

# A Study of the Effects of Computer-Assisted Packages on the Performance of Senior Secondary Students in Chemistry in Zaria Educational Zone, Kaduna State Nigeria

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**Abstract:** This study investigated the effect of computer-assisted instruction (CAI) package on the performance of Senior Secondary Students in Zaria, Kaduna state, Nigeria. The study also examined the significance difference of retention achievement scores of students taught using computer-assisted instruction and the conventional lecture method. The population for the study was made up of all the 1800 SSII senior secondary schools chemistry students in Zaria Educational zone, Nigeria. The sample consisted of forty senior secondary school students and was drawn from two secondary schools. Stratified random sampling was used to select the 40 students (20 males and 20 females) four research questions and four hypotheses were formulated, and tested at 95% confidence level. Chemistry Achievement Test (CAT) and Chemical Retention Test (CRT) made of 50 items of multiple-choice questions each were developed and validated for data collection. The Chemistry achievement Test (CAT) was administered to students as pretest-posttest and the Chemistry Retention Test (CRT) as a post treatment-test. The results of students were analyzed using t-test statistics to test the hypotheses. The result indicated that there is a significant difference between the performances of students taught using (CAI) package, and those taught using the conventional lecture method of instruction ( $t_{cal}=7.77 > t_{crit}= 2.093$  at  $P < 0.05$ ). and also between the retention performance of students taught using (CAI) package, and those taught using the conventional lecture method of instruction  $t_{cal} = 3.95 > t_{crit} = 2.093$  at  $P < 0.05$ . The result also showed there was no significant difference in the post-test performance scores of male and female students taught using CAI of package. Based on the findings it was concluded that the use of computer assisted instructional packages significantly improved the performance of students in chemistry. It was recommended that Computer-Assistant instructional packages should be encouraged for teaching and learning of chemistry.

**Keywords:** Computer Instruction Package, Chemistry, Retention, Gender

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## 1. Introduction

Despite the key role of chemistry as the central science that forms the basic foundation to many disciplines and in improving the quality of life, the achievement of Nigerian secondary students in the subject has for many years remained a matter of a serious concern [1]. However, there is a consistent decline in the performance of students in public examinations conducted by the West African Examination Council (WAEC) and the National Examination Council (NECO) in the sciences across the country over the years [2]. WAEC also confirmed this decline in performance in

Chemistry in its Chief Examiners report. [3]

Chemistry teaching can only be result-oriented when students are willing and the teachers are favourably disposed to using appropriate methods and resources in teaching the students. With the current increase in scientific knowledge the world over, much demand is placed, and emphasis is laid on the teacher, the learner, the curriculum and the environment in the whole process of teaching and learning of science. Despite the importance of chemistry to mankind and the efforts of researchers to improve on its teaching and learning, the

achievement of students in the subject remains low in Nigeria. Among the factors that have been identified with poor performance in chemistry are, poor methods of instruction [4].

Problems solving, and lab work, yet we all have been frustrated by the frequent failure of our students to learn basic concepts of science. Because of the pace and large enrolment of many science courses, students are often not able to discuss and reflect on difficult materials. Evidence is mounting that these traditional methods are less effective than we once thought in helping our students in developing understanding of the science concepts that we are teaching [5].

The importance of chemistry in national development makes it necessary for the use of innovative pedagogical strategy that will enable teachers meet the challenges of teaching and learning of the subject especially in this era of ICT. The use of computer in the classroom has given rise to Computer Assisted Instruction (CAI) software packages for classroom instructional purposes. CAI has ended up being successful and beneficial instructional approach for boosting interest, uplifting mentality, building up students' retention capacity and boosting the students' performance [6, 2]. Computer assisted learning can have a great potential as instructional tool in the classroom [7].

Computer assisted instruction (CAI) is an instructional approach where a computer is used to communicate the instructional materials and evaluate the learning outcomes. It uses a blend of graphs, texts, sounds and videos for learning process [8]. CAI refers to virtually any sort of computer application in instructional settings comprising of drill and practice, simulations, exercises, supplementary exercises instructional management data base development, programming using word processors and other different applications [9, 10]. CAI is learner centered and activity inclined [10].

The international society for technology in education suggested that teachers who move away from traditional learning environment to new learning environment promote active learning, higher level thinking, collaborative and multisensory stimulation [11]. These environments support multiple intelligence, constructivism and cooperative learning in education and learning process, traditional education and the existing educational materials neither helped to solve the existing problems nor assisted in the development of conceptual learning [12].

Many studies have revealed that the students' achievements increase when the CBI technique is provided as a supplement to the classroom education. CBI is more effective on less successful children. The reason for this is that the Computer-Based Instruction enables the children to progress at their own pace and provides them with appropriate alternative ways of learning by individualizing the learning process [2]. Computer Assisted Instruction has been confirmed as a tool which can be used to increase academic achievement of students in schools. Many researches have been carried out on the effectiveness of Computer Assisted Instruction (CAI). Studies carried out revealed that students that were instructed through CAI performed better than those who were instructed through

conventional teaching strategy such as lecture method. [13], [14].

The advantages of CAI method include, the application of proven teaching methods to students, offering equal educational opportunities for students by using the same programmer, changing the role of the teacher from teaching capacity to that of a guide, also when properly handled, removing fright and embarrassment on students and bringing about meaningful learning and academic achievement [15]. Research has discovered that those learners who utilize computers have extensive self-assurance, confidence and are more efficacious and propelled to learn than those learners who are subjected to learn in traditional learning environment [16]. It has been proved empirically that CAI is an excellent approach of teaching that strengthens students' achievement, stimulate their interest and decrease their exhausting and abstract nature [17]. CAI provides flexibility to learners which are sometimes denied by the traditional process and method. CAI could be of great assistance as it comprises of drill-and-practice, tutorial, or simulation activities. Investigators have additionally discovered that CAI improves learning proportion, that is, students become able to learn a similar amount of content in less time than the conventionally taught students. Besides, CAI has a significant better effect on retention of the students [9]. CAI can encourage the advancement of students' decision-making and critical thinking aptitudes, data processing skills and communication abilities. By the application of computers, students can get accessibility to extensive learning links and expand their exposure to differing individuals and points of view [18].

CAI was found to be very effective for teaching chemistry [19] also in teaching technical education courses [20], geography [19], counseling education [13] and mathematics [22]. They all confirmed that CAI was seen to be more effective in enhancing students' performance in other subjects than the conventional classroom instruction.

Looking at effect of gender on students' performance at secondary school level, there was no significant difference in performance between male and female students taught physics and history respectively using computer-assisted instructional package [23-25].

Teachers are expected to provide assistance, equip the students, provide the techniques involved and at the end clarify students' worksheet [2]. Hence, chemistry teachers should be involved in using computer assisted instructions. On this basis, this study investigated the effect of computer assisted instruction on the performance of senior secondary students in chemistry.

### **1.1. Statement of Problem**

Studies have revealed that students' results in Chemistry have continued to be poor despite several attempts by researchers to proffer solutions. Also, works done in the area of the effect of Computer Assisted Instruction on students' academic performance, in various subject areas, revealed that computer assisted instruction can improve students' academic performance while the results of some others studies found

otherwise.

The noticeable introduction of computer into the curriculum of the secondary schools is a welcome development to curb the slide which the performance in chemistry is taken. Admittedly, poor performance in chemistry has been attributed to poor teaching techniques as one of the key factors. The adoption of computer assisted instructional packages has been acknowledged to be effective in improving the performance of students in other subjects. Thus this study sought to study the virility of computer based instructional packages in enhancing performance of students' in chemistry.

### 1.2. Objectives of the Study

The purpose of the study was to determine;

1. The effect of teaching chemistry using computer assisted instructional package on academic performance
2. The effect of teaching chemistry using computer assisted instructional package on the retention ability of students
3. The effect of teaching chemistry using computer assisted instructional package on gender of the student

### 1.3. Research Questions

The following research questions were posed for the studies;

1. Is there any difference in the performance of students in chemistry in the experimental and control groups in the pretest?
2. Is there any difference in the academic achievement of students taught chemistry using computer assisted instructional package and those taught using the conventional method?
3. Is there any difference in the retention test of students taught chemistry using computer-assisted instructional package and those taught with the conventional chalkboard method?
4. Is there any difference in performance between male and female students taught Chemistry using computer-assisted instructional package?

### 1.4. Research Hypotheses

Four null hypotheses were formulated at  $P < 0.05$ .

Ho<sub>1</sub> There is no significant difference between the academic achievement of students of control and experimental groups on pre-test.

Ho<sub>2</sub> There is no significant difference between the mean achievement scores of students taught chemistry using computer- assisted instructional package and those taught with the convention chalk and board method.

Ho<sub>3</sub> There is no significant difference between the mean achievement scores in the retention of students taught chemistry using computer- assisted instructional package and those taught with the convention chalk and board method.

Ho<sub>4</sub> There is no significant difference between male and female students taught chemistry using computer-assisted instructional instruction.

## 2. Methodology

### 2.1. Research Design

The research design adopted for the study was a quasi-experimental pretest-posttest design. In this design, the internal validity of an experiment is ensured to be at a high level. The principle behind the design is relatively simple and involves randomly assigning subjects two groups, a test group and a control group. Both groups are pretested and both are post tested. The ultimate difference being that one group was administered the treatment. This design allows a number of distinct analyses, giving the researchers the tools to filter out experimental noise and confounding variables. The internal validity of this design is strong because the pretest ensures that the groups are equivalent.

### 2.2. Population for the Study

The population for the study is comprised of all SSII senior secondary schools' chemistry students in Zaria Educational zone of Kaduna state, Nigeria. The population comprises of both sexes. The schools are either single sex or co-educational. The total number of students learning chemistry at SSSII level is 1800, comprising 1000 males and 800 female students respectively.

### 2.3. Sampling Technique

Stratified random sampling procedure was adopted for this study. A stratified sample is obtained by taking samples from each stratum or sub-group of a population. The sample comprised of 40 (20 males and 20 females) students who were randomly selected from two grade one secondary schools in Zaria educational zone. In each of the selected schools, 20 students were randomly selected for the study from each of the two schools and gender was considered in the selection.

### 2.4. Instrumentation

Two instruments were used for the study these were the chemistry achievement Test (CAT) and Chemistry Retention Test. This consists of 50 multiple choice item and short answer type questions carefully drawn from past WAEC and NECO past question papers and from the investigators who are also specialists in Chemistry. A Control group of twenty students was taught with the conventional (chalk-and-talk) method for a period of four weeks while the experimental group was taught using the CAI package for the same period. Test questions were administered to the students before and after the teaching treatment. Each of the tests was marked and scored accordingly. The research questions were answered using mean, standard deviations and t-test for the hypotheses at 0.05 level of significance.

#### 2.4.1. Validity and Reliability

To confirm the validity and reliability of a research instrument is crucial for precise and authentic outcomes of a study.

Without confirming validity and reliability of the

instrument, conduction of research is useless and time wasting. Therefore, after developing the achievement test, it was properly validated through experts having doctorate degrees in the relevant field with respect to criterion validity, content validity and constructs validity. Apart from validity, reliability was also confirmed through test retest reliability technique. For this purpose, the test was distributed among 25 students of another school which were not in the sample. Then again the same test was given to the same students after two weeks. Pearson's product moment correlation was applied between the results of tests. The reliability coefficient was 0.75 which showed that the test was reliable.

#### 2.4.2. Pretest Session

Before the commencement of the main treatment which lasted for 8 weeks, the subjects in the experimental and Control groups were given the CAT based on the topics selected for the study. This is to determine the equivalence of the two groups.

#### 2.4.3. Chemistry Retention Test

The Chemistry Achievement Test (CAT) was rearranged and reshuffled and administered as CRT two weeks after the main treatment session. Mean scores of students were ranked and analyzed through t-test analysis.

#### 2.4.4. Instructional Procedure

Before conduction of the experiments, formal approval was sought from the head of schools in which experiment is to be

conducted. After getting permission, the experimental process was started. Students of control group were taught using conventional lecture teaching method while students of experimental group were taught using a computer assisted instruction. The experimental process was completed in four weeks. A posttest was then given to the students of both groups immediately to examine their academic achievement. Then after two weeks, the said posttest with slight sequential change in the items in the CAT was given to both groups as retention test. After completion of experimental process, raw data was organized, tabulated and analyzed through statistical tool i.e., mean, standard deviation and independent samples t-test.

#### 2.5. Data Analysis

The study was experimental and therefore, data was collected through pretest, posttest and retention test. After collection of data, was organized properly, classified, tabulated, analyzed and interpreted based on descriptive statistics i.e., mean, standard deviation and inferential statistics i.e., independent samples t-test through SPSS.

### 3. Results

Research question 1 Is there any difference in the performance of students in chemistry in the experimental and control groups in the pretest?

**Table 1.** T-test analysis of the performance of students in chemistry in the experimental and control groups in the pretest.

| Variable           | N  | Df | $\bar{x}$ | SD   | t-calculated | t-critical |
|--------------------|----|----|-----------|------|--------------|------------|
| Experimental group | 20 | 19 | 29.3      | 5.55 | 1.16         | 2.093      |
| Control group      | 20 |    | 27.3      | 5.43 |              |            |

N= number of students, Df= degree of freedom,  $\bar{x}$  = sample mean, SD = standard deviation

Table I showed the t-test comparison of the mean scores of experimental and control group in the pretest. The mean score of the experimental group is 29.3 while that of the control group is 27.3. With the standard deviation of 5.55 and 5.43 the values of 1.16 t-calculated and 2.093 t-critical from the tables respectively, these indicate that there is no significant difference in the mean scores of experimental and control

groups. This implies that the experimental and control groups have similar academic ability before the instruction started

Research question 2: Is there any difference in the academic achievement of students taught chemistry using computer assisted instructional package and those taught using the conventional method?

**Table 2.** T-test analysis of the mean scores of the experimental and control groups in the post test.

| Variable           | N  | Df | $\bar{x}$ | SD   | t-calculated | t-critical |
|--------------------|----|----|-----------|------|--------------|------------|
| Experimental group | 20 | 19 | 37.83     | 4.23 | 7.77         | 2.093      |
| Control group      | 20 |    | 27.25     | 4.38 |              |            |

Table 2 showed the t-test comparison of the posttest mean scores of the experimental and control groups. The mean score of the experimental group was 37.83 while that of the control group was 27.25. The calculated t-value of the analysis was 7.77 while the critical from the tables was 2.093. The result shows that the t calculated of 7.77 is higher than the critical t-value = 2.093. This indicates that there is a statistical significant difference between the mean scores of the

experimental group, 37.83 and that of the control group, 27.25. This shows that, the null hypothesis should be rejected since there is significant difference in the mean scores between the experimental and control group results.

Research question 3 Is there any difference in the retention test of students taught chemistry using computer-assisted instructional package and those taught with the conventional chalkboard method?

**Table 3.** T-test analysis of mean scores in the retention test of students in the experimental and control groups.

| Variable           | N  | Df | $\bar{X}$ | SD    | t-calculated | t-critical |
|--------------------|----|----|-----------|-------|--------------|------------|
| Experimental group | 20 | 19 | 37.60     | 10.13 | 3.95         | 2.093      |
| Control group      | 20 |    | 22.60     | 13.24 |              |            |

Table 3 shows the t-test comparison of retention mean scores of the experimental group and control group. The mean score for the experimental group was 37.60 and control group, 22.62. This shows that calculated t-value of 3.95 is greater than the critical t-value of 2.093 from the result it shows that there is significant difference between the mean score in the retention of the experimental group of 37.60 and that of the control

group that is 22.62 at 0.05 level of significance. The null hypothesis is rejected, since there is significant difference between the experimental and control group.

Research question 4 Is there any difference in performance between male and female students taught Chemistry using computer-assisted instructional package?

**Table 4.** T-test analysis of mean scores of males and females in the experimental group in the post test.

| Variable           | N  | Df | $\bar{X}$ | SD   | t-calculated | t-critical |
|--------------------|----|----|-----------|------|--------------|------------|
| Experimental group | 10 | 9  | 39.80     | 7.34 | 0.0703       | 1.83       |
| Control group      | 10 |    | 37.60     | 5.20 |              |            |

Table 4 shows the test result of male and female students that were taught using CAI package. From the table the calculated t-value (=0.0703) is less than the critical t-value of 1.83. This shows that there is no Significant statistical difference in the mean scores of males (=37.80) and females =37.60 experimental group at 0.05 level of significance. The table of results shows that the hypothesis should not be rejected since there is no significant difference between the mean achievement scores of male and female taught mole concept with the CAI package.

## 4. Discussion

The study was conducted to explore the effects of CAI on students' academic achievement in Physics at secondary level. The study was quantitative and experimental in nature and pretest-posttest equivalent groups designed was used. Students were seated in two similar rooms with similar facilities. The room of experimental group was facilitated with computer, multimedia and other related gadgets. Students of experimental groups were instructed through CAI while students of control group were taught through traditional method. This experimental process was ended in six weeks. After completion of experiment, students of both groups were subjected to posttest and retention test in order to investigate and compare their academic achievements. However, it clearly indicates that computer assisted instruction is very effective in different level of cognitive domain. Likewise, based on retention test, students of experimental group showed more excellent academic performance than students of control group. The students of experimental group retained learning for longer time than students of control group. The findings of the current study support the findings of [26] and [27] who found that CAI was significantly more viable than conventional teaching in learners' achievement in physics. The findings of the study are in line with the findings of many research outcomes in which it was found that CAI has positively affected learners' perceptions about computer supported instruction and their scholastic accomplishment [18, 28-32].

The findings also agreed with [19], [20][21] and [13] that students taught with CAI in chemistry, geography and Counseling Education respectively performed better than those taught with normal classroom instruction. The result of the analysis of t-test on the retention performance of students taught chemistry using CAI packages and those taught using conventional method of instruction show a significant difference in favour of the students taught with CAI. The students exposed to CAI package performed better than those exposed to conventional method of instruction in the retention test.

The influence of gender on the academic performance of student was also studied. The results of analysis of t-test on the performance of male and female taught using CAI package indicate no significant difference. The finding agrees with [23], [24] and [25] who found no significant difference between male and female students taught physics and history using CAI package. Thus, this shows that computer- assisted instruction enhanced the performance of both male and female students.

## 5. Conclusion

The study observed that there is a significant difference between the performances of students taught using (CAI) package, and those taught using the conventional lecture method of instruction ( $t_{cal}=7.77 > t_{crit}= 2.093$  at  $P < 0.05$ ). and also between the retention performance of students taught using (CAI) package, and those taught using the conventional lecture method of instruction  $t_{cal}=3.95 > t_{crit}= 2.093$  at  $P < 0.05$  The result also showed there was no significant difference in the post-test performance scores of male and female students taught using CAI of package. Based on the findings it was concluded that the use of CAI packages improved the performance of students in the learning of chemistry. The improved performance in the post treatment test conducted could be as a result of the effectiveness of the CAI package. The CAI package of instruction significantly enhanced the retention performance of students taught chemistry than those taught with conventional method. In addition, the effect of CAI on male and female students in learning of chemistry was similar.

## 6. Recommendations

Based on the findings of the study the following recommendations were made:

1. Computer-Assisted Instruction/Learning should be encouraged for teaching and learning of chemistry.
2. Computer should be used to motivate male and female students especially in the learning of chemistry.
3. Computer should be provided and adequately programmed with variety of computers-assisted instructional packages.

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