

Effect of Computer Animation on Chemistry Academic Achievement of Secondary School Students in Anambra State, Nigeria

Ikwuka, O. I. (Ph.D) and Samuel, N.N.C. (Ph. D.)

¹Department of Educational Foundations

Nnamdi Azikiwe University, Awka

²Department of Science Education

Nnamdi Azikiwe University, Awka

Corresponding Author: Ikwuka, O. I.

Abstract

The study investigated the effect of computer animation on Chemistry academic achievement of secondary school students in Awka South Local Government Area of Anambra State, Nigeria. A quasi- experimental pre-test, post-test nonequivalent control group design was used for the study. The sample for the study comprised 100SS2students from two randomly selected co-educational secondary schools. One of the schools was assigned to the experimental condition, and the other assigned to control condition. The instrument known as Chemistry Achievement Test (CAT), validated by three experts with a reliability coefficient of 0.82 was used for data collection. The CAT was used as pretest and posttest for both experimental and control groups. Mean and standard deviation were used to answer the research questions, while ANCOVA was used to test the null hypotheses at $P < 0.05$. The result revealed that computer animation Chemistry instruction CACI had significant effect on students' academic achievement in Chemistry; and that gender had significant effect on the academic achievement in Chemistry of male and female students who were taught CACI in favour of males. The finding implies that there is need for Chemistry teachers to use CACI in teaching Chemistry. Based on the findings of this study, it was recommended that computer animation instruction (CACI) should be adopted by Chemistry teachers for teaching chemical concepts to secondary school students. Also, other instructional materials like computers, storage devices, and projectors should be made available for the Chemistry teachers to prepare and teach their lessons. The use of animation in the teaching of chemical reactions as used in this study added real value to the teaching of chemistry, not only did it increase students' understanding of the concepts, it added to the teachers instructional strategies for teaching difficult and abstract concepts. Teachers adopting the use of computer animation in abstract chemistry concepts teaching will enhance the efficiency of teaching –learning of chemistry concepts and assimilation of information.

Keywords: computer animation, chemistry, academic achievement, chemistry instruction, gender.

INTRODUCTION

Many students in senior secondary schools in Nigeria have continuously shifted away from offering science subjects except Biology which is often chosen by students not offering pure sciences. Ali (1998) asserts that in most secondary schools, the number of students who offer Arts and Commercial subjects in the West Africa Senior School Certificate Examinations (WASSCE) have been much higher than those offering pure science subjects like chemistry. According to him, students fear Chemistry or develop what is referred to as “chemophobia” so much that anyone who enrolls in Chemistry is looked upon with awe; because the course is believed to be difficult and not easy to pass in examination. This stance maybe due to poor teaching strategies or lack of adequate teaching materials presented in our secondary schools. Chemistry is a subject of universal interest in human development with regards to the utility of its knowledge in real-life situations to be faced by many students someday (Jegede, 2012).

According to Ojokuku (2010), Chemistry is concerned with the utilization of natural substances and the creation of artificial ones. The power of chemical science is what creates as a whole an enabling infrastructure that delivers the food, machines and materials that are the hallmarks of modern life (Samuel, 2008). Despite the immense importance of chemistry to national development, Nigerian Senior School Certificate Examination (SSCE) has continued to record poor performance in Chemistry over the years. Research by Kozma and Russel in Pekdag (2010) shows Chemistry as an abstract subject and difficult to understand. This is because the basic concepts have to be mentally visualized by the students to understand the chemical phenomena. More so, understanding Chemistry is based on assigning meaning to the unseen and the intangible.

To make Chemistry more relevant, enjoyable, easy and meaningful to students, adequate instructional materials need to be provided and properly utilized as

the teaching and learning situation may demand. This is where Information and Communication Technology (ICT) comes in. Previous research by Ikwuka (2010) has shown that learners are motivated when their learning is supported by technology, which in turn leads to increased understanding. Njoku and Eze-Odurukwe (2015) indicated that students' academic achievements are greatly improved when taught with computer animations. Queen (2012) observed that the use of ICT in education results in increased effectiveness of educational process; and use of technology in training, results in increased productivity through enhanced human capacity. In the age of internet revolution with the corresponding knowledge explosion which resulted from ICT, the role of media in technology and learning as a key instrument in globalization cannot be over emphasized.

Yusuf (2008) said that ICT and computer assisted instruction (CAI) as computer based tools should be used by teachers to make teaching more meaningful. The value of computer animation led education is not only recognized by academics and private sector but also highly valued by students themselves, who appreciate the opportunities, contextualization and challenges the package offers. Computer animation is a useful tool for instruction and meaning making. This strategy is such that during instruction, students view the animated pictures as real objects and frictions with meaningful ideas as reality of life.

Achievement is determined by attempts. The more you attempt what others see as impossible, the more incredible achievements you make on the track of success. Academic achievement is the outcome of education; the extent to which a student, teacher or institution has achieved their educational goals; and this is commonly measured by examinations or continuous assessment.

Gender disparities have been noticed and reported by various researches as concerning enrolment in science and poor learning outcomes. Ekeh (2003) discovered that male secondary school students performed better than females in sciences and Mathematics. Umoh (2003) opined that there is societal gender stereotype, males chose male stereotype occupations and females chose female stereotype occupations. Udousoro (2011) stated that male in secondary schools are more likely to take difficult subjects areas and challenging problem-solving situations, while females will prefer simple subjects and less difficult tasks easy problem-solving situations. Otor (2011) cited reasons for poor female enrolment in Chemistry as fear of the subject and the belief that it is an abstract and volatile subject and most suitable for males.

Statement of the Problem

The state of Chemistry teaching and learning seems to be fast deteriorating in most secondary schools in Nigeria as most schools do not have well equipped laboratories to enhance learning. Over the years, there has been poor performance in Chemistry in West Africa Senior School Certificate Examinations (WASSCE). For instance, the WAEC Chief Examiner's Report of May/June 2014(SSCE) in Chemistry showed that the performance of candidates was poorer than in May/June 2013. This situation makes students to become disenchanted and apathetic towards Chemistry. The problem of this study is therefore; can the use of computer animation improve students' academic achievement in Chemistry?

Purpose of the Study

The purpose of this study is to determine the effect of computer animation on secondary school students' academic achievement in Chemistry.

Specifically, the study sought to achieve the following;

1. To determine the academic achievement of Chemistry students taught with computer animation and those taught in a conventional way.
2. To determine if there is difference in the academic achievement of male and female students when taught Chemistry with computer animation.

Research Questions

Two research questions guided the study.

1. What are the differences in the academic achievement of SS2 students taught Chemistry concepts using computer animation with those taught with conventional method?
2. Are there differences in the academic achievement of male and female SS2 students taught Chemistry concepts using computer animation?

Hypotheses

Based on the research questions, the following hypotheses were formulated and tested at 0.05 level of significance

1. There is no significant difference in the academic achievement of SS2 students who were taught Chemistry concepts with computer animation and those taught in a conventional way.
2. There is no significant difference in the academic achievement of male and female SS2 students who were taught Chemistry concepts with computer animation.

METHOD

The design adopted for this study was quasi-experimental non-randomized pre-test, post-test

control group design. The experimental design allows the researchers to manipulate the independent variables in order to determine its effects on the dependent variable. The population of the study comprised all the 2,500 senior secondary school two (SS2) Chemistry students in the 21 public secondary schools in Awka South local government area of Anambra State. The sample was made up of 100 SS2 students (50 boys and 50 girls) from two intact classes selected from two secondary schools. No sampling technique was used for selecting the sample since intact class was used. While criteria sampling technique was used for the selection of two secondary schools out of the 21 secondary schools. One of the criteria is that the school must have presented candidates for Senior School Certificate Examination (SSCE) for at least 5 times. Secondly, the school must have a functional Chemistry laboratory.

Instrumentation

The instrument used for data collection was researchers' developed 20-items multiple choice questions on Chemistry Achievement Test (CAT), and the development and validation of computer animation Chemistry instruction used as the treatment. The Chemistry Achievement Test (CAT) and Computer Animation Chemistry Instruction (CACI) were produced based on the Chemistry concepts of chemical kinetics, chemical equilibrium, and collision theory according to the senior secondary two(SS2) Chemistry curricula. The CAT and CACI were validated by experts in Chemistry and Educational Technology from Faculty of Education, Nnamdi Azikiwe University Awka and comments and suggestions made by them were used in the production of the final test items and CACI.

The topics chemical kinetics, chemical equilibrium, and collision theory were chosen because of their relevance to the study of Chemistry at the senior secondary level. The test items covered the three topics which the subjects were taught. The test was scored according to the marking scheme developed by the researchers.

To ensure the reliability of the instrument, the 20 multiple choice items were administered to a trial testing group of 10 students who were not part of the main study. The result obtained in the administration was subjected to Kuder-Richardson formula 20, and a reliability co-efficient of 0.82 was obtained. The study covered a period of six weeks. The SS2 Chemistry teachers of the two schools served as research assistants. The teachers were given detailed information and instruction concerning the study. Subjects were pre-tested before the teaching commenced. The experimental group was taught Chemistry concepts of chemical kinetics, chemical equilibrium, and collision theory using computer animation, while the control group was taught the

same Chemistry concepts using conventional method. A post-test was administered to the two groups for 30 minutes one week after the treatment. The post-test contained the same set of items as in pre-test but was re-arranged. The procedure is summarized as follows:

1st week: Visiting the participating schools and training the research assistants.

2nd week: Administration of Computer Chemistry Achievement test (CAT) as pretest to determine the equivalence of the experimental and control groups.

3rd – 5th week: Three weeks of teaching the experimental and control group students, the Chemistry concepts of chemical kinetics, chemical equilibrium, and collision theory using Computer Animation Chemistry Instructional (CACI) package and conventional method.

6th week: Post-test administration.

The data obtained from the pre-test and post-test of the two groups were analyzed using Mean, t-test and Analysis of Co-variance (ANCOVA) statistics.

RESULTS

The results are presented with regards to the effects of CACI and conventional method, and their effect on students' achievement in Chemistry.

Table 1: Pre-test and Post-test Mean Achievement Scores of Students

Source of Variation	N	Pre-test Mean Score	SD	Post-test Mean Score	SD
Experimental Group	50	23.48	3.44	77.20	20.23
Control Group	50	24.33	5.67	51.30	13.51

Table 1 shows that the post-test mean score of students in experimental group (77.20) is higher than the control group post-test mean score (51.30). This means that CACI enhances students' academic achievement in Chemistry concepts more than the conventional method with a mean difference of 9.61.

Table 2: Pre-test and Post-test Mean Achievement Scores of Male Students

Source of Variation	N	Pre-test Mean Score	SD	Post-test Mean Score	SD
Experimental Group (Male)	27	23.47	5.14	65.78	3.03
Control Group (Male)	26	27.46	4.92	54.66	4.99

Table 2 shows that the male experimental group has a post-test mean score of 65.78 and the control group has a post-test mean score of 54.66 with a mean difference of 11.12. This implies that the use of CACI is effective in enhancing Chemistry teaching and learning among the male students. The standard deviation 3.03 of the experimental group shows a

more homogeneous achievement cluster among the students than the control group.

Table 3: Pre-test and Post-test Mean Achievement Scores of Female Students

Source of Variation	N	Pre-test Mean Score	SD	Post-test Mean Score	SD
Experimental Group (Female)	23	23.50	5.89	64.25	3.79
Control Group (Female)	24	21.72	6.21	51.00	8.92

Table 3 shows that the female experimental group has a post-test mean score of 64.25 against the control which has a post-test mean score of 51.00 with a mean difference of 13.25. This indicates that the use of CACI is effective in enhancing Chemistry teaching and learning among the female students.

H₀₁: There is no significant difference in the academic achievement of SS2 students who were taught Chemistry concepts with computer animation and those taught in a conventional way.

Table 4:t- test Analysis of Post-test Mean Achievement Scores of the Experimental and Control Groups

Group	N	Mean	SD	Df	t-cal	t-crit	Decision
Experimental	5	77.2	20.2	9	7.528	1.98	Sig
Control	5	51.3	13.5	4		0	

Table 4 shows that the calculated value 7.5284 of the t-test statistics is greater than its table value of 1.980 at 0.05 level of significance. Thus the null hypothesis is rejected, implying that there is a difference in the mean achievement of the experimental group and the control group. The mean difference is statistically significant in favour of the experimental group.

Table 5: ANCOVA on Mean Scores of Chemistry Students Achievement Taught with CACI and those Taught with Conventional Method (CM)

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Decision
Correct Model	80.085	2	40.042	7.912	0.001	
Intercept	224.815	1	224.815	44.421	0.000	
Pretest	12.845	1	12.845	2.536	0.114	
Treatment	43.542	1	43.542	8.604	0.004	Sig.
Error	490.915	97	5.061			
Total	17212.000	100				
Corrected total	571.000	99				

R squared=.140(Adjusted R Squared=.123)

Table 5 showed that there is a significant mean effect of mode of instruction on students' achievement in Chemistry since $F(1, 97) = 8.604, p < 0.05$. The null hypothesis therefore was rejected indicating that there was significant difference in the achievement score of

the students taught Chemistry using CACI and those taught using conventional method.

H₀₂: There is no significant difference in the academic achievement of male and female SS2 students who were taught Chemistry concepts with computer animation.

Table 6:t- test Analysis of Post-test Mean Achievement Scores of Male and Female in the Experimental Group

Group	Sex	N	Mean	SD	Df	t-cal	t-crit	Decision
Experimental	Male	27	86.20	11.39	48	5.541	2.000	Sig
Control	Female	23	68.20	23.18				

Table 6 shows that the calculated value 5.541 of the t-test statistics is greater than its table value 2.000 at 0.05 level of significance. The null hypothesis is therefore rejected, implying that there is a significant mean difference in the academic achievement of the male and the female students in favour of the males.

DISCUSSION

The result of this study had shown that students taught using CACI performed better than students taught using conventional method (CM). The significant difference could be as a result of the ability of the CACI to provide aural and visual representations of the experimental procedures and the microscopic concepts which were since imagined are made visible by CACI. This could also be due to the fact that CACI has the potential of making students learn more because fun and entertainment are naturally ways through which students learn, therefore, improving performance of students. The result of the study supports the views of previous researchers like Njoku and Eze-Odurukwe (2014), who indicated that students' performance are greatly improved when taught with computer animations. The result also showed that gender had significant effect on achievement in favour of males. The findings of this study, effect of computer animation on chemistry academic achievement of secondary school students in Anambra State, therefore shows that there is significant difference in academic achievement of male and female students in favour of males who were taught chemistry using CACI.

CONCLUSION

Based on the findings of the study, it was concluded that students who were taught Chemistry concepts with CACI had higher mean achievement scores than those students taught with conventional method (CM); and that male students achieved significantly higher than female students when taught Chemistry concepts with CACI.

RECOMMENDATIONS

Based on the findings and their implications, the following recommendations were made:

1. Since the use of CACI in teaching has been found to enhance achievement in Chemistry, Chemistry teachers should employ it more in the teaching of the subject especially for topics that are abstract.
2. Chemistry teachers' capacity in the preparation and effective use of computer animations in teaching concepts needs to be built.
3. Chemistry teachers should be provided with the facilities such as computers, storage devices and projectors which they need for preparing and teaching their lessons using computer animations.

LIMITATIONS TO THE STUDY

The use of computers, storage devices and projectors depended on the knowledge of the research assistants who were trained only for one week and constant supply of electricity which was inconsistent through the weeks of the study. The above factors must have affected the study in many areas, some of which was not the focused of this study.

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