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Impact of Computer Based Instructional Package on Chemistry Students' Achievement in Learning Oxidation-Reduction Reactions

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Abstract

This study examined the impact of Computer Based Instructional Package on Chemistry students' achievement in learning oxidation-reduction reaction. Three research questions were raised and further hypothesised. The research design adopted for the study was the pretest posttest non-equivalent control group quasi experimental design. The population of the study was four hundred and eighty one (481) Chemistry students in senior secondary two in public schools in Oshimili South Local Government Area of Delta State. Simple random sampling (balloting) was used to select two secondary schools. The instrument for data collection was the Chemistry Achievement Test (CAT). The reliability of the instrument was established using Kuder-Richardson Formula 21 and a value of 0.75 was obtained. Data collected were analysed using descriptive statistics (mean and standard deviation), t-test and Analysis of Variance. The study concluded that Computer Based Instructional Package significantly improved students' achievement in oxidation-reduction reactions. It was recommended that chemistry teachers should make use of Computer Based Instructional Package for the teaching and learning of chemistry.

Keywords: Computer Based Learning, Oxidation-reduction reactions and Achievement

Introduction

Chemistry is one of the science subjects taught at the secondary school level in Nigeria. It is a science that deals with the composition, properties and uses of matter. The knowledge of this subject is indispensable for the pursuit of professional courses in Engineering, Medicine, Nursing, Pharmacy and other science related disciplines. Poor knowledge of Chemistry at the Secondary School level will hinder future effort to promote scientific and technological development. Studies have shown that students perform poorly in chemistry in recent times. Many factors have been attributed to the students' poor performance such as high level of abstraction of some chemistry concepts and teachers find it difficult to concretize such concepts through laboratory demonstration and

experimentation (Njoku & Eze-Odurukwe, 2014). Also, science educators have identified factors such as learners' cognitive styles, learners' conceptions and border crossing, quality of teaching, quality of teachers, quality of curriculum and quality of teaching –learning resources. One of such concepts most students find difficult in chemistry is oxidation-reduction reaction.

Oxidation-reduction reaction is an important concept in Chemistry in which one specie loses electrons and another specie gains electrons simultaneously. This concept has a lot of applications to real life situations such as in photosynthesis, respiration, combustion and corrosion. Green plants manufacture their own food through this process and animals depend on plants for food and as such one can say without this concept there will be no life.

Achievement is the extent to which an academic goal is accomplished. The level of achievement is determined using both formative and summative evaluation. The class work, assignment and continuous assessment test given to students are formative evaluation while the assessment written at the end of the term is summative evaluation. Formative evaluation can be used to track students' progress and enables the teacher to know the kind of support the student requires before summative evaluation is given.

Gender is the state of being male or female. Studies on gender and achievement in Chemistry have shown that gender does not have anything to do with students' achievement in learning Chemistry. This is supported by Ajayi and Ogbeba (2017) who found no significant difference in the mean achievement scores of males and females taught stoichiometry using hands-on activities.

The empirical researches on computer based learning by scholars have confirmed the effectiveness and enhancement of this teaching strategy on students' achievement than the traditional lecture method. Adegbija and Falode (2014) observed that students that were taught concept of waves using animated based physics Camstudio instructional package performed significantly better than the students taught the same concept using conventional lecture method. Gambari, Falode and Adegbenro (2014) researched on the effectiveness of computer animation and geometrical instructional model on Mathematics achievement and retention among Junior Secondary School students. It was found that the students taught geometry using computer animation performed significantly better than the students taught geometry using conventional method.

Engaging students positively in the learning process increases their participation and motivates them to learn more which also leads to deeper understanding of the subject and eventually leads to better achievement. This study attempted to develop and use Computer Based Instructional Package as an innovative teaching strategy to actively engage students and improve their achievement in oxidation-reduction reactions.

Statement of the Problem

There has been persistent poor achievement of students in Chemistry in recent times. Literature and WAEC Chief Examiners' Reports have shown that many of the students lack knowledge of technical terms, have poor understanding of the demands of the questions, lack knowledge of stoichiometry, chemical reactions and lack good knowledge of oxidation-reduction reactions. The Chief Examiners' reports indicates that teachers do not cover the contents of the curriculum and are not familiar with the demands of the examination syllabus. These reports also noted that candidates memorise Chemistry concepts as they may not have been properly taught most

of these concepts. Can the use of Computer Based Instructional Package meaningfully engage students and improve their achievement in oxidation-reduction reactions in Chemistry?

Research Questions

To guide this study, the following research questions were raised.

1. Is there a difference in the mean achievement scores of students taught with Computer Based Instructional Package and those taught using lecture method?
2. Is there a difference in the mean achievement scores of male and female students taught oxidation-reduction reactions using Computer Based Instructional Package?
3. Is there interaction effect of methods and gender on students' mean achievement score?

Hypotheses

Three hypotheses were stated to further guide the study and tested at 0.05 level of significance.

1 There is no significant difference in the mean achievement scores of students taught with Computer Based Instructional Package and those taught using lecture method.

2 There is no significant difference in the mean achievement scores of male and female students taught oxidation-reduction reactions using Computer Based Instructional Package.

3 There is no significant interaction effect of methods and gender on students' mean achievement score.

Methodology

The research design adopted for this study is the pretest posttest non-equivalent control group quasi experimental design was used with intact classes. The population of the study was made up of 481 Senior Secondary II students in Oshimili South Local Government Area of Delta State. The sample for the study consisted of one hundred and ninety one chemistry students (109 males and 82 females) in two sampled schools. Simple random sampling (balloting) was used to select two schools which are intact classes. All the chemistry students in senior secondary two in the experimental group and the control group were involved. Students in the experimental group were taught oxidation-reduction reactions using Computer Based Instructional Package while students in the control group were taught oxidation-reduction reactions using lecture method.

The validity of Chemistry Achievement Test was done by two science educators and one experienced Chemistry teacher. The content validity of this instrument was determined by using table of specification. The reliability of the instrument was established using Kuder-Richardson Formula 21 and a value of 0.75 was obtained. This means that the Chemistry Achievement Test score is reliable. Data were collected using the Chemistry Achievement Test (CAT). The instrument was made up sections A and B. Section A contains information on students' bio-data which includes student's registration number and sex. Section B consists of twenty multiple choice objective questions with four response options (A-D). Students were expected to read the questions carefully and then choose the correct option.

Computer Based Instructional Package was used to teach the students oxidation-reduction in the experimental group and the treatment procedure is as follows: In the first week of instruction, the pretest was administered to the students in both experimental and control groups. Lessons were taught to the experimental group using Computer Based Instructional

Package. Students in their smaller groups in the experimental group were asked to watch animated videos on oxidation-reduction reactions. The students were selected based on their performance in Chemistry lessons taught by their teacher. The outstanding students, good students and those that need help were selected and were grouped together in eight students per group. The control group was taught using lecture method of instruction. At the end of the lessons, a posttest was administered to both the experimental and control groups

Results/Findings

Pretest scores were analysed for significant difference before the treatment. The results shows a significant difference in the mean achievement score of students taught with Computer Based Instructional Package and those taught using lecture method but no significant difference was observed in the mean achievement score of male and female students taught oxidation-reduction reactions using Computer Based Instructional Package. Therefore, hypotheses one and two were tested using t-test of independent samples at post -test. However, the hypothesis on interaction effect was tested using two-way ANOVA instead of ANCOVA.

Hypothesis One: There is no significant difference in the mean achievement score of students taught with Computer Based Instructional Package and those taught using lecture method.

Table 1**: Summary of Independent samples t-test of Achievement scores of Students by groups at posttest**

Group	N	$\overline{X}$	SD	t	df	$\overline{X}$ diff	Sig (2-tailed)
Experimental	95	14.75	3.96	26.36*	189	11.24	.00
Control	96	3.51	1.33				

*significant at $\alpha < 0.05$

Result on Table 1 shows that the posttest mean achievement score for students taught with Computer Based Instructional Package is 14.75 and standard deviation of 3.96 while the posttest mean achievement score for students taught using lecture method is 3.51 and standard deviation of 1.33. The mean difference in achievement between the students taught using Computer Based Instructional Package and those students taught using lecture method is 11.24 yielding a t-value of 26.36 significant at 0.00. At 0.05 level of significance, the table shows a statistically significant difference at .00. The hypothesis tested significant difference in favour of use of Computer Based Instructional Package. The null hypothesis of no significant difference is rejected.

Hypothesis Two: There is no significant difference in the mean achievement score of male and female students taught oxidation-reduction reactions using Computer Based Instructional Package .is summarised in Table 2.

Table 2**: Summary of Independent sample t-test of mean achievement score of male and female students using Computer Based** Instructional Package **at posttest**

Gender	N	$\overline{X}$	SD	T	df	$\overline{X}$ diff.	Sig
Male	40	14.38	4.08	-.78*	93	-.64	.44
Female	55	15.02	3.88				

*significant at $\alpha < 0.05$

Table 2 shows a calculated t-value of -0.78 and a p-value of 0.44, since 0.44 is greater than 0.05 there is no significant difference in the mean achievement score of male and female students taught oxidation-reduction reactions using Computer Based Instructional Package. This may mean Computer Based Instructional Package impacts equally for males and females.

Hypothesis Three: There is no significant interaction effect of methods and gender on students' mean achievement score.

Table 3**: Summary of Two Way ANOVA on the interaction effect of methods and gender on students mean achievement score**

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	6039.500[a]	3	2013.167	231.014	.000
Intercept	13934.717	1	13934.717	1599.028	.000
Method	5325.044	1	5325.044	611.056	.000
Gender	2.122	1	2.122	.244	.622
Method * Gender	7.415	1	7.415	.851	.357
Error	1629.610	187	8.714		
Total	23484.000	191			
Corrected Total	7669.110	190			

*significant at $\alpha < 0.05$

Table 3 shows that F = 0.851, df = 1 and p-value of 0.357. The p-value is greater than alpha level 0.05. Results show no interaction effect of methods and gender on students mean achievement score. The null hypothesis of no significant interaction effect was accepted. Therefore, there is no significant interaction effect of methods and gender on students' mean achievement score.

Discussion of Findings

The finding of this study revealed that Computer Based Instructional Package teaching method actively engage students, rescuing students from boring traditional lecture method, increase their level of participation and significantly improved students' achievement in oxidation-reduction reactions. The finding of this study is in agreement with the studies (Gambari, Falode and Adegbenro, 2014; Njoku and Eze-Odurukwe, 2014; Aydin, 2015; Oskay and Efil, 2016; Falode, Sobowale, Saliu, Usman and Falode, 2016; Ikwuka and Samuel, 2017; Naomi and Chigozie, 2017) involving secondary schools students.

Also, there was no significant difference in the mean achievement score of male and female students taught oxidation-reduction reactions using Computer Based Instructional Package teaching method. This is in agreement with the studies (Gambari, Falode and Adegbenro, 2014; Falode, Sobowale, Saliu, Usman and Falode, 2016; Ajayi and Ogbeba, 2017; Godpower-Echie G. and Ihenko, 2017) involving male and female students. The study is not in agreement with Naomi and Chigozie (2017) who found that gender had significant effect on the academic achievement of male and female students that were taught Chemistry using Computer Animation in favour of the male students.

Similarly, there was no significant interaction effect of methods and gender on students' mean achievement score. The finding is in agreement with the studies carried out by Ajayi and Ogbeba(2017), Bamidele and Yoade (2017).

Conclusion

The results of this study have shown that the use of Computer Based Instructional Package is better in teaching oxidation-reduction reactions than lecture method. The researcher also concluded that students' gender had no significant influence on students' achievement in oxidation-reduction reactions in Chemistry. It was also concluded that there was no interaction effect of methods and gender on students' mean achievement score. Computer Based Instructional Package can be used to teach students irrespective of their gender for better achievement in oxidation-reduction reactions in Chemistry.

Recommendations

Based on the findings, the following recommendations are made:

1. The school administrators and Chemistry teachers should ensure the development of Computer Based Instructional Package for the teaching and learning of Chemistry concepts.
2. Government should make computers available (educational packages well installed) in schools with standby generators to teach Chemistry concepts.
3. The school administrators should encourage Chemistry teachers to use Computer Based Instructional Package in teaching and learning process.
4. Regular workshop should be organised to educate Chemistry teachers on the use of Computer Based Instructional Package to concretise abstract concepts.

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