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Effects Of Instructional Computer Animation On Secondary School Students' Achievement In Chemistry In Awka Education Zone

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Abstract: ***This study investigated the effect of instructional computer animation on secondary school students' achievement in chemistry in Awka Education Zone. Two research questions and three null hypotheses guided the study. The study adopted a quasi-experimental design. The sample consisted of 186 students drawn secondary schools in Awka Education Zone. Chemistry Achievement Test (CAT) was used to collect data for the study. The CAT of 25 items validated by experts and has a reliability coefficient value of 0.72 established using Kuder Richardson 20. The CAT was administered to the students as pretest and posttest for data collection. Mean and standard deviation were used to answer the research questions while Analysis of Covariance was used to test the null hypotheses at 0.05 level of significance. The result revealed that instructional computer animation had significant effect on students' achievement. Female students performed better than the male students taught using instructional computer animation. The study recommended that instructional computer animation be adopted by chemistry teachers for teaching chemistry concepts to secondary school students.***

Keywords: animation, chemistry, bonding, equilibrium

I. INTRODUCTION

Chemistry is a subject in the physical science. It is the science that deals with the composition, properties, reactions and structure of matter. The importance of chemistry in everyday life cannot be over emphasized. For all living things to function and survive their bodies perform various chemical processes such as respiration, digestion, producing new cells, filtering and removal of waste substances from their bodies. So all living things depend on chemical reactions to function and survive. Chemistry is the foundation of medicine. Human beings use chemical reactions to create medication for a broad spectrum of illness and they utilize medical plants and animals. Chemistry is needed for the advancement of technology. Unfortunately, many chemistry students in secondary schools find some chemistry concepts difficult to understand (WAEC chief examiner's report, 2009). Students' difficulties in learning these chemistry concepts have been attributed to their abstract nature which students find difficult to visualize (Ozmen, 2009). These abstract concepts include; particulate nature of mater, chemical equilibrium, chemical bonding, rates of reactions and energy effects, and conservation of mass (WAEC Chief Examiner's report, 2009).

Available statistics from West African Examination Council (WAEC) on students' achievement in chemistry show that students' achievement in chemistry in Senior School Certificate Examination (SSCE) over the years has not been encouraging. Evidence of poor performance in chemistry has been reported by WAEC chief examiner's reports 2009—2011. The WAEC statistical analysis of the 2014 and 2015 May/June SSCE results revealed that only 42.2% and 44.1% respectively passed chemistry at credit level, showing that there has not been much improvement from what was reported by WAEC Chief Examiner's Report 2009 -2011.

The poor achievement of students in chemistry at SSCE has been attributed to a number of factors ranging from poor attitude of teachers and learners towards the teaching and learning of chemistry respectively, the broad chemistry

curriculum, poor teaching methods used by chemistry teachers, inadequate instructional material, mathematical deficiencies in students and teachers amongst several other factors (WAEC Chief Examiner, 2009). In the past, several attempts have been made at solving these problems but such efforts had focused more on ways of improving the popular conventional methods of teaching chemistry. Little or no attention has been given to the use of innovative teaching methods such as the use of Information and Communication Technology (ICT) in chemistry curriculum delivery.

In recent years, computer technology has permeated into the society in such a way that almost everything being done involves the use of computer. So science teachers need to key in into the current trend. To achieve this, chemistry teachers need to change their lesson delivery through the use of conventional methods to innovative methods that suit the needs of the present time.

Conventional method of teaching is a teacher-led method of instruction which some teachers prefer to use in their lesson delivery. Conventional methods amongst others include; lecture method, discussion, project method, demonstration and discovery method. The methods are popular and often used by teachers to disseminate information, knowledge and skills to students (Eggari, 2003). For the purposes of this research, conventional method simply means lecture method. The researcher chose this method because most chemistry teachers prefer using it to other conventional methods of instruction. Lecture method is commonly used by chemistry teachers in teaching chemistry. In spite of the above advantages lecture method has a serious disadvantage of emphasizing only on superficial learning instead of in depth knowledge of the facts (Gordon, 2002). There is need therefore, for teachers to adopt other innovative teaching methods that have the potency to improve achievement such as instructional computer animation.

Instructional computer animation is a modern electronic technological instructional method that offers deep learning to students. Computer animation is traditionally defined as an inanimate entity that appears to take on dynamic attributes such as movement, growth and speech which are normally associated with living organisms (Ploatzner &Lowe, 2012). A typical example of computer animation could be likened to the robot which is seen on television performing the action of cooking or gathering items into a basket. Computer animation has been educationally defined by Lander and Lunderstorm (2013) as a set of varying images presented dynamically according to users' action in ways that help the user perceive a continuous change over time and develop a more appropriate mental model of a task. Animation reduces abstraction and tends to improve achievement of students.

Academic achievement is the knowledge acquired and skills developed in schools (Vein, Parveen, Syed & Nazir, 2013). It describes the scholastic standing of the student at any given time. The scholastic standing could be expressed in terms of scores obtained in tests and examinations whether internal or external. When technology such as animation is integrated into the instructional process, male and female students could improve on their achievement as a result of the inherent advantages of using technology in learning.

Gender has been differently defined by various authors. Okeke (2001) defined gender as social differences and relations occurring between males and females which are learned and vary widely among cultures and societies. There has been conflicting findings on gender differences in achievement in science subjects. Adeyegbe (2010) found male students performing generally better than the females in physics, chemistry and biology. However, Olom (2010) revealed significant differences in performance of male and female students in mathematics in favour of females. Adigwe (2014) observed that male students have higher academic achievement in chemistry than the females. Aiyedun (2000) found that there was no difference in performance between the males and females in mathematics. It does appear that these gender differences in students' achievement vary with the method of instruction.

PURPOSE OF THE STUDY

The purpose of the study was to determine the effect of the use of instructional computer animation on students' achievement in chemistry. Specifically, the study determined the:

- ✓ effect of instructional computer animation on students' academic achievement in chemistry when compared with those taught using conventional teaching method.
- ✓ effect of instructional computer animation on the male and female students' achievements in chemistry.
- ✓ interaction effect of instructional methods and gender on students' achievement in chemistry.

RESEARCH QUESTIONS

The following research questions guided the study.

- ✓ What are the mean achievement scores of students' taught chemistry concepts using instructional computer animation and those taught using the conventional method?
- ✓ What are the mean achievement scores of male and female students' taught chemistry concepts using instructional animation?

HYPOTHESES

The following hypotheses were tested at 0.05 level of significance:

- ✓ There is no significant difference between the mean achievement scores of secondary school students taught chemistry concepts using instructional computer animation and those taught using the conventional method.
- ✓ There is no significant difference between the mean achievement scores of male and female students' taught chemistry concepts using instructional computer.
- ✓ There is no interaction effect of teaching methods and gender on students' achievement in chemistry.

II. METHOD

The study adopted a quasi-experimental research design. The population of the study comprised 2,927 senior secondary school year two (SS 2) chemistry students in Awka Education Zone of Anambra State. The sample for the study consisted of 186 senior secondary year two (SS 2) chemistry students drawn from four classes in two coeducational schools in Awka Education Zone. The instruments were used for data collection was Chemistry Achievement Test (CAT). CAT was a 25-item multiple choice test developed by the researcher. The 25-item multiple choice tests was based on chemical bonding and chemical equilibrium which were the concepts taught to the students in this study. Thirteen (13) items were drawn from chemical bonding and twelve (12) items from chemical equilibrium. The weighting was based on the scope of the content area as the two topics appear to have equal weight. The instrument was validated by experts in Nnamdi Azikiwe University Awka. The reliability of CAT was established using Kudder Richardson Formular (KR-20) which yielded a reliability index of 0.72.

Before the experiment began, the CAT and CIS were administered as pretests to the experimental group and control group. At the end of the test, the experimental group was taught some chemistry concepts using computer animation involving pictorial designs of animated chemistry concepts by one of the two chemistry teachers for the experimental group while the other teacher was a standby or reserve. This was done so that in case of any accident or illness the standby teacher would take over to avoid stopping the experiment abruptly. In the experimental group, the teacher introduced the topic as chemical bonding, explained the periodic table of Group O elements as noble gases with stable atomic structure. She showed animated moving images of different shapes and colours of Group O elements carrying two or eight electrons in their outer most shells. Students seeing these moving images smiled and began to whisper to one another.

The teacher listed types of bonding differentiating each with moving pictures of varying colours indicating different bonds. The students seeing them widened their eyes, touching one another, discussing their observances. The teacher discussed electrovalent bonding using animated Sodium (Na) and Chlorine (Cl) atoms that were flapping their wings. Students watching them started flapping their two hands like birds on flight. As Na atom was donating its electron to Cl atom, students dived as someone who wants to catch a ball. They shouted, clapped and laughed. Students hands were up to ask questions, discuss their observations, to demonstrate the actions and to make contributions. They were allowed to air their views one by one. So it continued till the end of the lesson. Similar approach was used to teach the concept of chemical equilibrium. The control group was taught by one of the other two class teachers using conventional method of instruction. At the end of the treatment, the items were reshuffled and administered again to the students as posttest.

Mean and standard deviation scores were used to answer the research questions while two-way analysis of variance (ANCOVA) was used to test the hypotheses at 0.05 alpha levels. Two-way ANCOVA was used to analyse the experiment because the experiment has two independent variables and because there are three basic types of effects that are tested; main effect for independent variable A, main effect for independent variable B, and effect for the interaction of A and B. When the P-value was greater than 0.05, null hypothesis was not rejected but when p-value was less than 0.05, null hypothesis was rejected.

III. RESULT

RESEARCH QUESTION 1: What are the mean achievement scores of students' taught chemistry concepts using instructional computer animation and those taught using conventional method?

Method	N	Pretest mean	SD pretest	Posttest mean	SD posttest	Gain in Mean
Instructional Computer Animation	95	31.79	11.55	76.89	11.69	45.10
Conventional method	91	31.81	12.39	54.43	10.01	22.62

Table 1: Mean Pretest and Posttest Achievement Scores of Students Taught using Computer Animation and Conventional Method

Table 1 shows that the group taught chemistry concepts using instructional computer animation has a gain in mean achievement score of 45.10, while those taught using conventional method has a gain in mean of 22.62. Students taught chemistry concepts using instructional computer animation therefore, have higher gain in mean achievement than their counterparts taught using the conventional method. The use of instructional computer animation increases the spread of scores among the students while the conventional method reduced the spread of scores among the students.

RESEARCH QUESTION 2: What are the mean achievement scores of male and female students' taught chemistry concepts using computer animation?

Gender	N	Pretest mean	SD pretest	Posttest mean	SD posttest	Gain in mean
Male	45	31.56	12.70	75.67	7.04	44.11
Female	50	32.00	10.55	76.20	13.80	44.20

Table 2: Mean Pretest and Posttest Achievement Scores of Male and Female Students Taught using Computer Animation

Table 2 shows that the female students taught chemistry concepts using instructional computer animation method have higher mean achievement gain score of 44.20 while their male counterparts have gain in mean score of 44.11. The use of computer animation increases the spread of scores for females but decreases the spread of scores for males.

HYPOTHESIS 1: There is no significant difference between the mean achievement scores of secondary school students taught chemistry concepts using instructional computer animation and those taught using conventional method.

Source	SS	Df	Mean Square	F	P-value	Decision
Corrected Model	9643.763[a]	4	2410.941	24.032	.000	
Intercept	46343.196	1	46343.196	461.940	.000	

Pretest	910.721	1	910.721	9.078	.003	S
Gender	1096.850	1	1096.850	10.933	.001	S
Method	6650.190	1	6650.190	66.288	.000	S
Method * Gender	511.375	1	511.375	5.097	.025	S
Error	18158.473	181	100.323			
Total	507720.000	186				
Corrected Total	27802.237	185				

Table 3: Analysis of Covariance for Test of Difference in Achievement of Students Taught Chemistry Concepts using Computer Animation and Conventional Method

Table 3 shows that at 0.05 level of significance, there was significant main effect of the treatment in the achievement scores of the students with respect to post achievement, F(1,185) = 66.288, P-(0.000) < 0.05. Thus, There is a significant difference between the mean achievement scores of secondary school students taught chemistry concepts using instructional computer animation and those taught using conventional method in favour of instructional computer animation.

HYPOTHESIS 2: There is no significant difference between the mean achievement scores of male and female students taught chemistry concepts using instructional computer animation.

Table 3 also shows that at 0.05 level of significance, there was significant main effect of the treatment in achievement scores of the male and female students with respect to post achievement, F (1,185) = 10.933, P- (0.001) < 0.05. Therefore, the null hypothesis is rejected. Thus, there is significant difference between the mean achievement scores of male and female students taught chemistry concepts using instructional computer animation.

HYPOTHESIS 3: There is no interaction effect of teaching method and genders on students' mean achievement scores.

Table 3 further shows that at 0.05 level of significance, there was significant interaction effect of teaching method and gender on the achievement scores of the students, F (1,185) = 5.097, P-(0.026) < 0.05. Therefore, the null hypothesis is rejected. Thus, there is interaction of teaching methods and gender on the achievement of the students in chemistry. The interaction is shown in Figure 1.

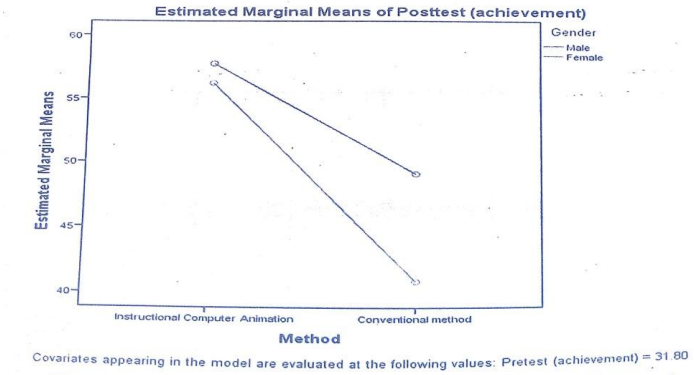

Figure 1: interaction of teaching methods and gender on achievement

The plot of the interaction of gender and teaching method is significant and ordinal. This shows that the effect of teaching method is greater in one category of variable (gender), for example, the effect of teaching is greater in males than females or otherwise. This implies the teaching method is gender biased.

IV. DISCUSSION

One of the major purposes of this study was to determine whether instructional computer animation provides better students' academic achievements in chemistry than the conventional method of instruction. It was found that instructional computer animation provides a better academic achievement in chemistry. The mean score of students taught with computer instructional computer animation is higher than those taught with conventional method. The finding is further confirmed by the result of table 3 which indicates that the teaching approach was a significant factor in the achievement of students taught chemistry. This is shown by the rejection of null hypothesis of no statistical significant difference in the mean academic achievement scores in chemistry students taught with instructional computer animation and those taught with conventional lecture method. Thus, this finding confirms that the group taught chemistry with instructional computer animation achieved better than the group taught with conventional method.

The finding of this study is supported by the earlier findings of Gambari, Folade and Adegbenro (2014) which proved that instructional computer animation improved the academic achievement of chemistry students more than the conventional method. The difference may be as a result of the interactive nature of computer animation providing the students an opportunity to be actively involved in the learning process. This finding had support from what had been found by other researchers such as Chang, Quintans and Krajcik (2010). Chang, Quintans and Krajcik found that instructional animations improved students learning. Gigninna (2013) found that there was significant difference in the achievement of students taught chemical bonding with instructional computer animation against those taught with conventional method. Those taught with instructional computer animation achieved significantly higher than their counterparts.

Another major finding of this study is that there is gender difference in the academic achievement of students taught with instructional computer animation and those taught with conventional method. The result indicated that differences existed between the gain in mean scores of the male students and that of the female students. That is to say that female students achieved better than the males in chemistry when taught with instructional computer animation. This notwithstanding, researchers have revealed significant gender differences in science achievement across educational systems but there is conflicting evidence on gender difference in science achievement (Nwogu, 2005; Olom, 2010). In line with findings of this study is the result of Egbunonu (2012) on the effect of computer assisted instruction on secondary school students' cognitive achievement on ecological concepts.

V. CONCLUSION

It can be concluded from the findings of the study that chemistry teacher could enhance students' achievement in chemistry through the use of instructional computer animation.

VI. RECOMMENDATIONS

Based on the findings of this study the following recommendations are put forward:

- ✓ Instructional computer animation should be adopted in the chemistry curriculum delivery in all public secondary schools.
- ✓ Since many serving teachers are not very familiar with instructional computer animation and its benefits, conferences, seminars and workshops should be organized by relevant professional bodies to educate them on computer animation.

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