



## **Effect Of Computer Simulation On Students' Academic Achievement In Chemistry In Senior Secondary Schools In Ahoada-East Local Government Area, Rivers State.**

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### **ABSTRACT**

The study examined the effect of computer simulation on students' academic achievement in chemistry in senior secondary schools in Ahoada-East Local Government Area, Rivers State. The study which adopted Quasi-experimental research design was carried out in Ahoada East Local Government Area of Rivers State. The population for the study was all the chemistry students in public senior secondary schools in Ahoada East Local Government Area of Rivers State. Purposive sampling was used to draw out a sample size of 82 students from two selected secondary schools out of all the public senior secondary schools in Ahoada East Local Government Area of Rivers State. Two research questions were answered and two hypotheses were tested at 0.05 level of significance. The instrument for the study was a self-structured Chemistry Achievement Test. The instrument was face and content validated by the research supervisor, one other lecturer from the Department of Science Education, Rivers State University, Port Harcourt and a chemistry teacher from County High School Ahoada. The reliability of the instrument was established using test retest method which yielded a reliability coefficient of 0.96. Mean statistics was used to answer the research questions while Analysis of Covariance was used to test the null hypotheses at 0.05 level of significance. The findings showed that students taught with the computer simulation technique performed better than those taught with the traditional lecture method. Based on the findings, it was recommended among others that science teachers should adopt computer simulation technique in the delivery of their lessons.

**Keywords:** computer simulation, Chemistry, students, academic achievement

### **INTRODUCTION**

Education in Nigeria is considered an investment that covers the all-round development of an individual which enables such individual to get practical skills, creativity, innovativeness, advancement of mental, physical and social capacities that will empower him/her to live, produce and add to the improvement of the society. Federal Republic of Nigeria through the National Policy on Education (FRN, 2013) stated that Nigeria operates an educational policy of 6-3-3-4 or 9-3-4 system which stands for 6 years in primary school, 3 years in junior secondary (9 years of basic education), 3 years in senior secondary school and 4 years for university education.

The policy therefore of 6-3-3-4 is initiated to link every educational level for the attainment of basic skills especially the secondary stage. Kola (2013) stated that subjects studied in senior secondary school comprise English, Mathematics Biology, Economics, History, Chemistry etc. Chemistry has been identified as a very important school subject and its importance in scientific and technological development of any nation has been widely reported (Are & Are 2017). It was as a result of the recognition given to chemistry in development of the nation that it was made a core subject among the natural sciences and other science related courses in the Nigerian educational system.

Hambly (2021) defines Chemistry as the branch of science that deals with the properties, composition, and structure of elements and compounds, how they can change, and the energy that is released or absorbed when they change. The study of Chemistry is based on the study of the composition, properties, and structure of matter, including atomic structure and the changes influenced by chemical reactions. As such, it can be considered a branch of physical science, alongside astronomy, physics and earth sciences including geology.

The realization of the goals of chemistry to some extent has been impeded because the academic achievement of students in chemistry remains low in Nigeria (Aretal, 2017). Students' academic achievement has to do with what a learner is able to accomplish by executing class work or a given task in the college workshop laboratory. As expressed by Omeh (2010), students' academic achievement is the extent to which a student has achieved his/her short or long-term educational goals. According to John (2021) the students' academic achievement in chemistry is unsatisfactory sequel to the wrong instructional methods such as simulation strategies.

Dauda (2015) asserted that simulation is an instructional strategy (teaching method) that can be used with appropriate learning material at any level from the primary grades through graduate studies. Effective instructional methods stimulate learners' interest which therefore forms a base for achieving desired curriculum objectives in a school setting (Bello, Ibi & Bukar, 2016). In other words, classroom simulations motivate students by keeping them actively engaged in the learning process through requiring that problem solving. In this case, computer imputed with design simulation help student to learn to achieve specific objectives actively rather than passively. They take learning out of area of abstraction and make it participatory skills. It involves learning by doing and this is of particular benefit where skills are required through practice and enables participants to learn facts, processes and alternative strategies.

#### **Statement of the Problem**

The purpose of establishing secondary education in Nigeria is to enable students acquire basic cultural elements, especially humanistic, artistic, scientific and technological aspects, develop and strengthen their study and work habits and prepare them for further studies and/or access to the labour market (FRN, 2013). However, it has been observed by Guloba, Wokodola, and Bategeka, (2010) that low achievement in chemistry by students in senior secondary schools is as a result of many factors such as the teaching methods and strategies used by the teachers of chemistry in the classroom and laboratory. Also Frederick (2020) asserted that teachers usually use lecture and traditional methods against the active learning strategies in teaching topics like atomic structure, chemical equilibrium among others in secondary schools in Nigeria. Frederick further stated that science teachers in recent times, instead of adopting a more practical approach of instruction in carrying out instructions, they rather employ the talk-chalk method of teaching.

These observations are in agreement with the reports of the chief examiner 2002, 2004 and 2014 of the West African Examination Council (WAEC) which stated that the shortcomings of the traditional teaching method partly accounted for the poor performance of students in science subjects in WAEC Examinations in recent years. Amen (2014) also observed that the low level of achievement has been attributed to certain factors, which are inadequate qualified science teachers, lack of students' interest, non-exposure to field trip, non-inclusion of science students in Students Industrial Work Experience Scheme (SIWES) and above all, poor method of teaching. It is in the light of the above mentioned factors that the researcher conducted this study to determine the effect of Computer Simulation on Students' Academic Achievement in Chemistry in Senior Secondary Schools in Ahoada-East Local Government Area, Rivers State.

#### **Purpose of the Study**

The purpose of the study was to investigate the effect of Computer Simulation on Students' Academic Achievement in Chemistry in Senior Secondary Schools in Ahoada-East Local Government Area, Rivers State. Specifically, the study sought to:

- Determine the effect of computer simulation technique on students' academic achievement when taught atomic structure.

- Determine the effect of computer simulation technique on students' academic achievement when taught chemical equilibrium.

### **Research Questions**

- What is the effect of computer simulation technique on students' academic achievement when taught atomic structure?
- What is the effect of computer simulation technique on students' academic achievement when taught chemical equilibrium?

### **Hypotheses**

- There is no significant difference in the mean scores of students taught atomic structure with computer simulation technique and those taught with the traditional lecture method.
- There is no significant difference in the mean scores of students taught chemical equilibrium with computer simulation technique and those taught with the traditional lecture method.

### **Literature Review**

This study was guided by Theory of Instruction Jerome E.S. Bruner (1915). The theory sees learning as not just something one acquires possibly because of reinforcement or the other but as a process in which the learner actively reasons out principles or rules underlying an event or objects and tests them out . Ngwoke (2014) contends that learning involves three major processes which are as follows: First process – involves acquisition of incoming information. Second process – involves transformation of the information into a usable form. Third process – involves testing and checking the adequacy of the transformed information. Continuing, Ngwoke stated that Bruner in this position, refuses to see the stimulus as something separate from the learner and only capable of making him emit a mechanistic response but as something he identifies and understands in his own way.

The implication of this theory to effective teaching and learning of chemistry is on the bases that meaningful learning, involves the active search for solution to problems by so doing, the learning will become part and parcel of the students and he/she finally finds the solution to such problem. On this basis, teachers are implored to encourage students to explore alternative solutions to problems, so as to enable them discover new relationships between events or objects which can be done easily with simulation and modelling of objects with the help of computer.

### **Use of Computer in Chemistry Teaching and Learning**

Secondary education is very crucial because it is a gate way to the opportunities and benefits of economic and social development. Furthermore, globalization and the increasing demand for a more sophisticated labour force combined with the growth of knowledge-based economies gives a sense of urgency to the intensified demand for secondary education. In today's world, secondary education is being recognized as the cornerstone of educational systems in the 21st century (Gonczi, 2008).

Quality Secondary education is indispensable in creating a bright future for individuals and nations alike. In secondary education, the use of computer is relevant because its knowledge helps learners to search for the information and to organize their findings. The recent emergence of the computer as an educational tool has given rise to the quality of education experienced and schooling (Fu, 2013). Learners become more and more responsible for their own learning as learners develop through the school system (Otis, Grouzet, & Pelletier, 2006). Many believe that computer needs to be better integrated into curriculums so that all schools produce computer literate, independent learners.

For chemistry education at secondary level, to be more innovative pedagogical methods should be applied in teaching this is because learners often do not perform satisfactorily in basic Chemistry concepts due to the traditional teaching methods employed by teachers. In those lecturing settings, learners are required to sit passively and become listeners (Morgil, Oskay, yavuz, & Arda, 2003). Particularly, for difficult and abstract concepts, learner-centered approaches, especially those that employ modern Information and communication Technologies such as computer simulation technique should be used. In a learner-centered environment, with the assistance of computers, learners are able to work together, use critical thinking and find alternative solutions to problems (Schroedoeer & Greenbowe, 2008).

According to Cigrik, and Ergul (2009) using computers for simulation technique in teaching has led to an improved teaching quality which in turn leads to better learner achievement. Papert (1993) saw the computer as the ultimate tool for learners to use to create their own knowledge and to introduce them to the process of intellectual investigation. Ward (1994) saw computer as a powerful technology that gives teachers and learners extraordinary control over an amazing array of resources as it makes learning more vibrant, interactive, collaborative, exciting, memorable, and more satisfying. Active learning approach can fundamentally change the role of the teacher in the classroom when properly utilized. The approaches allow teachers to spend more times working alongside the learners instead of using "chalk and talk" at the front of the room.

### **Simulation**

Simulation in teaching has recently entered the field of education. The word Simulation means to imitate exactly. Interest is aroused in the pupils through 'Role Playing' while teaching (Alessi and Trollip, 2001). In the simulated teaching technique, the students are only acquainted with the conditions. It is used at different levels of instruction. By the same token classroom simulation removes the risk from the first steps of a new type and enables him to come to terms with demand of a complex skill learning without the stress of the real situation. Computer simulation has been defined in different ways by different researchers.

Alessi et al (2001) stated that simulation is just one type among many of computer assisted instruction (CAI). Simulations are tools that facilitate learning through representation and practice in a repeatable, focused environment (Aldrich, 2004). According to Goldsim (2011), Computer simulation helps to identify and understand factors which control the system and or to predict the future behavior of the system. Simulation includes role plays, games, computer programs that encourage students to become active participants in classroom.

Simulation can be classified in many ways:

- Physical simulation: 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 students can manipulate the temperature to see its effect in the movement of electrons.
- Process simulation: processes that are not visible can be demonstrated using processing simulations. For example, how population grows and declines or rise and fall of stock exchange.
- Procedural simulation: here procedures are followed in order to understand sequence of event. Students can be asked to follow a set of procedures in observing reaction rate which ends in a particular product.
- Situational simulations: this has to do with attitudinal and behavioral changes of people. The students use this simulation to explore the effects of different approaches to a problem (Tippler, 2003).

### **METHODOLOGY**

The research design for the study was Quasi-experimental. Specifically, the type of quasi-experimental design used was the non-equivalent control group which involves two groups (control and experimental). This design is considered to be appropriate because, true experimental design may not be feasible (Akaninwor, 2014). This design involves the use of pretest-posttest. In this research design, no randomization was employed in order to ensure the equivalence of the two groups. The population of this study consisted of 1,538 chemistry students in all the Public Senior Secondary Schools in Ahoada East Local Government Area of Rivers State. One school was purposively sampled out of seventeen (17) secondary schools in Ahoada East Local Government. Two classes taught by same teacher were used. The school has four (4) SS2 arms (A,B,C and D). Arms A and C are for science students while B and D are for arts students. Arm A has 50 students, while B has 32 students. The sample size includes 50 students of experimental group from Arm A and 32 students of control group from Arm C, both in UPATA I Community Secondary School Edeoha in Ahoada East Local Government Area. UPATA I Community secondary was purposively sampled out because they have computer facilities. Coin was tossed once to assign experimental group to Arm A, and control group to Arm C. SS2 was considered for this research work because SSS 3 students were preparing for their secondary examinations and also

SS1 students were not grounded in Chemistry because they just graduated from JSS 3. A pre-test was administered to the two groups. The pre-test was used to ascertain the learners' prior knowledge in Chemistry, before the intervention. After the intervention, a post-test was also administered to access the effect of the intervention and to measure learners' academic achievement after the lessons. The content appropriateness was content validated by the research supervisor and two other experts from Science Education Department of Rivers State University and a Chemistry Teacher from County High School Ahoada. The reliability of the instrument was determined using test retest method. The coefficient of the reliability obtained for equivalent test was 0.96. The instrument for data collection in the study was Chemistry Achievement Test (CAT).

The data generated from the research questions of this study were analyzed using mean. Analysis of covariance (ANCOVA) statistics was used to test hypotheses at 0.05 level of significance. The ANCOVA was used for easy comparison of the mean of the two groups. Decision was taken after ANCOVA test and analysis technique based on statistical rule as follows: If f-calculated (f-cal) is less than the f-critical (f-crit),  $H_0$  should be accepted. On the other hand, if f-calculated (f-cal), is greater than or equal f-critical (f-crit),  $H_0$  should be rejected.

## RESULTS

**Research Question 1:** *What is the effect of computer simulation on students' academic achievement when taught atomic structure with the technique?*

Data necessary to provide answer to research question one were analyzed and presented in Table 4.1.

Table 4.1: Mean Scores of Students' Academic Achievement in atomic Structure.

Groups	Pre-Test (N)	Post-Test (N)	Pre-Test Mean ( $\bar{X}_1$ )	Post-Test Mean ( $\bar{X}_2$ )	Mean Gain
Experimental Group	50	50	26.76	59.76	33.00
Control Group	32	32	20.81	46.31	25.50

Source: Field Study (2021).

Results from Table 4.1 show that the pre-test mean score for experimental group was 26.76 while that of the control group was 20.81. The post-test mean scores for the experimental group were 59.76 while that of the control group was 46.31. The mean gain on the basis of the differences between the pre-test and post-test scores of each group indicated 33.0 for the experimental group and 25.50 for the control group as indicated in Table 4.1. Consequently, the post-test mean scores for the two groups show that students in the experimental group (59.76) also performed better than those in the control group (46.31). The results show that students taught with computer simulation technique of instruction are better than those instructed with the traditional lecture method in atomic structure.

**Research Question 2:** *What is the effect of computer simulation on students' academic achievement when taught chemical equilibrium with the method?*

Table 4.2: Mean Scores of Students' Academic Achievement in Chemical Equilibrium.

Groups	Pre-Test (N)	Post-Test (N)	Pre-Test Mean ( $\bar{X}_1$ )	Post-Test Mean ( $\bar{X}_2$ )	Mean Gain
Experimental Group	50	50	23.56	62.28	38.72
Control Group	32	32	24.75	36.81	12.06

Source: Field Study (2021).

Results from Table 4.2 show that the pre-test mean score for the experimental group was 23.56 while that of the control group was 24.75. The mean of the pre-test scores for the two groups revealed that students in the traditional lecture group performed better on the pre-test than those in the computer simulation group. Furthermore, the mean gain on the basis of the differences between the pre-test mean scores and post-test mean scores of each group indicated 38.72 for the experimental group and 12.06 for the control group as shown in Table 4.2.

Consequently, the post-test mean scores for the two groups show that students in the experimental group (62.28) have higher academic achievement than those in the control group (36.81). The results apparently show that students taught with computer simulation technique are better than their counterparts taught with the conventional lecture method in diesel engine system.

**Hypothesis 1:** There is no significant difference in the mean scores of students taught atomic structure with computer simulation technique and those taught with the traditional lecture method.

**Table 4.5: Analysis of Covariance (ANCOVA) For Scores in Atomic Structure.**

Source of Variation	Sum of Squares	Df	Mean Square	F-cal	F-crit	P-value	Decision
Between groups	4517.23	1	4617.23	14.13	3.96	0.0003	Significant
Within groups	25246.7	79	319.58				
<b>Total</b>	<b>29763.93</b>	<b>80</b>					

From the result in Table 4.5, F-calculated 14.13, F-critical 3.96. At 0.05 level of significance, degree of freedom (df) is 1 and 79. This shows that since the F-calculated > F-critical, the null hypothesis is rejected. This shows that there is a significant difference in the mean score of academic achievement of students taught atomic structure with computer simulation instructional technique and those taught using the traditional lecture method.

**Hypothesis 2:** There is no significant difference in the mean scores of students taught chemical equilibrium with computer simulation technique and those taught with the traditional lecture method.

Data for test of this hypothesis were analyzed and the result presented in Table 4.6.

**Table 4.6: Analysis of Covariance (ANCOVA) For Scores in Chemical Equilibrium.**

Source of Variation	Sum of Squares	Df	Mean Square	F-cal	F-crit	Pvalue	Decision
Between groups	13063.89	1	13063.89	33.09	3.96	0.0000	Significant
Within groups	31187.55	79	394.78				
<b>Total</b>	<b>44251.44</b>	<b>80</b>					

From the result in Table 4.6, F-calculated 33.09, F-critical 3.96. At 0.05 significant level, degree of freedom (df) 1 and 79. Since the F-calculated is greater than F-critical (F-cal > F-crit), the null hypothesis is rejected. This indicates that there is a significant difference in the mean score of academic achievement between students taught chemical equilibrium with computer simulation instructional technique and those taught using the traditional lecture method.

## DISCUSSION OF FINDINGS

The result of research question one on atomic structure showed that the students taught with computer simulation instructional technique performed better than the students taught with conventional lecture method, with pre-test mean scores of 26.76 and 20.81 as well as post-test mean scores of 59.76 and 46.31 respectively.

Also, the finding showed a significant difference between the effect of computer simulation instructional technique and conventional lecture methods of teaching on students' academic achievement in atomic structure. The finding is in agreement with the opinions of Okebukola and Okoye (2013) who were of the opinion that computer simulation instructional technique should be adopted in teaching science and technology because it is activity oriented and involves practical demonstration.

The analysis of the results on research question two suggested that chemical equilibrium revealed that the students taught with computer simulation instructional technique performed better than the ones taught with conventional lecture method with pre-test mean score of 23.56 and 24.75 as well as post-test mean score of 62.28.81 respectively. These findings indicated a significant difference between the effect of computer simulation technique and the traditional lecture methods of teaching on students' academic achievement in chemical equilibrium.

This finding is in agreement with Ali (2014) who was of the view that the adoption of student-centered instructional approaches improves the academic achievement of students. It was further opined and 36that

computer simulation technique of instruction would strengthen weaker students while brighter ones would further excel. The finding also was supported by the view of Richards (2014) who posited that computer simulation technique is an effective strategy that makes available learning by doing. Richards further stated that students instructed using computer simulation would in no small measure perform better than those taught with the traditional lecture method.

## CONCLUSION

Based on the findings from the study, it was concluded that students taught with computer simulation technique have higher academic achievement than those taught with the traditional lecture method in senior secondary school chemistry. Students taught with computer simulation technique are better than their counterparts taught atomic structure, chemical equilibrium, electronic configuration and chemical bonding with conventional lecture method.

## RECOMMENDATIONS

- Chemistry teachers should adopt computer simulation technique amongst other active instructional methods.
- Government of Rivers State should declare a state of emergency on the improvement of learning facilities in secondary schools.

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