of Enugu State, Nigeria. The design of the study was quasi-experimental with specifically the pre-test and post-test. The sample of the study consisted of 159 senior secondary school I students (80 males and 79 females) randomly selected from two schools out of the secondary schools in Enugu East Local Government Area of Enugu State, Nigeria. The experimental group comprised of 39 males and 39 females (78 students) while the control had 41 males and 40 females (81 student). Two research questions and two hypotheses guided the study. The achievement test in simulation (ATIS) was used to collect data on the student achievement. Means and standard deviation were used to answer the research questions while the t-test was used to test the hypotheses a 0.05 level of significance. The results showed that simulation increased students' achievement in chemistry more than the conventional method. There was no significant different in the achievement of male and female students on the chemistry concepts. Based on the results it was recommended that chemistry teachers should be re-trained on the use of simulation in teaching while the government and stake holders in Education should sponsor the purchase of simulators to be used in teaching chemistry in schools.

Keywords: simulation, education, students' achievement, chemistry, science and technology, National Policy on Education, gender, experimental and control groups.

1.0 INTRODUCTION

There is a rapid development in the world today and every Nation strives to meet up with the requirement needed. She does so through science and technology. Science and technology education therefore became the factory that produces technologists, technicians, craftsmen and skilled artisans who are required to change the economy of any nation. Scientific and technological skills acquisition are necessary for nations to cope with the present today challenges.

Avaa (2007) pointed out that technology advancement can elevate Nigeria nation from a consumer to a producer and from developing to a developed nation. Ali (2001) defined technology as the successful application of scientific ideas, principles, laws and theories, for the purpose of developing techniques for and or providing goods and services. It is through technology that appliances such as computers, televisions, refrigerators, fan, vehicles, airplanes etc. are invented. Ali went further to state that science benefits technology while technology enhances the understanding of science. The contributions of science and technology to overall development of all nations cannot be emphasized. This is the reason science holds an important position in the curriculum of Nigerian educational system.

In Nigeria, science teaching and learning are emphasized in the National Policy on Education (FME, 2008). In order to inculcate the necessary scientific knowledge, skills, competencies and attitudes in various development: strategies such as World Declaration on Education for Ail (EFA) are put in place in Nigeria educational system. Other strategies like the NEEDS (National Economic Empowerment goals) of MDGS (Millennium Development Goals) are put in place in orders to meet these goals. Nigeria began to update the existing curriculum to cater for the needs of the nation who is aspiring to be among the first 20 economist in the world by the year 2020. Chemistry education became the best avenue to meet the global challenges facing Nigerian Nation. Adesoji and Olatanbosun (2008) stated that it was as a result of the recognition given to chemistry in the development of the individual and the nation that it was made a core-subject among sciences and science- related courses in Nigerian education system.

Chemistry as defined by Ababio (2005) is the study of matter-what it is made of, how it behaves, its properties and how it changes during chemical reaction. Many new substances have been created through chemistry which have many important applications in our lives. Ezeudu, 1998 narrated the areas chemistry contributed in the manufacturing industries, Nigerian National Policy on Education (FRN 2008) stipulated that chemistry is taught in the senior secondary schools from SSI-SS3 classes. According to the Federal Ministry of Education (FNE 2009) Nigerian senior secondary school curriculum is aimed at enabling student to:

- ❖ Develop interest in the subject of chemistry.

- ❖ Acquire basic theoretical and practical knowledge and skills.
- ❖ Develop interest in science, technology and mathematics. (STM).
- ❖ Acquire basic (STM) knowledge and skills.
- ❖ Develop reasonable level of competence in information computer and technology (ICT) application that will engender entrepreneurial skills.
- ❖ Apply skills to meet societal needs of creating employment and wealth.
- ❖ Be positioned to take advantage of numerous career opportunities offered by chemistry and
- ❖ Be adequately prepared for further studies in chemistry.

These aims can only be realized if students in chemistry achieve better in the subject. But poor academic achievement of students in chemistry had been much pronounced in recent times as observed by Ajah (2004). This is supported by West African Examination Council (WAEC) Chief Examiner's report. Arong and Ogbadu (2010) outlined some factors contributing to the decline in quality of education. These are lack of instructional materials, library facilities and students' attitude towards learning. Some author (Olatoge and Atuwape (2004), Adesoji and Ogini (2012) blamed the poor achievement in chemistry to the poor academic background of students in Basic sciences taught at the Junior secondary schools classes (JSS 1-3) level.

The main aim of teaching is to transfer knowledge to the learners. For effective teaching and learning to take place, the teacher needs to use different methods and techniques in teaching. Unfortunately poor chemistry achievement has been attributed to poor teaching methods used by teachers (Zimmerman in Nbina (2010), Angela and Ugwuegbulam (2011) and Rasari (2004). The present Nigeria chemistry classroom does not provide the fun, hands-on, challenging, interactive and collaborative environment needed by new generation of students who have been exposed to internet, computer usage, hand-set and other sophisticated gadgets. The problem of this nature can only be solved by the use of simulation.

Simulations are tools that facilitate learning through representation and practice in a repeatable, focused environment (Aldrich 2004).

According to Goldsim (2011) simulation helps to identify and understand factors which control the system and or to predict the future behaviour of the system. Simulation programmes can be applied to chemistry by providing real life settings for the application of chemical concepts. Simulation includes role plays, games, computer programs that encourage students to become active participants in chemistry classroom. Simulation can be inferior substitute, imitating an original or a display of not real behaviours Simulations can be classified in many way:

- ❖ **Physical simulation:** Here the physical object is presented on a screen and the students learn about it. For an example when electrons are displayed to observe the influence of temperature. Here the students can manipulate the temperature to see its effect in the movement of electrons.
- ❖ **Process simulations:** Processes that are not visible can be demonstrated using process simulations. For example how population grows and decline or rise and fall of stock exchange.
- ❖ **Procedural simulations:** Here procedures as follows in order to understand sequence of events. Students can be asked to follow a set of procedures in observing reaction rates which end in a particular product.
- ❖ **Situational Simulations:** This has to do with attitudinal and behavioural changes of people. The students use this simulation to explore the effects of different approaches to a problem. (Tippler, 2003)

Simulation has three types namely:

- **Live Simulation:** This shows human behaviour in real life. Examples is training of soldiers in war games.
- **Virtual simulations:** Simulation occurs in a computer controlled setting. For example a pilot flying and air craft but is controlled from the control room.
- **Constructive simulations:** This does not involve humans or equipment but by proper sequencing of events. For example weather changes like wind directions or water waves and be controlled through application of temperatures and pressures. (Institute of Simulation and Training (IST) University of Florida (2002).

In this paper life simulation will be used since humans (student) are involved. Simulation in teaching and learning of chemistry helps understanding of abstract and difficult concepts by allowing the students to experiment on the variables that form the concept. Computer simulation helps students to develop their own understanding of chemistry concepts. It also helps the students to be independent problem solvers. Chen and Howard (2010) observed that the use of simulations to teach chemistry gives positive results over time. It is important to determine whether male and female students will benefit equally with the use of simulation in teaching chemistry.

Gender is any physical and behavioural difference between males and females which are social culturally based, (Okeke 2008, Ezech 2013). Ogunleye and Babajide (2011) observed that science subjects such as

chemistry are given masculine outlook by many educationists. That means that women and girls grapple with a lot of discriminations and difficulties (Okeke, 2008). Applying feminist theory in Science Education which stated that by changing the science curriculum and how science is taught with make a significant change on women participation in science. This study will then see the influence of simulation in students' achievement in senior secondary school chemistry.

Many theorists had advocated for active participation of the learner in the learning process. Vygotsky (1978) emphasized on social interaction as the best ways of learning. To him a child learns better in collaborative activities than when he/she learns alone. Vygotsky social theory is applied in this study since simulation involves role plays and computer programs that encourage students to become active participants in the application of chemical concepts. Students are able to learn better when they have social interaction among themselves and the relevant learning resources. Simulation provides co-operative work skills and cognitive apprenticeship needed in the study of chemistry. The teacher provides simulated experiences which helps in demonstrating concepts to students and makes for the students understanding of the concepts. Many researchers had used simulation successfully.

Poripo (2008) experimented on the effect of simulation on male and female students' achievement in chemistry in Bayelsa State, Nigeria. The researchers used two research questions and two null hypotheses and the instrument used was Achievement Test in Simulation (ATIS). Means and standard deviation were used to answers the research questions while t-test was used to test the hypotheses at 0.05 level of significance. The design of the study was quasi-experimental and the population was 250 senior secondary school 1 students. The results showed that the use of simulation method increased the achievement of students in chemistry and male and female students achieve highly with no significant difference in their mean responses.

This work is similar to the present work but the present work is done in Enugu East Local Government Area of Enugu State where achievement in chemistry is so poor. The researcher wants to see if simulation can also be used to increase the students' understanding of chemistry.

Chen and Howard (2010) worked on the effect of live simulation on middle school students' attitudes and learning towards science. They used 311 middle school students who accessed and interpreted satellite data and images and they designed investigations. The design of the study was pretest, posttest which enabled them to compare students learning and attitudes before and after the simulation. The result showed positive changes in students' attitudes and perceptions toward scientists. Male students had more positive adoption towards scientific attitudes than the female students. The study also found that the change in students' learning was significantly influenced by the teacher. The present study wants to see the effect of simulation on students' achievement in chemistry. The work of Poripo (2008) showed that simulation was gender sensitive while the work of Chen and Howard (2010) showed that the males experienced better change in learning and attitudes. The influence of gender on achievement and learning is still a controversial among science researchers. Therefore more investigation has become necessary. Hence the present work will like to see the effect of simulation of gender in order to make a significant contribution to world concern on gender issues.

The results of students in the Senior Secondary School Certificate Examination (SSSCE) in chemistry in Enugu East Local Government Area showed that most students achieved poorly in chemistry. Most research studies on chemistry have not traced the root cause of this problem of poor achievement and students' failure in chemistry. This study is designed to fill this gap by finding the effect of simulation on students' achievement in chemistry in Enugu East Local Government Area of Enugu state, Nigeria.

1.1. Research Questions

To carry out this study effectively, the following research questions guided the study.

1. What is the effect of simulation on students' achievement in senior secondary school chemistry?
2. Is there any differential effect of simulation on male and female students' achievement in chemistry?

1.2 Hypotheses

The study was guided by the folioing hypotheses which were tested at 5% ($P < 0.05$) level of significance.

HO₁: There is no significant difference between the mean achievement scores of students taught chemistry with simulation and those taught using the conventional methods.

HO₂: There is no significant difference between the mean achievement scores of male and female students in Achievement Test in Simulation (ATIS).

2.0 The design of the study was a quasi-experimental research in which intact classes were used for the study.

2.1 The area of the study was Enugu East Local Government Area of Enugu State, Nigeria. The choice of this area is because chemistry students in the area achieved poorly in chemistry and this was reflected in the results of the SSSCE of the students in the area.

2.2 The population of the study were senior secondary school I students comprising of 78 experimental and 81 control groups. It was conducted in two schools in Enugu East local Government Area of Enugu State, Nigeria. The Population was manageable and so there was no sampling.

2.3 The instrument used to collect the data was an achievement test in simulation (ATIS). It was an essay test with extended and restricted free response test formats. It was a 50 test items that was answered by both experimental and control groups. The test lasted for an hour and it was conducted under strict examination conditions for both groups. The test blue print was formulated in order to construct the test which was based on the chemistry concepts taught during the class session.

2.4 The instrument was validated by three subject experts and two classroom teachers of St. Joseph College, Emene, Enugu State, Nigeria

2.5 The reliability of ATIS was established by administrating it to a sample of SSS 1 students of a school different from the schools used in the study. The result from this trial test was analyzed using standardized Cronbach's Alpha and it gave the reliability coefficient of 0.73.

2.6 The administration of the instrument was as follows: The lesson plans for both the experimental and the control groups were produced which was based on the chemistry concepts taught during the period of the experiment - introduction to chemistry, standard separation techniques for mixtures and criteria for testing purity. The regular chemistry teachers were trained on how to teach both groups using the lesson notes. The regular class teachers did the teaching and conducted the test after the teaching. The test instrument was given to the students before the experiment and after the experiment.

2.7 Extraneous variables were controlled as in Ezeudu (2013).

2.8 Analysis of data collected were done using means and standard deviations for research questions and t-test statistics for the null hypotheses at 0.05 level of significant.

3.0 Results are presented in accordance with the research questions and hypotheses.

Research Question 1: What is the effect of simulation on student's achievement in senior secondary school chemistry?

Table 1: Means and Standard Deviation Scores of Students

Group	Mean (\bar{x})	Standard Deviation (SD)
Experimental	53.95	35.70
Control	41.19	28.5
Difference in mean	12.76	

The table 1 above shows that the experimental group has a mean of 53.95 and standard deviation of 35.70, while the control group has a mean of 41.19 and a standard deviation of 28.5. The difference in mean is 12.76

Research Question 2: Is there any differential effect of simulation on male and female students achievement in chemistry.

Table 2: Means and Standard Deviation scores of male and female students' taught using simulation.

Gender	Mean (x)	Standard Deviation (SD)
Male	55.03	34.44
Female	52.87	37.35
Difference in mean	2.16	

The table 2 above shows that the males have a mean of 55.03 and standard deviation of 34.44, while the females have a mean of 52.87 and a standard deviation of 37.35 the difference in mean is 2.16.

Hypothesis 1:

HO₁: There is no significant difference in the mean achievement scores of the students taught chemistry with simulation and those taught with conventional method.

Table 3: T-table for difference in mean of the experimental and controlled groups

Group	Mean ()	t-cal	t-crit	Decision
Experimental	53.95	2.48	1.96	Reject
Control	41.19			Ho

This t-table shows that t-calculated (t-cal) is 2.48 and that t-critical (t-crit) is 1.96. Since t-calculated (t-cal) is greater than t-critical (t-crit), Ho is rejected and so, the researchers conclude that there is a significant difference in the mean achievement scores of the students taught chemistry with simulation and those taught with the use of the conventional. method.

Hypothesis 2:

HO₂ : There is no significant difference in the mean achievement scores of male and female student's in the chemistry achievement test.

Table 4: t-table for difference in the mean achievement scores of male and female students taught using simulation.

Group	Mean ()	t-cal	t-crit	Decision
Males	55.03	0.27	1.96	Accept
Female	52.87			Ho

This t-table shows that t-calculated (t-cal) is 0.27 and that t-critical (t-crit) is 1.96. Since t-cal is less than t-crit, Ho is accepted and so, the conclusion is that there is no significant difference in the mean achievement scores of male and female student's in the chemistry achievement test.

4.0 Discussion of the findings.

The results of the tables show that students taught using simulation got a higher mean scores than those taught with the conventional method. It then means that students in the experimental group achieved better than those in the control group. This is confirmed by the test of hypothesis which revealed that there is significant difference in the mean achievement scores of students taught using simulation and those taught with the conventional method (table 3).

This is in agreement with the work of Tippler (2003), Akinsola (2003) and Poripo (2008), which indicate that simulation used in teaching and learning promote better understanding of the concepts.

Table 2 shows that male students had a higher mean scores than the female students. The t-test on table 4, indicated that there is no significant difference in the achievement mean scores of male and female students in the study. This shows that simulation is gender sensitive. This is in agreement with the work of Poripo (2008) but differ from that of Chen and Howard (2010). It then means that with the use of simulation in teaching chemistry concepts that gender stereotyping in science education will be eradicated. This is good news to many scientists.

4.1 Conclusively,

Simulations are good techniques that replicate complex real life situations which make learning easier. The use of simulation has been found to be effective in increasing achievement of students in chemistry. Simulation provides active participation and manipulation of materials which make the lesson more meaningful. Also simulation enables students to apply their senses to the lesson. All these contributed to their achievement in the chemistry when simulation is used. Teachers should be encouraged to use simulation in teaching chemistry. Simulation also found to be gender sensitive which means that male and female students achieved equally with the use of simulation. These have implications to the curriculum planners who are expected to plan for active involvement and use of simulations in the curriculum. They should also create the awareness of the use of simulations to teachers of chemistry and other teachers.

4.2 Recommendations.

Based on the findings of this study, the following recommendations were made:

- ❖ Chemistry teachers should be trained to use simulation in making their lessons interesting, interactive as well as making the students to achieved better.
- ❖ Government and stake holders in education should provide in-service training to chemistry teachers on how to use simulation in teaching.
- ❖ Federal, State, Institutions and those concerned with education in Nigeria should provide adequate funds for the purchase of simulators to enable teachers to use simulation in teaching chemistry.
- ❖ Students should be encouraged to participate in simulation activities because the method provide cooperative and collaborative skills which improve their understanding of chemistry concepts.

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