

Effect of Computer Assisted Instruction on Secondary School Students' Achievement and Problem-Solving Skills in Biology

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ABSTRACT: Biology has been taught and learnt in the Nigerian school system for several decades, but students' poor performance and problem-solving skills have been a serious concern. This study investigated the effect of Computer Assisted Instruction (CAI), as an alternative mode of instruction, on senior secondary school students' achievement and problem-solving skills in biology. The research was a quasi experimental with a nonrandomized pre-test-post-test control group in which intact classes were assigned to experimental and control groups. A sample of 100 students were purposively selected from two state-owned secondary schools. The students' pre-test and post-test scores were subjected to Analysis of Covariance (ANCOVA). The findings of the study revealed that the students exposed to CAI performed better than their counterparts taught with the lecture method. However, there was no discrimination along gender. Based on the research findings, recommendations were made on the need for teachers to develop and use CAI packages for teaching biology in Nigerian secondary schools.

KEYWORDS: *Computer Assisted Instruction, problem-solving skills, senior secondary students, students' academic achievement.*

I. INTRODUCTION

The school should provide knowledge and skills to students for effective living in the society. Hence, classroom teaching and learning is expected to be transferred to solving problems in real life situation, and also facilitating functional and continued learning. Unfortunately, the present Nigerian educational system seems to be far from achieving the desired educational goals and objectives as there are noticeable evidences of secondary school students not living up to expectations (Oni, 2012; Oyeleke & Akinyeye, 2013). Science, as studied in the secondary school is seen as a means to technological advancement and students are required to study at least a science subject to equip them for transition into the larger society (Opara, 2013). Biology is the most commonly studied of the secondary school science subjects. In spite of its importance and popularity among Nigerian students, performance at senior secondary school has been found to be poor (Osuafor & Okonkwo, 2013). Reports by Chief Examiners in public examinations in Nigeria show that the percentage of students that pass biology at credit level had consistently been less than 50 percent in Anambra state government secondary schools from 2011-2015 (ANSPPSSC, Awka 2016). The search for a solution to this problem makes it imperative to adopt instructional approaches that will enable students to grow in line with current trends in order to meet the demands of today's world. Computer Assisted Instruction (CAI) is one of such approaches. It involves use of computer to provide instruction to the students in such a way that they react to instruction accordingly. Anyanwu, (2017) sees CAI as an interactive instructional technique whereby a computer is used to present the instructional material and monitor the learning that takes place. It is worthwhile to explore the effectiveness of CAI in the teaching and learning process.

Problem-solving skills refer to the abilities or efforts needed to resolve problems, to think logically and/or literally, to use ingenuity to overcome difficulties and to research and implement solutions. Dinah, (2013) reiterated that they involve the process of working through details of a problem to reach a solution or achieve a goal. A fundamental achievement in education is to enable students use their knowledge in solving problems.

Senior secondary students are post basic education students who are studying in any of the senior secondary schools in the country. The senior secondary education is received subsequent to the junior secondary education, and prior to tertiary stage. Senior secondary education is indispensable for national development (Olibie, Egboka & Ofojebe, 2017).

Students' academic achievement shows the extent to which long or short-term educational goals are achieved (Adepoju & Oluchukwu, 2011). It also indicates something that has been accomplished successfully especially by means of skills, practice or perseverance. Ali, Toriman & Gasim, (2014) believe it plays a significant role in the educational system and society at large and is easily measurable.

Gender issues have been linked with performance of students in academic tasks in several studies without any definite conclusion. Some authorities like Uwadie, (2010) believe that good teaching should break the boundaries of gender while others like Tolga, (2010) believe that knowledge is gender-related. Not much has been said about gender and skill acquisition as most of the studies on problem-solving skills were silent on gender.

Even though some work had been done on CAI, most of it was in 'special' private schools where the students already exhibited a great tendency for high performance. Thus much remain to be empirically studied using computer assisted packages based on the biology scheme of work in state owned or public secondary schools to ascertain if there be any remarkable effect. The observation of the researcher also revealed that most secondary schools in Anambra state are not using CAI in the classrooms despite its importance in science instruction and the availability of computers in schools. Some of the attributes of CAI in making the learning experience more active and inclusive thus sustaining and inspiring the students' interest and attention were considered. An attempt was then made to see if CAI can enhance students' academic achievement and problem-solving skills in biology.

II. METHOD

The quasi-experimental design was adopted for this research. Specifically, the study utilized the non-randomized pre-test-post-test control group design involving intact classes. The study was carried out in the Onitsha Education Zone of Anambra state, Nigeria where there are 30 state-owned secondary schools managed by the Anambra State Post Primary Schools' Service Commission (ANPPSSC). The population for the study comprised of all the 4,166 Senior Secondary Two (SSII) students in the zone for the academic session. The multi-stage sampling procedure was used to select the local government areas, the schools and the classes for the study. Purposive sampling was used to select 100 students from two co-educational schools that were clear representatives of typical community schools. Separate schools were used for experimental and control groups to prevent contamination among participants. Two instruments were used for data collection: A Biology Achievement Test (BAT) and a personal Problem-solving Skills Inventory (PSSI). Both instruments were administered as pre-test and rearranged for post-test. The basic instructional material used for instruction was the lesson plan prepared by the teachers with the prototype written by the researcher. Other instructional materials include the computer assisted package which served as the instrument for treatment.

The face and content validity of the BAT was done by two experienced biology teachers from Otuocha education zone and a lecturer in measurement and evaluation from the university. The PSSI was critically reviewed by two experts in the Faculty of Education, Nnamdi Azikiwe University Awka. The computer assisted instructional package was validated by two computer programmers and two biology teachers. The end users' usability evaluation was done through a trial test on 50 SSII students of another school not used for the study and results obtained used for the improvement of the package. The test-retest method was used to ascertain the reliability of the instrument and the scores were correlated using the Pearson Product Moment Correlation technique which yielded a co-efficient of $r=0.731$ for BAT and 0.85 for PSSI. The data obtained were analysed using mean to answer the research questions; while the Analysis of Covariance (ANCOVA) was used to test the null hypotheses. Nworgu, (2015) believes that ANCOVA has the ability to adjust treatment means, interpret data, estimate missing data, increase precision in experiments, and take correlation between pre and post-test measures into account. It helps to eliminate any further imbalance in the entry abilities of the students before the treatment. The decision rule is to reject the null hypothesis if P-value is less than 0.05 alpha level, otherwise, accept the null hypothesis.

III. RESULTS

The data collected were analysed and the summaries presented in tables to highlight the findings.

Table 1: Mean achievement scores of students taught biology with CAI and lecture method

Group	N	Mean	Mean Gain Score
CAI Pre-test	50	13.02	
Post-test	50	32.44	19.42
Lecture Pre-test	50	16.04	
Post-test	50	27.48	11.44

Key: CAI = computer assisted instruction.

This table shows that the mean achievement score of students taught biology with CAI which was 32.44 is greater than the mean achievement score of students taught with lecture method which indicate that those students taught biology with CAI performed better than the students taught with lecture method.

Table 2: Mean achievement scores in biology of male and female students taught with computer assisted instruction (CAI)

Source of Variation	Mean	Mean pre-test	Mean post-test	Mean Gain Score
Male	26	13.77	32.73	18.96
Female	24	12.21	32.12	19.91

This table revealed that the mean achievement score of male students before the use of CAI was 13.77 and it became 32.73 after CAI. This showed a very high performance of the male students taught with CAI.

Table 3: Mean scores on problem-solving skills of students taught biology with CAI and those taught with lecture method.

Group		N	Mean	Mean Gain Score
Control	Pre-test	50	91.80	20.92
	Post-test	50	70.88	
CAI	Pre-test	50	90.68	24.52
	Post-test	50	66.16	

Key: CAI = Computer Assisted Instruction.

This table revealed that the mean score on problem-solving skills of students taught biology with CAI was 90.68 for the pre-test and 66.16 for the post-test while the mean score on problem-solving skills of students taught biology with lecture method was 91.80 for the pre-test and the post-test mean score was 70.88. This showed a remarkable change in the mean score of the post-test for the group taught with CAI which indicates that they acquired greater problem solving skills than those taught with lecture method.

Table 4: mean scores on problem-solving skills of male and female students taught biology with computer assisted instruction (CAI)

Group		N	Mean	Mean Gain Score
Control	Pre-test	24	90.42	24.7
	Post-test	24	65.72	
CAI	Pre-test	24	90.92	24.38
	Post-test	24	66.54	

This table revealed that the mean score on problem-solving skills of female students taught biology with CAI was 90.42 for pre-test and 65.72 for the post-test while that of male students was 90.92 for the pre-test and 66.54 for the post-test. This did not show any remarkable change in the mean scores of the post-test for both groups.

Table 5: Analysis of Covariance of mean scores of the students taught biology with CAI and lecture method.

SV	DF	SS	MS	F	P-Value	Decision
Corrected Model	2	1768.114	884.057	121.671	.000	
Pre-test	1	912.475	912.475	125.582	.000	
Post-test	1	1540.104	1540.104	211.962	.000	
Group	1	1638.668	1638.668	225.527	.000	Significant
Error	97	704.796				
Total	100	23585.000				
Corrected Total	99	2472.910				

Keys: SV= source of variance, DF= Degree of freedom, SS= Sum of squares, MS= mean square

The analysis of variance presented in this table revealed that p-value = .000 which is less than the 0.05 α -level. This indicates that there is a statistically significant difference between the mean achievement scores of students taught biology with CAI and those taught with lecture method.

Table 6: Analysis of Covariance of the mean scores in problem-solving skills of students taught biology with CAI and those taught with lecture method.

SV	DF	SS	MS	F	P-Value	Decision
Corrected Model	2	253.663	126.831	8.885	.000	
Pre-test	1	74.093	74.093	5.191	.025	
Post-test	1	222.303	222.303	15.574	.000	
Group	1	73.636	73.636	5.159	.025	Significant
Error	97	1384.57	14.274			
Total	100	834112.000				
Corrected Total	99	1638.240				

Key: SV= Source of variance, DF= Degree of freedom, SS= Sum of squares, MS= Mean square.

The result of the ANCOVA for the significant difference in problem-solving skills of students taught biology with CAI and those taught with lecture method in this table shows a statistically significant difference since the p-value of .025 is less than the α - value of 0.05.

From the analysis of data presented, the major findings from the study revealed that:

-Computer Assisted Instruction is more effective in improving students' academic achievement in biology than the lecture method. The mean achievement scores differed significantly in favour of those taught with CAI.

-The mean problem-solving skills scores of students taught biology concepts with CAI differed significantly from those taught with the lecture method in favour of the CAI group.

-there was no significant difference in both the achievement scores and problem-solving scores of male and female students taught biology concepts with CAI.

IV. CONCLUSION

From the results obtained, the following conclusions were drawn:

The CAI used in teaching biology to senior secondary school students has proved more effective in academic achievement and problem-solving skills. This is evident from the fact that the group taught with CAI performed significantly better than the group that was taught with the lecture method. The use of the CAI had apposite effect on the students' problem-solving skills. The results of the research indicate that the use of the computer assisted instructional package, which is an interactive learning package, helped the students in increasing their achievements and developing their problem-solving skills in biology in the senior secondary schools.

CAI provided a better academic achievement and problem-solving skills for both male and female students as indicated in the absence of significant difference in the achievement and problem-solving skills of both students taught biology with CAI.

Based on these findings, the following recommendations are made:

1. Biology teachers should use innovative and more effective student-centred strategies such as computer assisted instructional packages to promote meaningful learning of biology concepts. The researcher advocates that CAI be adopted in the biology class in all secondary schools. The biology teachers should therefore develop, adapt or adopt appropriate computer instructional packages for use in the Nigerian schools.
2. The curriculum planners should consider the introduction of CAI when revising and organizing the biology curriculum.
3. The Ministry of Education, the Post Primary Schools Service Commission and other stakeholders involved in Biology Education should organize regular workshops and in-service training sessions for biology teachers on the effective use of computer assisted instructional packages to enhance the effective application of computer lessons in the classroom.

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