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Computer –Based Learning/Instruction in Chemistry Class

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Abstract

The study looked into the effects of computer-based instruction in chemistry classes, the effect on gender, and the effect on students' pretest and post-test scores. The pretest-post-test control group design was used in this investigation. Participants were in two groups (experimental and control). Sample made up of all 416 chemistry students from the chosen schools. Two hundred and eight students were randomly assigned to the experimental and control groups. The chemistry achievement test (cat) was utilized to collect data. The instrument's validity was established with the help of relevant experts in chemistry education, test and measurement, psychologists, and curriculum experts to assure face, content, and construct validity. The split-half approach was used to determine the reliability of the chemical accomplishment test, whereas 0.88 coefficients were obtained. The instrument was administered to individuals prior to treatment, and the post treatment was performed four weeks afterwards. The collected data were subjected to inferential statistics of analysis of T-test, ANOVA, ANCOVA, and Multiple Classification Analysis at the 0.05 level of significance to test for the acceptance or rejection of the null hypotheses. The study revealed that there was no significant difference in the performance of students in experimental and control groups before treatment, while after treatment students in the experimental group performed much better than those in the control group. The results demonstrated that computer-based instruction outperformed the traditional approach of teaching, hence should be introduced in the teaching and learning of chemistry.

Keywords: *Computer base l instruction, performance, Teaching, Academic Achievement.*

INTRODUCTION

Chemistry is a precise and important science topic in Nigerian secondary schools, and its teaching frequently necessitates innovation and improvisation. Chemistry teachers must use creative teaching approaches and be prepared to answer to questions and explain topics in a typical manner in order to make chemical concepts comprehensive to students (Nbina, 2012). Teaching chemistry should be more than a job for teachers with the necessary profession to educate with the appropriate perception. According to Maithya and Ndebu (2011), a variety of factors influence chemistry teaching and learning. These factors, according to Kavagi (2010), are either instructional or teacher-related. Chemistry education helps students have a better understanding of the cosmos and their place in it. It trains students for professional jobs in sectors such as medicine, pharmacy, engineering, nursing, and so on. Chemistry is very important since the study of it can contribute to the growth of a country's science and technology. Chemistry necessitates the active creation of information that is relevant to new experiences. This will assist students in applying their knowledge to scientific engagement. This emphasizes that chemistry is a vital subject that must be treated carefully. Chemistry performance has historically been dismal. Wathanga (2022), for example, and many academics have questioned the technique in teaching chemistry subjects when the teaching method is

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unsuitable for the students. The impact will most likely be fear of the sciences. According to Wambugu (2006), a teacher's teaching strategy affect students' accomplishment. Teaching must be enhanced by adopting diverse techniques, (Wachanga, Chebi, and Kiboss (2005).

Chemistry is a catalytic component required for sustainable development and the progress of nations (Igbonago 2014). It also plays a significant role in the creation of new information, which benefits wealth creation, social welfare, and international competitiveness (Awad 2014). Investing in teaching learning materials for chemistry in secondary schools should foster the spirit of inquiry and the proper attitudes toward scientific methods, resulting in great academic performance for students. Computer instruction is one of the methods for improving knowledge conceptualization processes and learning chances in a specific topic. According to Hotstein et al. (2011), science-based disciplines, particularly chemistry, continue to be a game changer in technological growth in emerging economies since they create the foundation of every individual in a community.

Some instructional tactics used by instructors in the classroom are now considered orthodox or conventional methods by scholars and teachers who follow the principle of growth in the pedagogical process (seweje & Jegede 2005) .Heads, Train Elechi, and Jun.Fan (2014) all agree. Our students' new generation wants to learn things differently and faster, and they are less patient to read books, even though we believe that is the only method to gain new information. Worse, some of these students will never open their books before the tests. Some students would just copy and paste online answers and claim credit for them. Some programs in computer include audio-visual presentations. CBI allows students to learn by self-evaluating and reflecting on their experiences. According to Gepni, Tas, and Kose (2006), the most familiar function of the discipline of scientific education is to teach children the principles of science in a relevant fashion so that the students can use these concepts in their daily life. The usage of computers in the classroom has resulted to the development of computer-assisted instruction (CAI) programs for classroom instruction. Umaru (2003) defines computer aided instruction as "a program of instruction or packages presented as computer software for instructional purposes." As a result, computer-assisted instruction will result in an innovative pedagogical method that will enable teachers to tackle the problems of teaching and learning the topic, particularly in this information and technological age. It has thus become unavoidable since it gives students with a more conducive learning environment, fosters curiosity and a learning-centered setting, and aids in increasing student motivation. If computers are used in day-to-day education, they have the capacity to use many forms of visualizations, which will make chemistry teaching distinctive. A computer can also support and enrich practical work.

STATEMENT OF THE PROBLEM

Computer education has become unavoidable as a result of the rapid growth of information and communication technologies. Most nations' growth and development are reliant on science and technology. The educational system requires an innovative science teaching technique to ensure that pupils have a solid foundation of science and can apply scientific knowledge to solve challenges in an ever-changing society. The purpose of this study was to see how much computer-based instructional materials influenced academic achievement and whether there was a difference between students who were taught on computers and those who were not. This will assist us in determining the strategy that will best suit our kids in the twenty-first century.

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RESEARCH HYPOTHESES

(1) There are no significant differences in the academic achievement of students in the two groups before treatment

(2) There are no significant differences in the academic achievement of students in the two groups after treatment.

(3) There are no significant differences in male and female academic achievement in the two groups before treatment

(4) There are no significant differences in male and female academic achievement in the two groups after treatment

LITERATURE REVIEW

Studies have indicated that when the Computer base instructions (CBI) technique is used as complement to classroom education, students' achievement increases. Senemoglu (2003). CBI allows students to grow at their own pace and provides them with acceptable alternative ways of learning. Liao (2007) discovered that CBI had a positive effect on individuals by comparing 52 research studies conducted in Taiwan in his meta-analysis study, which corroborated Senteni (2004)'s findings that CBI allows students to increase their motivation, achievements, and develop positive attitudes. On the other hand, several research indicated no substantial difference between CBI and traditional approaches (Bayraktar 2001; Alacapinar, 2003, Cetin; 2007). Serin (2011) explained how using computer technology to deliver educational materials helps students assimilate and develop information, uncover alternative answers, participate actively in the learning process, and improve problem solving skills. Many studies on CBI have found that it creates more useful learning scenarios than standard teaching approaches such as teacher presentation, and discussion. Further studies demonstrated that CBI helps students build meta-cognitive skills and learn in a meaningful fashion rather than rote memory learning while also enhancing their achievements (Gance, 2002; Moodly, 2004; Renshav & Faylor, 2008). Ragasa 2008, Lin 2009).

According to Parmar (2013)'s research, computers are useful for learning chemical ideas, and students and chemistry teachers have good reactions to them. Computer will provide pupils with meaningful and retentive learning, preparing them for their future educational lives. According to Shamal (2001), the CBI environment provides a platform for applying information in a specific context that can facilitate discovery of new knowledge Similarly, CBI has a beneficial and significant impact to the knowledge of chemistry ideas. This is consistent with the findings of Opara (2011), Kiboss, and Ogunniyi (2005). Pietzner (2014) investigated computer-based learning in chemistry classes and discovered that topics such as matter structure, chemical binding, and structure-related features might benefit from the inclusion of computer-based learning phases. Similarly, Ranade (2001) investigated scientific instruction with CAI and concluded that well-designed CAI is certainly helpful in bringing about change, income, but when the teacher is exceptional, a few students prefer CAI to regular face-to-face instruction. When used in the self-learning/group learning mode, the packages can be a superior alternative to ineffective teaching.

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DIFFERENCES IN GENDER AND PERFORMANCE

Gender disparities in schools have a significant impact on student attitudes on any particular subject. Some of these researchers asserted that there is no substantial gender difference in students' academic performance and retention in various subjects (Boris 2016), but others discovered a considerable difference, with either boys or girls outperforming each other. According to Niel Sen (2015), there was no statistical difference in the capacity of males and girls to manipulate appropriate equipment in practical classes. Abubakar & Eze (2010), Abubakar & Ejimaji (2010), Abubakar & Ihiegbulen (2012), and Abubakar & Ibon (2010) found no statistically significant gender differences in mathematics, chemistry, or integrated sciences. Anaso & Anaso (2006) discovered that students in males' schools outperformed those in girls' schools in their study of guided discovery approaches. This is consistent with the findings of Okwoh and Otubah (2007), who discovered that male students outperformed female students in science. According to Orimogunje (2010), there is no link between gender and intellectual capacity in science.

MATERIALS AND METHODS

Research Design

The researcher employs a quasi-experimental control group design. The study's population consisted of all Senior Secondary Class I (SSI) chemistry students from all public senior secondary schools in Ekiti State. The decision to use (SSI) students in the study was based on the premise that computer-based training would help them establish a solid foundation. The study's sample consists of 416 Chemistry students from the School's Senior Secondary Class I chosen as the experimental and control groups, respectively. Multistage sampling method was used, stratified random sampling for sex (male and female) as a stratification. 400 students were identified from the 20 secondary schools chosen. The participants were randomized to the experimental and control groups at random in the ratio of 1: 1, 208 in each group. The experimental group received computer-based education as treatment. The Chemistry Achievement Test (CAT) constituted the pretest and post-test instrument for the students. The CAT was drawn by selecting questions relating to the topics that were covered by this study from the syllabus of Senior School Certificate Examinations of West African Examination Council (WAEC) between 2016-2022. The instruments have two sections A and B. Section A consisted of the demographic data of the students while section B consisted of 20 question, four – option, multiple choice objective test based on the topics taught during the treatment period. The topics that were taught Atomic structure, chemical reactions, periodic table, chemical bonding, acids and bases were all studied at the time. Bloom's Taxonomy of Educational Objectives was used to draw all of the items in CAT. The two groups were taught the same topics, but the methods were different; the experimental group was taught using computer-based learning instruction, while the control group was taught using the traditional technique.

Validity of the Instrument.

Professionals in Science Education, test measuring, curriculum planning, and psychology assessed the Chemistry Achievement Test (CAT) for face, content, and construct validity. The chosen test Three Experienced Senior Secondary School Chemistry instructors in Ekiti State were given CAT items and lesson plans to grade and examine the content and face validity. s

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Reliability of the Instrument;

The internal consistency approach was used to determine the instrument's reliability. The instrument was tested on forty (40) senior Secondary School one (SS1) chemistry students who were chosen at random from among the regular students who were not included in the sample, using split half technique on the test results obtained. The total scores of individual testees in odd items and their total scores in even items were correlated using Pearson product moment correlation formula to obtain the reliability of the test thereafter obtained using spearman Brown prophecy formula on the previously computed half-length reliability. This yielded a reliability coefficient of O.80 which was high enough for this research.

EXPERIMENTAL PROCEDURE

The research first stage was the training of the research assistant which lasted for one week. Followed by the administration of the pre-test to all the students participating in the study, which lasted for a week. The following stage was the treatment stage, which lasted four weeks, and the final stage was the administration of the post-test. The study's program of work and lesson plans were already delivered to the teachers. The affected teacher's cooperation was sought for lesson delivery, and an agreement was also achieved on the treatment timetable. Every week, each group had two lesson periods.

THE ANALYSIS OF DATA

The study's data was analyzed using descriptive and inferential statistics. All hypotheses were tested at the 0.05 level of significance.

RESULTS AND DISCUSSION

Hypothesis 1: There is no statistically significant difference in the academic achievement of students before treatment.

T-Test Analysis of students' achievement scores in pre-treatment group.

Table 1

Group	N	Mean	Standard deviation	Df	Tcal	Table	Deasion
Experimental	208	11.66	3.46	415	1.52	1.960	NS
Control	208	12.06	1.54				

P>0.05 (Result not significant at 0.05 level

Table 1 above shows that experimental group has a mean score of 11.66 with standard deviation of 3.46 while the control group has a mean score of 12.06 with standard deviation of 1.54, t-calculated (1.524) was less than the t-table (1.950) at 0.05 level of significance. The null hypothesis was therefore accepted.

This means that before the treatment, there was no significant difference in the achievement mean scores of students in the experimental and control groups.

Hypothesis 2: There is no significant difference in the achievement scores of students in the experimental and control groups after treatment.

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Table 2: ANCOVA of students' achievement in chemistry after treatment

Source	SS	Df	Ms	Foal	Ftab	P	Deviation
Correlated	8020.79	2	4010.39	519.95	3.00	.000	
Covariate Pre Teat	82.04	1	82.036	10.64	3.84	.001	
Group	8015.01	1	8015.01	103.90	3.84	.000	
Error	3216.32	417	7.71				
Correlated Total	11237.13	419					
Total	115644.00	420					

P < 0.05 (Result Significant at 0.05 level) * Significant

The hypothesis is ruled out. This means after the therapy, there was a substantial difference in the achievement mean scores of students in the experimental and control groups. Multiple classification Analysis (MCA) was performed to determine the influence of treatment on students' chemistry achievement. The outcome is shown below.

Multiple classification analysis (MCA) of chemistry student achievement by treatment.

Variable + category	N	Unadjusted Deviation	Eta ^{2}	Adjusted Independent Covanta	For +	Beta
Experimental	210	4.34	.71	4.34		.02
Control	210	-4.35		-4.15		

Multiple R - 0.021

Multiple R^2 - 0.000

According to the table, students who received computer-based training had a higher adjusted mean score of 20.11 (15.77 + 4.34) than those in the control group with adjusted mean score of 11.62 (15.77) + (4.15). This means that the use of computer-based training had the potential of improving student's chemistry performance. The treatment accounted for approximately 71% (Eta2 = 0.71) of the variance in students' chemistry achievement.

Hypothesis 3: There is no significant difference in the achievement mean scores of sex in the experimental and control groups before treatment.

Table 3: A NOVA summary of student's achievement by sex.

Source	SS	df	MS	Fcal	F tab	P	Deviation
Corrected Model	80.30	3	26.77	3.77	2.60	.11	
Sex	40.51	1	40.51	5.70	3.84	.017	*
Group	17.27	1	17.22	2.43	3.84	.120	NS
Sex* Group	22.90	1	22.90	3.22	3.84	.073	NS
Error	2954.76	416	7.10				
Corrected Total	3035.06	419					
Total	6226.00	420					

P > 0.05 (Result not significant at 0.05 level)

Table revealed that Fcal (3.224) was less than F table (3.84), meaning that there was no significant difference in the achievement mean scores of male and female students in the experimental and control groups, and that main effect of treatment (f=2.432, P>0.05) on students' chemistry achievement (f=5.703, P0.05) was also not significant.

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Hypothesis 4: There is no significant difference in the achievement mean scores by sex in the experimental and control groups.

In testing the hypothesis, achievement mean scores of male and female students in the experimental and control groups after treatment were obtained and subjected to statistical analysis of covariance (ANCOVA) at 0.05 level. The result is present below:

Table 4: ANCOVA summary of student's achievement means scores by sex.

Source	SS	Df	Ms	Fcal	Ftable	P	Deviation
Correlated Mode	8151.05	4	2032.76	274.03	2.37	.000	
Covariate Pretest	54.71	1	54.71	538.11	3.84	.007	
Sex	41.30	1	41.30	7.357*	3.84	.019	*
Group	7934.60	1	7934.60	5.553*	3.84	.000	*
Sex* group	90.02	1	90.021	1067.002*	3.84	.001	*
Error	3086.09	415	7.44	12.11	3.84		
Corrected Total	11237.11	419					
Total	115644.00	420					

P < 0.05 (Result Significant at 0.05 level) * significant

After treatment, there was a significant difference in the achievement mean scores of male and female students in the experimental and control groups (F=1067.002 *0.05), according to Table 4. The null hypothesis was rejected, and the main effect of gender (F=7.357, *0,05 and therapy on chemistry student achievement was statistically significant at the 0.05 level.

Multiple classification Analysis (MCA) was used to examine the effect of treatment on the adjusted post achievement mean scores of individuals.

Table 4: shows Multiple Classification Analysis (MCA) of students' chemistry achievement by gender.

Variable + Category	N	Unadjusted Deviation	Eta^2	Adjusted for Independent covariate	Beta
Experimental					
Female	103	3.47	.73	3.50	
Male	105	5.18		5.17	02
Control					
Male	98			-4.20	
Female	110			-4.29	

Multiple R .023

Multiple R^2 ·001

The table showed that male students exposed to therapy had a higher adjusted mean score of 20.94 (15.77 +5.17) than female students with 19.27 (15.77+3.50). However, the adjusted mean scores of the male control group are marginally higher than those of the female control group.

Discussion Prior to the treatment, the findings established the homogeneity of the two group. The two groups that participated in the study are on the same level. There was a significant difference in the achievement mean scores of the experimental group after treatment.

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It was evident that the introduction of computer-based training, which served as the treatment, significantly improved the experimental group's performance. It also implies that computer-based training was superior to traditional methods of instruction since it created more effective learning. This finding is congruent with those of Oguz Serin (2011), Nihindo and Wachanga(2017), Liao (2007), Serin (2011), Mihindo, Wachanga and Anditi (2017), Ragasa (2010), Pietschner (2014), and Feyzioglu (2009). The traditional model of instruction, on the other hand, is a two-step instructional paradigm that consists of unit instruction followed by evaluation.

According to Njoku (2007) and Boris (2016), this strategy does not inspire students to do well, which has been linked to a lack of enthusiasm and poor performance in science. Njoku argued in Boris (2016) that limiting interest in science teaching to telling, reciting, and testing of facts is sterile since it does not impart Ihiegbulem (2012). The current lecture technique of instruction has to be improved for more effective teaching and learning. As a result, computer-based education is advised.

CONCLUSION AND SUGGESTIONS

The research looks towards computer-based training in chemistry classes. A pre- and post-test was completed, however, following treatment, performance improved, with the experimental group having higher achievement mean scores. When it comes to gender achievement.

There was no significant difference in male and female achievement mean scores in the experimental and control groups prior to treatment at P>0 0.5. At P005, there was a significant difference in the achievement mean scores of male and female in the experimental and control groups. This means that CBI, if improved, can lead to less route learning in our science lectures and more meaningful and productive teaching. As a result, it is concluded that CBI has a beneficial and considerable impact on our understanding of chemistry learning as evidenced by pupils' increased achievement while employing computer-based instruction.

Recommendations

The following recommendations were made based on the findings.

1) The government should establish a policy that will encourage the use of computer-based instruction.
2) Schools should allow children to practice computer science on a regular basis, and instructors should also build high computer skills so that (3) Chemistry educators and other stakeholders can attend advanced courses for unique computer applications to gain additional knowledge.
3) The curriculum should contain CBI for teaching and learning in the twenty-first century, particularly in the curriculum of pre-service CBI practice in our school, and seminars should be held at regular intervals in the schools.
4) The government should provide computers to a variety of schools.

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