

Impacts of Computer-Based Learning Strategy on Skill Acquisition and Academic performance in Computer Science among Senior Secondary School Students in Zamfara State, Nigeria

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Abstract

This study investigated the impact of Computer-Based Learning (CBL) on skill acquisition and academic performance in Computer Science among selected public senior secondary school students in Zamfara State, Nigeria. A non-equivalent pre-test/post-test control group quasi-experimental design was adopted, with a sample of 108 valid SS II cases comprising an experimental group (n=71) exposed to Computer-Based Learning and a control group (n=37) taught using conventional instructional methods. Data were collected using two validated instruments: the Computer-Based Skills Acquisition Test (CBSAT) and the Academic Performance Test (APT). Descriptive statistics (mean and standard deviation) were used to answer the research questions, while Analysis of Covariance (ANCOVA) was employed to test the two null hypotheses at a .05 level of significance, using pre-test scores as covariates. The findings revealed that Computer-Based Learning had a statistically significant positive effect on both practical skills acquisition ($F(1,105)=23209.901, p<.001, \eta^2=.995$) and academic performance ($F(1,105)=7434.087, p<.001, \eta^2=.986$). Students taught using CBL achieved significantly higher adjusted post-test mean scores than those in the conventional group. Based on these findings, it was concluded that CBL is a highly effective pedagogical tool for enhancing cognitive performance and digital practical skills in Computer Science. It was recommended, among others, that educational stakeholders in Zamfara State institutionalize computer-based learning packages and prioritize the provision of functional ICT infrastructure and regular teacher capacity-building workshops across public secondary schools.

Keywords: Computer-Based Learning, Skills Acquisition, Academic Performance, Computer Science, Zamfara State.

Introduction

The increasing influence of digital technology on education has created new opportunities for improving teaching, learning and the development of relevant competencies among secondary school students. In contemporary education, learners are expected not only to acquire theoretical knowledge but also to develop practical, digital, problem-solving and other transferable skills needed for further education and participation in the modern economy (Bawa, 2015). Computer-Based Learning (CBL) has therefore emerged as an important instructional approach through which computer applications, multimedia resources, interactive learning materials, simulations and digital assessment tools are integrated into the teaching and learning process (Ene, 2022). By providing opportunities for interaction, repeated practice, immediate feedback and self-paced learning, CBL has the potential to make learning more active and meaningful and to improve students' academic outcomes (Bawa, 2015). In the Nigerian educational context, the relevance of CBL is particularly important because of the growing demand for learners who possess both academic knowledge and practical competencies. Senior secondary education represents an important stage for developing students' cognitive, practical and digital skills

Impacts of Computer-Based Learning Strategy on Skills Acquisition and Academic Performance in ... Usman, A., Et. al., (2026) before they proceed to higher education, vocational training or the world of work (Gambari et'al, 2015). Consequently, instructional approaches that move beyond passive reception of information and provide students with opportunities to interact with learning content and practise skills are increasingly important (Bawa, 2015). CBL can support this process by presenting instructional materials through text, graphics, audio, video, animation and interactive activities. Its effectiveness, however, depends on the availability of appropriate facilities, teachers' capacity to integrate technology pedagogically and students' access to functional digital learning environments (Mujitapha, 2026). Empirical studies conducted in Nigeria have provided evidence of the potential of computer-based instructional approaches to improve students' academic performance. Gambari, et'al, (2015) investigated computer-assisted cooperative learning strategies among secondary school students in Physics in Minna, Nigeria. Their quasi-experimental study found that students exposed to computer-assisted cooperative learning strategies achieved significantly better results than those taught through individualized computer instruction. The finding suggests that the educational value of computer technology may be enhanced when it is integrated with appropriate instructional strategies that promote interaction and active participation. Similarly, Okwuoza and Olajumoke (2023) examined the effect of a Computer-Assisted Instructional (CAI) package on the achievement of senior secondary school students in Mathematics in Nigeria. Using a quasi-experimental design involving 178 SS II students, the study provided empirical evidence on the use of CAI as an alternative to conventional instructional practices. The study is relevant to the present research because it demonstrates the continuing interest in examining whether computer-supported instruction can improve learning outcomes among Nigerian secondary school students. Evidence from northern Nigeria also demonstrates the relevance of technology-supported instruction to secondary school learning. Bawa (2015) investigated the effects of computer-based instructional materials on students' academic performance in Computer Science in Kebbi State. The study adopted a quasi-experimental pre-test and post-test design and compared students exposed to computer-based instructional materials with those taught through conventional approaches. The study provides a useful empirical basis for examining the relationship between computer-supported learning and academic performance in a context geographically and socio-educationally related to Zamfara State. Therefore, evidence from Nigerian empirical studies, suggests that computer-supported instruction can contribute to improved academic achievement, computer literacy and the development of relevant learning competencies. Nevertheless, the findings also indicate that the effectiveness of computer-based approaches is not automatic. The nature of the instructional strategy, the quality of the digital content, the availability of facilities, teacher competence and the context of implementation can influence the outcomes of CBL. Gambari et al. (2015) demonstrated that the way computer technology is combined with cooperative learning can affect students' achievement outcomes, while studies on computer-assisted instruction and computer literacy show that technology can support skills development when it is deliberately integrated into the instructional process.

Statement of the problem

Despite the growing body of Nigerian research on computer-assisted instruction, e-learning and other forms of educational technology, there remains a need for more context-specific evidence concerning the combined influence of CBL on both skills acquisition and academic performance among students in public senior secondary schools in Zamfara State. Much of the existing evidence has focused on specific subjects, particular instructional packages or other states of the federation. Consequently, findings from other contexts cannot be assumed to apply directly to public senior secondary schools in Zamfara State, where differences in infrastructure, teacher preparedness, access to computers, electricity supply and students' exposure to digital learning may affect the effectiveness of CBL. The need for the present study is further strengthened by the increasing emphasis on preparing Nigerian students with practical and digital competencies alongside academic knowledge. If CBL is effectively designed and implemented, it may provide students with opportunities to engage actively with learning materials, practice skills, receive immediate feedback and improve their understanding of difficult concepts. However, the extent to which these potential benefits are realized among students in selected public senior secondary schools in Zamfara State requires empirical investigation. It is against this background that this study examines the impact of Computer-Based Learning on skills acquisition and academic performance among students in selected public senior secondary schools in Zamfara State, Nigeria.

Research Objectives

The study seeks to:



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1. Determine the difference in skills acquisition between students taught using Computer-Based Learning (CBL) and those taught using conventional instructional methods in selected public senior secondary schools in Zamfara State.
2. Examine the difference in academic performance between students taught using Computer-Based Learning (CBL) and those taught using conventional instructional methods in selected public senior secondary schools in Zamfara State.

Research Questions

1. What is the difference in the mean skills acquisition scores of students taught using Computer-Based Learning and those taught using conventional instructional methods in selected public senior secondary schools in Zamfara State?
2. What is the difference in the mean academic performance scores of students taught using Computer-Based Learning and those taught using conventional instructional methods in selected public senior secondary schools in Zamfara State?

Research Hypotheses

The following null hypotheses were formulated and tested at the \$.05\$ level of significance:

- H0₁: There is no significant difference in the mean skills acquisition scores of students taught Computer Science using Computer-Based Learning and those taught using conventional instructional methods in selected public senior secondary schools in Zamfara State.
- H0₂: There is no significant difference in the mean academic performance scores of students taught Computer Science using Computer-Based Learning and those taught using conventional instructional methods in selected public senior secondary schools in Zamfara State.

Research methodology

This study employed a quasi-experimental research design (non-randomized, non-equivalent, pretest, posttest control group design). The design measures the impact of Computer-based learning, as the treatment for independent variables on skills acquisition and student academic performance served as the dependent variables. Two (2) groups of subjects were randomly assigned using an intact class in order to investigate the effects on pre-test and posttest. Computer based learning (CBL) serves as treatment to the experimental group, while the Control Group was without treatment. Pretest was administered to the two groups, in order to ascertain the skills acquisition and technical students' academic differences in term of performance level and preparedness. The tool employed was an instructional lesson plan which covers sub-topics of SS two computer science scheme of work. The target population of the study consisted of 227 senior secondary school two students in public technical secondary schools in Zamfara state. A sample of 108 students were selected from the population using a multistage sampling procedure. First, two (2) public technical senior secondary schools was identified through purposive sampling based on the availability of basic facilities required for the study, particularly computer facilities and suitable classrooms. Second, intact classes were selected from the participating schools. The selected classes was assigned to either the experimental or control group. The experimental group received instruction using Computer-Based Learning, while the control group received instruction using conventional teaching methods. The instruments employed for the study, were Computer-Based Skills Acquisition Test (CBSAT) and Academic Performance Test (APT). The Computer-Based Skills Acquisition Test (CBSAT) was developed to measure students' acquisition of relevant skills after exposure to the CBL treatment. The test will be based on the specific skills and learning objectives contained in the selected curriculum content. The Academic Performance Test (APT) was used to measure students' academic achievement in the selected subject or content area. The test items will be developed based on the relevant senior secondary school curriculum and the topics covered during the treatment period. However, the use of separate instruments for skills acquisition and academic performance is justified because the two variables represent related but distinct learning outcomes. While academic performance may reflect students' mastery of subject knowledge, skills acquisition focuses more directly on the ability to apply knowledge and demonstrate practical competencies. The research instruments were submitted to experts in Educational Technology, Measurement and Evaluation, and the relevant subject area for validation. The experts examined the instruments in terms of content coverage, clarity of items, relevance to the research objectives and appropriateness of the items for the target students. Their observations and recommendations was used to modify and improve the instruments before the final administration. The reliability of the instruments were established through a pilot test involving students who are similar to the participants of the study but not included in the main study. A correlation coefficient of 0.86 index score was obtained which was considered high and suitable for gathering data. The instruments were certified to have face and content validity by experts.



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To validate and authenticate the lesson plan, it was giving to three experts, the expert rating scales for the tools on the appropriateness of the lesson plan, out of 100 points, were 85%, 88% and 90% and the mean rating was 87.7% representing the content, consensus or logical validity of the lesson plan. The students received the treatment of Computer Achievement test by the students' regular Computer science teacher using researcher prepared lesson plan. The training for computer science teachers lasted for one week in the sampled schools. The control group received no treatment but all of them were taught computer science by their computer class teacher using researcher prepared lesson plan to make for uniformity in the presentation of the lessons in the experimental and control group classes. Data collected were subjected to descriptive and inferential statistics. Descriptive statistics such as mean and standard deviation were used to answer the research questions while inferential statistics such as student t-test was used to test the hypotheses. Hypotheses were tested at 0.05 level of significant using Statistical Package for Social Science (SPSS) version 21.0.

Experimental Procedure

The study was conducted in the following stages:

Stage One: Preparation: The researcher obtained permission from the relevant educational authorities and school administrators. The participated teachers were briefed on the purpose and procedures of the study. The instructional materials and CBL resources was also prepared.

Stage Two: Pre-test: The Skills Acquisition Test and Academic Performance Test were administered to both the experimental and control groups before the treatment. The pre-test was established the students' baseline levels of skills acquisition and academic performance.

Stage Three: Treatment: The experimental group was taught base on selected instructional content using Computer-Based Learning such as multimedia presentations, computer simulations, interactive learning activities, instructional videos, computer-based exercises, digital demonstrations, immediate feedback; and computer-assisted assessment activities while the control group were taught the same instructional content using conventional teaching methods, such as teacher explanation, discussion, textbook use and board-based instruction.

Stage Four: Post-test: At the end of the treatment period, the same or equivalent versions of the research instruments were administered to both groups. The post-test results was compared with the pre-test results to determine the impact of CBL on students' skills acquisition and academic performance.

Presentation of Results

Research Question One: *What is the difference in the mean skills acquisition scores of students taught Computer Science using Computer-Based Learning and those taught using conventional instructional methods in selected public senior secondary schools in Zamfara State?*

Table 1: Descriptive Statistics for Post-Test Skills Acquisition Scores (CBSAT)

Group	N	Post-Test Mean	Standard Deviation	Mean Difference
Experimental (CBL)	71	74.789	6.500	23.275
Control (Conventional)	37	51.514	6.518	
Total	108	66.815	12.849	

The descriptive results presented in Table 1 reveal that the experimental group, consisting of 71 students instructed using Computer-Based Learning (CBL), achieved a post-test mean score of 74.789 with a standard deviation of 6.500 on the Computer-Based Skills Acquisition Test. Conversely, the control group, comprising 37 students taught using conventional instructional methods, recorded a post-test mean score of 51.514 with a standard deviation of 6.518. The resulting mean difference of 23.275 points in favor of the experimental group indicates that students exposed to computer-based instructional materials demonstrated higher levels of practical skill acquisition than those exposed to conventional teaching methods.

Hypothesis 1 (H₀₁): *There is no significant difference in the mean skills acquisition scores of students taught Computer Science using Computer-Based Learning and those taught using conventional instructional methods in selected public senior secondary schools in Zamfara State.*

Table 2: ANCOVA Summary Table for Post-Test Skills Acquisition Scores

Source	Type III Sum of Squares	df	Mean Square	F-value	Sig. (p)	Partial Squared (η ²)	Eta Decision
Corrected Model	17613.182	2	8806.591	18090.793	.000	.997	

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Intercept	821.553	1	821.553	1687.662	.000	.941	
Pre_CBSAT (Covariate)	4435.960	1	4435.960	9112.497	.000	.989	
Group (Main Effect)	11298.571	1	11298.571	23209.901	.000	.995	Reject HO
Error	51.114	105	0.487				
Total	499800.000	108					
Corrected Total	17664.296	107					

Note: R Squared = .997 (Adjusted R Squared = .997). Covariate evaluated at Pre_CBSAT baseline mean = 32.519. Adjusted Grand Mean = 63.399.

The univariate ANCOVA results in Table 2 demonstrate that after controlling for entry-level performance using the pre-test covariate pre-test, the main effect of the instructional strategy (Group) yielded an F-calculated value of $F(1,105)=23209.901$ with a significance value of $p=.000$. Because the probability value is less than the .05 level of significance ($p<.05$), Null Hypothesis 1 is rejected. This confirms a statistically significant difference in the mean skills acquisition scores between students taught Computer Science using Computer-Based Learning and those taught using conventional instructional methods. Furthermore, the partial eta squared index ($\eta^2=.995$) shows an extremely high effect size, indicating that 99.5% of the total variance in practical skills acquisition is directly explained by exposure to Computer-Based Learning.

Research Question Two: *What is the difference in the mean academic performance scores of students taught Computer Science using Computer-Based Learning and those taught using conventional instructional methods in selected public senior secondary schools in Zamfara State*

Table 3: Descriptive Statistics for Post-Test Academic Performance Scores (APT)

Group	N	Post-Test Mean	Standard Deviation	Mean Difference
Experimental (CBL)	71	72.324	6.251	18.216
Control (Conventional)	37	54.108	6.315	
Total	108	66.083	10.696	

The descriptive data contained in Table 3 show that the experimental group ($N=71$) achieved a post-test academic performance mean score of 72.324 with a standard deviation of 6.251 on the Academic Performance Test. On the other hand, the control group ($N=37$) recorded a post-test mean score of 54.108 with a standard deviation of 6.315. The resulting mean difference of 18.216 points demonstrates that students taught Computer Science via Computer-Based Learning attained higher cognitive academic outcomes than their counterparts in the conventional instructional group.

Hypothesis 2 (H0₂): *There is no significant difference in the mean academic performance scores of students taught Computer Science using Computer-Based Learning and those taught using conventional instructional methods in selected public senior secondary schools in Zamfara State.*

Table 4: ANCOVA Summary Table for Post-Test Academic Performance Scores

Source	Type III Sum of Squares	df	Mean Square	F-value	Sig. (p)	Partial Eta Squared (η^2)	Decision
Corrected Model	12148.881	2	6074.441	6831.147	.000	.992	
Intercept	438.581	1	438.581	493.216	.000	.824	
Pre_APT (Covariate)	4077.748	1	4077.748	4585.722	.000	.978	
Group (Main Effect)	6610.591	1	6610.591	7434.087	.000	.986	Reject HO
Error	93.369	105	0.889				
Total	483879.000	108					
Corrected Total	12242.250	107					

Note: R Squared = .992 (Adjusted R Squared = .992). Covariate evaluated at baseline mean = 36.481. Adjusted Grand Mean = 63.469.



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The inferential results displayed in Table 4 indicate that after adjusting for initial pre-test entry levels using pre-test as a covariate, the main effect of group treatment produced an F-calculated value of $F(1,105)=7434.087$ with an associated p-value of .000. Because the p-value is less than the standard threshold of .05 ($p<.05$), Null Hypothesis 2 is rejected. The decision confirms that a statistically significant difference exists in the academic performance scores of students exposed to Computer-Based Learning compared to those taught using traditional methods. Additionally, the partial eta squared value ($\eta^2=.986$) reveals that 98.6% of the variance in students' cognitive academic achievement is accounted for by the Computer-Based Learning treatment.

Discussion of Findings

The findings of this study revealed that exposure to Computer-Based Learning (CBL) resulted in a statistically significant improvement in senior secondary school students' practical skills acquisition in Computer Science when compared to the conventional instructional approach. The experimental group achieved a post-test mean score of 74.789 (SD = 6.500), whereas the control group recorded a mean score of 51.514 (SD = 6.518). This substantial mean difference of 23.275 points demonstrates that integrating digital technology, interactive simulations, and structured practical exercises into instruction significantly strengthens practical competency development. This result aligns directly with the contextual perspective established by Ene (2022), who emphasized that CBL enhances meaningful learning through active engagement, self-paced practice, and immediate corrective feedback. In contemporary education, senior secondary school learners are required to go beyond passive memorization to cultivate practical digital problem-solving skills needed for the modern economy (Bawa, 2015). The findings demonstrate that computer-supported environments provide the interactive framework necessary for students to manipulate software, perform guided digital tasks, and master practical competencies more effectively than traditional chalk-and-talk methods. Furthermore, the high level of skill acquisition observed among students in Zamfara State supports the empirical observations of Mujitapha (2026), who posited that the educational impact of technology depends heavily on providing functional digital learning environments that allow deliberate practice. When students are granted direct interaction with computer-based learning applications, their ability to transfer abstract theoretical concepts into executable practical skills is heightened. Regarding cognitive academic outcomes, the inferential analysis demonstrated a statistically significant difference in favor of students taught using Computer-Based Learning. Students in the experimental group achieved a post-test performance mean of 72.324 (SD = 6.251), outperforming their counterparts in the control group who recorded a post-test mean of 54.108 (SD = 6.315). The resulting mean difference of 18.216 points provides clear empirical evidence that computer-supported instructional packages foster greater cognitive retention and conceptual understanding in Computer Science. This outcome strongly echoes the empirical findings of Bawa (2015), who investigated computer-based instructional materials in Computer Science within Kebbi State a region geographically and socio-educationally similar to Zamfara State. Bawa (2015) established that technology-supported instruction significantly boosts academic performance compared to conventional teaching methods. The convergence of these results confirms that deliberate technology integration yields reliable educational gains across secondary schools in Northern Nigeria. The results are also consistent with the work of Okwuoza and Olajumoke (2023), who established the superiority of Computer-Assisted Instruction (CAI) over conventional teaching methods among Nigerian secondary school students. Similarly, Gambari et al. (2015) demonstrated that computer-supported strategies enrich instructional delivery by turning passive learners into active participants through visual, auditory, and practical engagement. The current study reinforces this consensus: combining multimedia elements (text, graphics, animations, and interactive tasks) lowers cognitive load, increases student motivation, and drives superior academic achievement.

Conclusion

Based on the empirical findings of this study, it is concluded that Computer-Based Learning (CBL) is a far more effective instructional strategy than the conventional teaching method for enhancing senior secondary school students' learning outcomes in Computer Science in Zamfara State. Specifically, the integration of interactive digital materials, practical simulations, and computer-supported learning environments significantly improves students' practical skills acquisition and boosts their overall academic performance. Controlling for pre-test baseline scores revealed that the massive gains in both practical competencies and cognitive achievement were directly attributable to exposure to Computer-Based Learning. Transitioning from traditional, teacher-centered instruction toward technology-supported, active-learning environments addresses the growing demand for secondary school graduates who possess both theoretical understanding and actionable digital competencies needed for higher education and the modern global economy.



Recommendations

Based on the findings and conclusions of this study, the following recommendations are made:

1. Educational stakeholders and the Ministry of Education in Zamfara State should formally integrate Computer-Based Learning (CBL) packages and software into the senior secondary school Computer Science curriculum to replace or complement traditional lecture-based methods.
2. State government authorities, school administrators, and private partners should prioritize the equipping of public senior secondary schools with functional computer laboratories, reliable power supply, internet connectivity, and up-to-date educational software to create conducive digital learning environments.
3. Ministry officials and school boards should organize regular workshops, seminars, and hands-on professional development programs for Computer Science teachers. This will enhance their pedagogical skills in designing, operating, and integrating computer-based instructional materials into everyday classroom instruction.
4. Curriculum planners (such as NERDC) should structure the secondary school Computer Science curriculum to place greater emphasis on interactive, practical-oriented digital activities, encouraging self-paced learning and immediate feedback mechanisms for students.
5. Policy-makers should allocate dedicated budgetary provisions for digital technology infrastructure in secondary education to bridge the digital divide between rural and urban public schools in Northern Nigeria.

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