

## EFFECT OF COMPUTER-ASSISTED INSTRUCTION ON STUDENTS' ACADEMIC PERFORMANCE AND RETENTION IN CHEMISTRY CONCEPTS

BY

JAMILU ABDULLAHI GACHI

Department of Science Education,  
Faculty of Education,  
Ahmadu Bello University, Zaria, Nigeria.

Corresponding Author: [jamilugachi@gmail.com](mailto:jamilugachi@gmail.com)

### Abstract

*The study determined the effect of Computer-Assisted Instruction on students' academic performance and retention in chemistry concepts among senior secondary school students in Kankia, Katsina State-Nigeria. The study had two research objectives, two research questions and two null hypotheses. A total number of 123 students consisting of 78 males and 45 female selected using Simple random sampling techniques formed the sample for the study. The study adopted the pretest, posttest, and post post-test quasi experimental and control group design. The subjects in the experimental group were taught using Computer-Assisted Instruction (CAI), while the control group was exposed to lecture method for a period of six weeks. One validated research instrument, with reliability coefficient of 0.88, namely chemistry Performance Test (CPT), was used in data collection. Two null hypotheses were tested using t-test statistic at  $P \leq 0.05$  level of significance. The major findings from the study revealed that there is significant difference in the posttest mean performance scores of experimental and control groups in favour of experimental group. Furthermore, students exposed to Computer-Assisted Instruction had higher level of retention ability in learning chemistry concept than lecture group. The study found CAI an effective teaching method. Based on that findings emanating from this study it was recommended that federal and state governments should adequately train Chemistry teachers on using Computer-Assisted Instruction in teaching chemistry among others.*

*Keywords:* Computer-assisted instruction, Chemistry concepts, academic performance

### Introduction

The recent trends in the development of chemistry education in Nigeria have been considered in many articles advocating for science teachers to use modern experimental methods in chemistry on school learning and practice. Chemistry is one of the most important subjects in science and

contains a number of abstract concepts that students often find difficult to understand. Thus students sometimes lose interest in learning chemistry as a subject. One of the objectives of science education is to develop students' learning interest in science and technology as today's society depends largely on developments in science and technology (FGN 2015). Teachers are expected to devise ways of making their students to develop positive interest towards science and science-related disciplines (Cox 2019). There has been a great shift in emphasis in science teaching and learning over the years worldwide, the concern in recent times is to have science classrooms that are student-centred, activity oriented and which focus on understanding rather than rote learning and simple recall of knowledge. Students tend to memorize facts and principles, most of which they do not understand but only to regurgitate them during examination. Thus, the retention of ideas, facts and principles learned in this way might not be worthwhile (Bichi, 2013).

It is in line with this view that Abanikannda (2016), contended that the present teaching and learning of science in Nigeria seems inadequate. The scholar stressed that the level of academic and professional competence of science teachers need to be raised to the level that teachers can teach students with a focus on understanding rather than frequent use of only lecture method that often led to rote learning. Moreover, recall of knowledge and memorization are not appropriate focus of science learning. The contemporary problem and need of the society today centred on sound development of science and technology for which chemistry education is pivotal. However, with the importance of chemistry for development of science and technology and provisions made by the Federal Government of Nigeria for effective teaching and learning of chemistry, the objectives of its teaching and learning as stated in the Nigeria Secondary school chemistry curriculum is yet to be achieved. According to Kamisah and Nur (2013), the major problems that affect the teaching and learning of chemistry in the secondary schools are twofold: the abstract and highly conceptual nature of chemistry seems to be particularly difficult for students, and the teaching methods.

The teaching method used by teachers is very vital in any teaching-learning situation as it may promote or hinder learning. It may sharpen mental abilities and encourage students to learn effectively or may discourage initiatives and curiosity of the students to learn effectively (Paul & Dantani 2012). There is however, the need for science teachers to understand that different topics in science may require different teaching approaches depending on the complexity and structure of the topics. Lawal (2022), accentuated the need for educators to take advantage of the available knowledge base of learning, improving educational quality requires at least, placing learners in active rather than passive roles. People learn by being engaged actively, with Knowledge base. Yusuf (2017), opined that Lecture Method is teacher-centred and encourages rote learning. Emphasis therefore should be shifted to activity-based learning such as used of Computer-Assisted Instruction.

Computer-Assisted Instruction (CAI) in this study is the process by which written and visual information are presented in a Tutorial Mode of Instruction to learners through computer. The students learn by reading the text material presented or by observing the graphic information displayed. Each segment of text is followed by questions, for student 's responses. Feedback on responses is indicated immediately, Computer-Assisted Instruction can be characterized as interactive and individualized learning as it usually involves a dialogue between one student and a computer programme, and a student can learn at his own pace and time frame. Furthermore, the most important goals of teaching are those events (for instance; critical thinking, analytical reasoning and written/oral communication) that occur during the process. The actual use of

computer technology in chemistry education is still limited due to obstacles related to instructional facilities, technical potentials, teaching staffs, and available financial resources.

Academic performance is a variable in this research. It is defined as the extent by which learners perform in the lesson taught or examination result. (Usman 2010), Academic performance is affected by many factors such as retention, student ability, the quality of secondary education received, and teaching method. Researchers (Lawal 2009; Usman 2010; Abdulkarim & Lawal 2012) worked on teaching method and academic performance in science education. The overwhelming view of these researchers agreed that, there is relationship between the type of method adopted in teaching and students' academic performance and retention ability.

Retention ability work together with academic performances and it is defined as the ability of the learners to store information which can be recalled at a later time after exposure to series of instruction or training (Bichi, 2013). Several factors are known to influence retention of learned materials. Bichi (2013) revealed that, anything aiding learning should improve retention while things that cause interference among learned materials decrease efficiency of learning and accelerate forgetting. However, it is common for a student to learn material, take a test and forget the material soon after. This may likely be the reason for students' poor performance in chemistry WAEC and NECO examination. It is, important to consider knowledge retention when evaluating learning strategies. Thus, the present study determined the effect of Computer Assisted Instruction on students' academic performance and retention, in chemistry concepts among secondary schools' students of Kankia, Katsina-State, Nigeria.

### **Statement of the Problem**

Despite the importance of chemistry as one of the physical sciences to the socio economic and technological development of any nation, performance of Nigeria students in the subjects in both internal and external examination have remain consistently poor. Study conducted by Yusuf, Gambari, and Olomorin (2016), indicates that in ability of teachers and students to adopt different ways of teaching and learning strategies and lack of exposure to current instructional materials and resources for the effective learning processes are some of the challenges being face by chemistry teachers and students. The West African Examination Council Chief Examiner Report, (WAEC, 2019), identified some areas of weaknesses of the students which were reported as a contributing factor to student's poor performance in Chemistry. These include: Poor understanding of general principles and concepts, such as atomic structure, chemical equilibrium, Redox reaction among others. The results of the previous studies observed in Nigeria show that, there are a number of factors that can be attributed to students' failure in chemistry, these include: a lack of qualified chemistry teachers, lack of laboratory equipment and modern instructional material to demonstrate scientific principles and theories, (Nwane & Agommoh, 2017). Teachers lack the laboratory facilities and molecular models needed to make the abstract concepts of chemistry real and learnable for students (Kamisah & Nur 2013). The constant use of traditional lecture method as stated by Jack and Kyado, (2017) has led to inactive learning and decrease in retention ability because it ignores creativity of students. Therefore, there's need to provide an active based learning strategy like computer-Assisted Instruction in teaching chemistry concepts which are perceived to be very difficult to learn at secondary school level. Researchers, (Nwane & Agommoh, 2017; Rosali, 2020). Reported that, Computer-Assisted Instruction may possibly improve students' performance at various level. Therefore, in an attempt to possibly improve student academic performance and retention level in chemistry, the researcher perceived the need

to delve into research on the effect of Computer-Assisted Instruction on students' academic performance and retention in chemistry at senior secondary level in Kankia, Katsina State Nigeria.

### Objectives of the Study

The Objectives of the study are to:

- i. determine the effect of Computer-Assisted Instruction on the Academic Performance of senior secondary students when taught chemistry concepts,
- ii. determine the effect of Computer-Assisted Instruction on students' retention level when taught chemistry concepts,

### Research Questions

The following research questions were formulated for answering:

- i. What is the difference between the mean Academic Performance scores of students taught chemistry using Computer-Assisted Instruction and those taught using lecture method?
- ii. What is the difference between the mean retention ability of students taught chemistry using Computer-Assisted Instruction and those taught using lecture method?

### Null Hypotheses

The following null hypotheses were formulated and tested at 0.05 level of Significance:

**HO<sub>1</sub>:** There is no significant difference between the mean Academic Performance scores of students exposed to Computer-Assisted Instruction and those exposed to Lecture Method when taught chemistry Concepts.

**HO<sub>2</sub>:** There is no significant difference between the mean retention level scores of students taught chemistry concepts using Computer-Assisted Instruction and those taught using lecture method.

### Methodology

The population of the study covered all senior secondary year two (SSII) students' studying chemistry as a subject in the public senior secondary schools of Kankia Education Zone, Katsina state-Nigeria. There is total number of 1,383 senior secondary schools' students in these schools. The sample of the study involved 123 (SS II) chemistry students selected from two public co-educational secondary schools in the study area. In selecting the sample for the study, four out of the twelve schools were randomly selected and pretested to select schools that are not different significantly in terms of their academic performance. Their scores data obtained were subjected to data analysis using Analysis of variance (ANOVA), and Scheffe's post-hoc test. Two schools were found not significantly different in terms of their mean scores. Simple random sampling technique involving balloting without replacement was used in assigning the schools into experimental and control condition. However, in selecting students' sample, intact classes were used for experimental and control groups.

The study utilized quasi experimental and control groups design, because of non-randomization of research subjects, involving pre, post, and postpost-test. This is made of two groups; experimental and control. A pretest ( $O_1$ ) was administered to both groups to ensure that participants have comparative abilities in terms of academic performances and retention ability. The Experimental

Group (EG) were exposed to Computer-Assisted Instruction while the Control Group (CG) was exposed to lecture method for a period of six weeks to determine the effect of Computer-Assisted Instruction on students' academic performance in chemistry concepts. After an interval of two weeks of the post-test, postpost-test (O<sub>3</sub>) was also administered to students to determine retention ability in both groups.

Chemistry Performance Test (CPT) is an instrument developed by the researcher consisting of 50 objective test items using relevant WAEC (May /June 2021) past question paper. The pretest was administered to both groups to determine equivalence of students' performance prior to the treatment. The posttest was used to determine the effect of Computer-Assisted Instruction on the students' academic performance. The same instrument was also used in determining students' retention ability.

The reliability coefficient of Chemistry Performances Test (CPT) was determined after pilot testing using test, re-test method. The two results of the tests were compared and computed using Pearson Product Moment correlation Coefficient with the aid of (SPSS) software package. The result obtained was 0.88, positive correlation. The data obtained from the study were analysed using descriptive and inferential statistics to answer research questions, and the two null hypotheses were tested using t-test independent statistic at  $P \leq 0.05$  level of significance.

### Data Analysis and Results Presentations

This section presents the result and interpretation of the data collected from the study subject.

**Table 2**

*Pre-test Mean Performance Scores of the Experimental and Control groups*

Groups	N	Mean	S-dev.	Mean Diff
Experimental	59	16.27	4.41	
				0.36
Control	64	15.91	4.24	

Table 2. Presented the pre-test mean and standard deviation of students' academic performance of experimental and control groups. From the result, there is only a slight difference in the mean performance scores. The experimental group have mean scores of (16.27) while the control group have mean scores of (15.91) and Mean difference of (0.36). This shows that, they have comparative abilities in terms of academic performance.

**Research Question One: What is the difference between the mean Academic Performances scores of students' taught chemistry concepts using Computer-Assisted Instruction and those taught using lecture method?**

**Table 3**

*Post-test Mean Performance Scores of the Experimental and Control groups*

Groups	N	Mean	S-dev.	Mean Diff
Experimental	59	31.55	6.91	9.68
Control	64	21.87	7.84	

Table 3. Presented data on the mean and standard deviation of post-test academic performance scores of students in experimental and control groups. From the result obtained, there is difference in the mean academic performance scores of experimental and control groups the students' exposed to Computer-Assisted Instruction have mean scores of (31.55) while the students' exposed to Lecture Method have mean scores of (21.87), and Mean difference of (9.68). This shows that the computer-Assisted Instruction had higher effect on learning chemistry concepts.

**Research Questions Two What is the difference between the mean retention levels of students' taught chemistry concepts using Computer-Assisted Instruction and those taught using lecture Method?**

**Table 4**

*Mean Retention Level Scores between the Experimental and Control Groups*

Groups	N	Mean	S-dev.	Mean Diff
Experimental	59	27.50	8.56	6.85
Control	64	20.65	6.55	

Table 4. Presented data on the mean and standard deviation of the post-post-test score of students in experimental and control groups. From the result obtained, there is difference in the mean scores of experimental and control groups, students exposed to Computer-Assisted Instruction have mean scores of (27.20) while the students' exposed to Lecture Method have mean scores of (20.65) and Mean retention level difference of (6.85). This shows that the computer-Assisted Instruction had a higher positive effect on the retention ability of experimental group compared to the control group.

**Testing the Stated Null Hypotheses**

The following null hypotheses formulated were tested at 0.05 level of Significance:

**HO1: There is no significant difference between the mean academic performance score of students exposed to Computer-Assisted Instruction and those exposed to Lecture Method when taught chemistry concepts.**

The posttest data generated through chemistry performance test (CPT) were subjected to t-test statistic to determine if there is any significant difference between the students' academic performance of the experimental group and control group. Analysis summary is shown in Table 5.

**Table 5.**

*t-test Analysis of the Posttest Mean Academic Performance Scores of the Experimental and Control Groups*

Groups	N	Mean	S-dev.	Df	p-value	Remark
Experimental	59	31,55	6.91			
				121	0.001	Significant
Control	64	21.87	7.84			

Significant at  $\infty P \leq$  less than 0.05; and  $df = 121$

The result of the t-test shown in Table 5 shows that, p- value of (0.001) were observed at  $df= 121$ . Since the p-value is less than the alpha value of 0.05, there is significant difference between the two groups in terms of their mean academic performance scores in the Posttest. This indicates that experimental group had higher score than the control group. Therefore, the null hypothesis that stated. There is no significant difference between the mean academic performance score of students exposed to Computer-Assisted Instruction and those exposed to Lecture Method when taught Chemistry concept is rejected.

**HO2: There is no significant difference in the retention ability between students' taught Chemistry concepts using Computer-Assisted Instruction and those taught using lecture methods.**

The post-Posttest data generated through chemistry performance test (CPT) were subjected to t-test statistic to determine if there is any significant difference between the performance of the experimental group and the control group. Summary of the analysis is shown in Table 6.

**Table 6.**

*t-test Analysis of the Postpost-test Mean Academic Performance Scores of the Experimental and Control Groups*

Groups	N	Mean	S-dev.	Df	p-value	Remark
Experimental	59	27.50	8.56			
				121	0.001	Significant
Control	64	20.65	6.55			

Significant difference at  $P \leq$  less than 0.05;  $df = 121$

To determine whether Computer-Assisted Instruction and Lecture Method affect students' retention level following the respective treatments, the postpost-test mean academic performance scores of experimental and control groups were subjected to t-test. The result is shown in Table 6 shows that, p- value of (0.001) is observed at  $df = 121$ . Since the p-value is less than the alpha value = 0.05, it is evident from the results obtained, that there is significant difference in the post-post-test mean academic performance scores between experimental and control groups. Based on this result, the null hypothesis which stated, there is no significant difference in the retention ability between students' taught chemistry concepts using Computer-Assisted Instruction and those taught using lecture methods is rejected.

### Discussion of the Results

The finding from Table 3 showed that students in the experimental group had a higher mean performance score (31.55) in chemistry performance test (CPT) than the control (21.87) counterparts. This result is further confirmed by the finding from table 5, which indicates that the treatment is a significant factor in the performance of chemistry students. Thus, implies that students taught using Computer-Assisted Instruction performed better than those taught using lecture method. The findings emanating from this study are in agreement with the findings of Koni, Odegba and Mercy (2019); Lawal, (2022). The finding of this research is also in contrast with the finding of Vanita and Banswal (2016). The trend of higher performance by the treatment Computer-Assisted Instruction (CAI) group could be as a result of Excitement over the new approach of teaching using computer. It could also be as a result of interactive activities provided by Computer-Assisted Instruction (CAI) which helped students to master the chemistry concepts without much difficulty than the lecture method group.

The findings from Table 4, revealed that the students exposed to computer-Assisted Instruction, retained chemistry concepts learnt better than those in control group. This was shown by mean retention score of (27.50) for experimental group which was higher than (20.65) for control group. This finding is in agreement with that, of Bichi (2013) who reported that, understanding and retention are product of meaningful learning: When teaching is effective and meaningful to the students', retention will improve. The findings is on contrary to the findings of Okoli (2016). The



improved performance could be as a result of active engagement of the student in learning activities which improves student creativity, which in enhance the transfer of learning in new situation. The provision of active learning environment by the Computer-Assisted Instruction likely makes student engage in high order of thinking task such as analysis, synthesis and evaluation which in turn enhance student's retention and cognitive achievement of learning.

### Conclusion

Based on the findings from this study, conclusion was made:

- i) Computer-Assisted Instruction is an effective teaching method it enhanced students' academic performance and retention level in learning chemistry concepts

### Recommendation

Based on the findings, the following recommendations were made:

- 1) The Federal and State Governments should provide conducive learning environment by providing adequate Chemistry classrooms as well as properly equipped Chemistry laboratories, with adequate ICT facilities to enhance the students' acquisition of modern science learning using computer assisted instruction and improve science process skills.

### References

- Abdulkarim, B. & Lawal,T.E. (2012). Seasonal Variations and Academic Performance in Basic Science among Junior Secondary School Students' in Anchau and Zaria Education Zones, Kaduna state, Nigeria. *International Journal of Applied Science and Technology*. 2(8). 140-148.
- Abanikannda, M. (2016). Enhancing Effective Chemistry Learning Through Hypermedia Instructional Mode of Delivery. *European Journal of Educational Research*, 5(1), 27–34. <https://doi.org/10.12973/eu-jer>
- Bichi.S.S. (2013). Effect of Problem Solving Strategy and Enriched Curriculum on Students' Achievements in Evolution Concepts among Secondary School Students', Ph.D thesis Unpublished A.B.U Zaria.
- Cox, J. (2019). How to Motivate Students to Love Science. K-12 News, Lessons & Shared Resources by Teachers, For Teachers. *Educational Leadership*, 15, 327–338. <https://www.teachhub.com/howmotivate-students-love-science>
- Ekundayo, S. K. (2022), the effects of Computer-Assisted Instruction (CAI) on students' achievement in Chemistry among boys and girls in public secondary schools in Ondo State. Nigeria. *British Journal of Education* Vol.10, Issue 2, pp. 31-41, 2022 Online ISSN: 2054-636X (Online) Print ISSN: 2054-6351(Print) 31 ECRTD-UK <https://www.eajournals.org/> Journal level DOI: <https://doi.org/10.37745/bje.2013>
- Federal Republic of Nigeria (2015). *National Policy on Education*. Lagos, Nigeria: Nigerian educational Research and development council (NERDC) press.

- Jack, G.U & Kyado, I.J. (2017). Effectiveness of Brain-Based Strategy on students' academic achievement and Motivation and Knowledge Retention in Electrochemistry, *Journal of Education Society and Behavioural Science*. 21(3)1-13
- Kamisah, O. & Nur, S. (2013) Conceptual understanding in secondary school chemistry: A discussion of the difficulties Experienced by students. *American Journal of Applied Sciences*, 10(5):433-441
- Kerlinger, F.N. (1973). *Foundation of Behavioural Research*, London Holt Rinehart and Wiston.
- Lawal, I. (2022). The effect of Computer-Aided Instruction (CAI) on the performance of Senior Secondary School Students in Geometry in Katsina, Katsina State, Nigeria. *International Journal of Management, Social Sciences, Peace and Conflict Studies (IJMSSPCS)*, Vol.3 No.2 June, 2022; p.g. 124 – 129; ISSN: 2682-6135(Print), ISSN: 2682-6127(online)
- Nwanne, S. Chinwendu, N. & Agommuoh, P. (2017) Computer Assisted Instruction (Cai) On Students' Interest And Achievement In Physics In Imo State, Nigeria *IOSR Journal of Research & Method in Education (IOSR-JRME) e-ISSN: 2320-7388,p-ISSN: 2320-737X Volume 7, Issue 3 Ver. IV (May - June 2017), PP 53-58 www.iosrjournals.org DOI: 10.9790/7388-0703045358 www.iosrjournals.org*
- Okoli, J. N. (2016). Effect of Investigative Laboratory Approach and Expository Method on Acquisition, Different Levels of Scientific Literacy and Retention. *Journal of the Science Teachers Association of Nigeria* 41 (1 &2), 79-88
- Paul, O.A. & Dantani, Y.M. (2012). Effects of Lecture and Demonstration Methods on the Academic Performance of Students' in Chemistry in Nassarawa Local Government Area of Kano State *International Journal of Modern Social Sciences*, 1(1), 29-37.
- Rosali, L.J.D. (2020) Effect of Computer-Assisted Instruction (CAI) on the Academic Achievement in Secondary Physics. *Open Access Library Journal*, 7: e6319. <https://doi.org/10.4236/oalib.1106319>
- Vanita, B & Banswaal, S. (2016) the effects of computer assisted instruction and conventional instruction on students' performance in Chemistry *International Journal of Scientific and Research Publications*, Volume 5, Issue 11, November 2016. 488ISSN 2250-3153
- Yusuf, M.O; Gambari, I. A; & Olumorin, O (2016). Effectiveness of computer- supported Cooperative learning strategies in learning physics. *International Journal of social science & Education*. 2(2).