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Critical Analysis of the Effect of Computer Assisted Instruction (CAI) on Senior Secondary School Students' Achievement on Chemical Reaction and Equilibrium

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ABSTRACT

The implementation of Computer Assisted Instruction (CAI) as a mode of instructional technology in senior secondary school is paramount in the heart of many educators as it could lead to national technological development. This study investigates the effect of CAI on senior secondary school student's achievement on chemical reaction and equilibrium. The study employs a pretest, posttest quasi-experimental non-randomized control group design. The sample size of the study comprised of 128 males and 112 female students. Simple random sampling was used to assign intact classes to experimental and control group, while purposive sampling was used to select ten (10) public senior secondary schools in Oju LGA of Benue State. The instrument used for the study is the Equilibrium of Reversible Reaction Achievement Test (ERRAT). The student's scores from ERRAT were collected and analyzed using mean and standard deviation to answer the research questions and ANCOVA was used to test the hypothesis at 0.05 level of significance. The result showed that there is significant difference in the mean achievement of students taught chemical reaction and equilibrium using CAI and those taught using conventional strategy ($F_{1,239}$ =309.572;P=0.000< 0.05). Conversely, there is no significant difference in mean achievement between male and female students taught chemical reaction and equilibrium using CAI strategy ($F_{1,127}$=113;p=.733> 0.05). Based on the findings, the study recommends that government should increase funding for the entire educational sector in order to procure reasonable number of computers for senior secondary school to enhance teaching and learning with CAI strategy which is one of the contemporary issues in technology education.

INTRODUCTION

There is hardly any science discipline that does not require the knowledge of chemistry. It is, therefore, made compulsory for every science based course like medicine, engineering, agricultural science, geology, pharmaceutical science and so on.

However, the student's achievement in this subject has not been very encouraging. According to West African Examination Council (WAEC 2003), candidates that offered chemistry performed poorly in the areas of understanding of the concepts of equilibrium of reversible reaction, writing of formulae and correct balanced chemical equations as well as explanation of basic chemical principles concepts and their application. Chemistry is one of the subjects in which the students' achievement at the Senior Certificate Examination (SSCE) has remained persistently low in recent time WAEC (2002). The poor performance of students in chemistry at SSCE is attributed to a number of causes ranging from teachers' attitude, the learners' attitude, the curriculum method of instruction and instructional materials, mathematical deficiency among others WAEC (2003).

The problem of underachievement in chemistry is of great concern to the government, parents, chemistry teachers and researchers in chemistry and several attempts have been made to offset the problem. These attempts include curriculum reforms to reflect the need of the learners and the society, concretization of the learning produces as well as the use of computer – assisted instruction as a mode of instructional technology. Computer is an electronic device used for executing precisely slated rules with accuracy, rapidity and with real reliability. According to Eriba in Unongo (2009), he viewed computer as capable of making calculation, storing information in various field of study, designing devices, making graphical representation of engineering parts and providing leisure in form of music.

Also related to achievement in chemistry is the gender issue. Result from research findings have revealed that male students perform better than the female in physic, chemistry and biology (Danmole, 1998) while Agwagah as cited by Olom (2010) revealed significant different in achievement in favour of female. Researcher such as Aiyedun (2004) shows no significant difference in the performance of boys and girls in mathematics). Hence the researcher sees the need for computer assisted instruction method that may improve the achievement in chemical reaction and equilibrium for both male and female students.

Statement of the problem

The low achievement of students in chemistry particularly in chemical reaction and equilibrium at both external and internal examinations has been a matter of great concern to many educators. Most teachers are accused by the parents of inefficiency. According to them persistent underachievement in schools does not justify the huge investments on education and science in particular by the government. Most teachers attribute this poor performance to abstractness of the subject and the instructional strategy adopted according to Ukwuru (2011).

It has been observed that in Oju LGA where the study was carried out, the conventional method of instruction has not provided the varied activities, attention as well as lesson paced according to students' abilities. And so, this study is aimed at verifying the effect computer assisted instruction could have on students' achievement in chemistry. Over the years, the experience in our school system in Nigeria generally and particularly in Oju L.G.A of Benue State has continued to show a downward trend in students' performance in science especially chemistry and it is, therefore, the need to adopt strategy. There is, therefore, the need to adopt strategies that could enhance meaningful learning among male and female students and hence, improve their achievement in chemistry.

Purpose of the Study:

The purpose of the study was to investigate the effect of computer assisted instruction on students' achievement in senior secondary school chemical reaction and equilibrium in Oju LGA. Specifically, the objectives of this research work are as follows:

1. To investigate if CAI has any impact on students' achievement as compared with conventional method in senior secondary school chemical reaction and equilibrium.

2. To determine if the use of CAI will enhance the achievement of female students more than male in senior secondary school chemical reaction and equilibrium.

Research Questions

The following research questions guided the researcher in this study;

1. To what extent does the use of CAI in teaching chemical reaction and equilibrium improve students' achievement as against the use of conventional method?

2. What is the achievement of male and female students who are exposed to CAI method in chemical reaction and equilibrium?

Hypotheses

Based on the purpose of the study the following null hypotheses were tested at 0.05 level of significance.

1. There is no significant different in the mean achievement scores between students taught chemical reaction and equilibrium using conventional method and those taught using CAI.

2. There is no significant difference in the mean achievement scores of male and female students taught chemical reaction and equilibrium using CAI strategy.

MATERIALS AND METHODS

A quasi-experimental design was employed for the study. Specifically, the non-randomized control group, pretest, post -test design was adopted for the study. A total of 240 SSII students were drawn from ten public schools in Oju Local Government Area of Benue State.

This comprises of 127 male students and 113 female students. The number of students taught chemical reaction and equilibrium were made of 128 students that consist of 68 males and 60 female students and 112 students were taught using conventional strategy.

A 20 multiple choice questions constructed by the researcher were patterned after WAEC Senior School Certificate Examination Chemistry paper 2 called Chemical Reaction and Equilibrium Achievement Test (CREAT). It was validated by two experts from the department of curriculum and teaching Benue State University, Makurdi. The reliability of the instrument was determined using the Kuder-Richarson formula 21 (K-R-21) and was found to be 0.70. The students were grouped into experimental and control groups and were both subjected to CREAT as pretest. The control group students were exposed to the conventional teaching strategy with lesson plans on the same content used for experimental group (CAI) strategy. The treatment for all the groups lasted for six weeks. After the treatment, the two groups were exposed to the CREAT which has been reshuffled as posttest

the mean and standard deviation were used to answer the research questions while the hypotheses were tested using the analysis of covariance ANCOVA at 0.05 level of significance.

RESULTS

The data analyses were hereby presented in the order of the research questions and hypotheses as follows:

Data relevant to the research question one are presented in Table 1.

Table 1. Achievement of pretest and posttest scores of students taught with CAI and conventional strategy.

Method		Pretest	Posttest	Mean Gain
CAI	Mean	35.3906	62.2656	26.8750
	N	128	128	
	Std. Deviation	7.75129	8.60002	
Conventional	Mean	26.4732	39.1071	12.6339
Strategy	N	112	112	
	Std. Deviation	8.42664	8.25315	
Difference				14.2411

Source: Analysis of data collected with CREAT using ANCOVA.

Table 1 shows that the pretest mean achievement scores of students in the CAI method is 35.3906 with a standard deviation of 7.75129, while the conventional strategy has mean and standard deviation of 26.4732 and 8.42664 respectively. Analysis of the results further showed that the posttest mean achievement score in the CAI method and standard deviation is 62.2656 and 8.6002, while the conventional strategy has a mean score of 39.1071 and standard deviation of 8.25315. This implied that both methods improved in the achievement after treatments. Students in the CAI gain by mean achievement difference of 26.8750 while those in the conventional strategy of 12. 6339 with a difference of 14.2411 in favour of CAI method.

Data relevant for research question 2 are presented in Table 2.

Table 2: Achievement of male and female Students' pretest and posttest scores in CAI method.

Sex		Pretest	Posttest	Mean Gain
Male	Mean	35.3676	62.0588	26.6912
	N	68	68	
	Std. Deviation	8.30016	9.51179	
Female	Mean	35.4167	62.2656	27.0833
	N	60	60	
	Std. Deviation	7.1485	7.50706	
Difference				0.3921

Source: Analysis of data collected with CREAT using ANCOVA.

Table 2 showed the mean achievement scopes of male to be 35.3676 with standard deviation of 8.30016, while the female has mean achievement scores and standard deviation of 35.3906 and 7.75129. Analysis showed that the posttest mean achievement scores and standard deviation of male to be 62.0588 and 9.51179 respectively, while female has a mean achievement scores and standard deviation of 62.5000 and 7.5076. The difference in posttest mean achievement scores between male and female is 0.3921. Based on this, it implies that the female students outperformed their male counterpart in CAI strategy.

Data relevant to research hypothesis 1 are presented in table 3.

Table 3: Tests of Between-subjects Effects on means of pretest and posttest of Students taught with CAI and conventional strategy.

Source	Type III Sum of Squares	df	Mean square	F	Sig	Partial Eta squared
Corrected Model	38604.956a	4	9651.239	218.404	.000	**.788**
Intercept	14123.864	1	14123.864	319.617	.000	**.576**
Pretest	6557.095	1	6557.095	148.384	.000	**387**
Method	13679.959	1	13679.959	309.572	.000	**.568**
Sex	13.701	1	13.701	.310	.578	**.001**
Method Sex	.299	1	.299	.007	.934	**.000**
Error	10384.627	235	44.190			
Total	684500.000	240				
Corrected Total	**48989.583**	**239**				

Source: Analysis of data collected with CREAT using ANCOVA.

Table 3 reveals that there is a significant difference between students taught chemical reaction and equilibrium using conventional method and those taught using CAI with ($F_{1,239}$=309.572, P<0.05).which indicates that teaching with CAI method is more effective than teaching with conventional strategy. Hence hypothesis 1 was rejected, it than implies that there is a significant difference in the mean achievement score of students taught with CAI and those taught with conventional strategy.

Data relevant to research hypothesis 2 are presented in table 4.

Table 4: Tests of between – subjects Effects of pretest and posttest means of male and female students taught with CAI.

Source	Type III Sum of Squares	df	Mean square	F	Sig	Partial Eta squared
Corrected model	3497.011	2	1748.505	37.070	.000	.372
Intercept	8546.517	1	8546.517	181.194	.000	.592
Pretest	3490.807	1	3490.807	74.008	.000	.372
Sex	5.307	1	5.307	.113	.738	.001
Error	5895.958	125	47.168			
Total	505650.000	128				
Corrected Total	9392.969	127				

Source: Analysis of data collected with CREAT using ANCOVA.

The result of table 4 reveals that gender has no significant effect on students' achievement when taught chemical reaction and equilibrium using CAI strategy. The calculated ($F_{1,127}$=113;P=.738>0.05) which implies that the difference is not significant. Therefore the null hypothesis 2 is retained.

DISCUSSION

The result of analysis of covariance on the achievement of students taught chemical reaction and equilibrium using CAI is significantly higher than those students taught with conventional strategy. This shows that the use of CAI and conventional method in teaching chemical reaction and equilibrium can produce positive differential on the students' achievement.

The $F_{1,239}$=309.572; P=0.000<0.05 for achievement is Significant.

These finding agrees with the findings of Geban, Askar, and Ozkan (1992). And the findings of Inci, John, Nilgun and Ozge (2006) which are directly on chemistry, similarly, the findings agrees with the studies of Mudasiru and Adedeji (2010) in Biology, this confirmed that CAI has been effective in enhancing student's achievement in other subjects than the conventional strategy.

The study revealed, that gender had no significant influence on the achievement of students in chemical reaction and equilibrium when taught with CAI strategy, $F_{1,127}$=113; P=.7387 0.05).

These findings on gender agrees with the earlier findings of Mudasiru and Adedeji (2010) on gender, thus it can be deduced that the use of CAI method enhances the achievement of both male and female.

Recommendations

1. Computer literacy and operation in the secondary schools and relevant CAI packages should be accorded attention and developed for use within the Nigeria school system.

2. Further empirical studies should be carried out on the use of computer for instructional purpose, on different subjects and at different levels to provide sound basis for the integration of computer assisted instruction in Nigeria schools',

3. Educational curriculum planners should endeavor to integrate a practical computer application course in their curriculum design for pre service teachers.

CONCLUSION

The use of CAI in teaching chemistry concept as against the conventional method improved the achievement of students in chemical reaction and equilibrium in favour of the CAI method. There is gender differential in achievement among students exposed to CAI and conventional strategy on chemical reaction and equilibrium in favour of the male students.

Contemporary issues on technology education of which the implementation of computer assisted instruction is one, places emphasizes on training and retraining of optimal utilization of manpower development programme. The teaching and learning of chemistry using CAI has the prospects of bringing development to the nation since the cognitive, affective and psychomotor domain of the students are involved.

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