EFFECT OF COMPUTER ASSISTED INSTRUCTION (CAI) WITH ANIMATION ON STUDENTS' ACADEMIC RETENTION IN SECONDARY SCHOOL PHYSICS

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Abstract
Physics education provides a platform for a nation to attain economic and technological advancement. In spite of the benefits, average Nigerian students have a phobia for physics. This fear that physics is complex to learn, abstract in nature and difficult to assimilate causes many students not to attempt physics at all; thus affecting their future aspiration. Notwithstanding the strategies teachers use and efforts students also make, retention in physics concepts is low as manifested in the high number of failures recorded in the WAEC and NECO examinations. This study therefore, used a combination of CAI and animation to teach concepts in Electrostatics. The study adopted quasi-experimental design. A sample size of 167 SS I students out of the population of 3,438, selected from co-educational schools in Anambra State was used. 30-item MCQ Electric Charge Electric Field Achievement Test (ECEFAT), with a reliability of 0.89 was used. Pre-tests were applied on groups before treatments. "Electrostatic" was taught to experimental group using CAI with animation package produced by the researchers which is based on the content of the SS I physics scheme of work. The control group was taught, using conventional method. One week after the treatments were applied, post-tests were conducted followed by retention test after three weeks. Data Analysis of Covariance showed a significant difference between the mean retention scores of experimental and control groups in favour of the experimental group. There was no significant interaction effect of treatment and gender on students' retention in physics. Based on the findings, some recommendations were made.

Introduction

Science education provides the knowledge required for building and operation of systems and infrastructures upon which modern development is based. The emphasis on science education is more important in a developing country like Nigeria where the need for growth requires an accelerated process of knowledge build- up. Physics with mathematics, biology and chemistry form the core of the science curricula in Nigeria. Physics is an intellectually

challenging subject that requires strong practical foundations and adequate mathematical skills for a thorough understanding.

Atadoga, Zara, Mari, and Danjuma (2016) observed that physics is an aspect of science that helps to explain the cause-effect relationships of matter and energy, and their application to natural phenomena. Its place in the scheme of things as far as science education is concerned makes it imperative for students to take the subject seriously.

In recent years, one of the more important realization in the teaching of physics (Omorogbe & Ewansiha, 2013) is the inadequacy of the current pedagogies utilized as the basis for the teaching and learning process. According to Aina and Ayodele (2018), the current paradigm informing the transmission of scientific knowledge is curriculum- driven. As such teachers are more interested in finishing the curriculum rather than tailoring the process of knowledge acquisition, transmission and retention to the effective way the learner learns. A dominant thought in modern education, especially in the developing countries is the forgetting that there is a very strong connection between the brain processes and learning. Mayer (2005) stated that people learn more deeply from words and pictures than from words alone. That is to say that learners attempt to build meaningful connections between words and pictures and that they learn more deeply than they could have with words or pictures alone. Omorogbe and Ewansiha (2013) maintained that the various challenges facing science education including poor students' mode of learning, poor students' enrolment, and poor teachers' pedagogies require new approaches. Computer Assisted Instruction (CAI) with animation has being touted as one of the innovative teaching strategies with demonstrated potentials to solve the problem associated with science education in Nigeria.

CAI is an innovative instructional method which encourages interaction between the computer and a learner. It is an electronic form of education which allows the learner in a friendly learning interaction with the computer to present and enjoy programmed learning activity. In using CAI, computer plays the teacher's role as it provides and imparts knowledge and skills to learners. Thus, the teacher instead of teaching the learners, only guides and assists them on how to ask questions and pose problems, formulate hypotheses, locate information and critically assess the information found in relation to the problems posed (Ater, 2006, Haddad &Jurich in Akinola, 2012). CAI, according to Rabia (2014) is an interactive instructional technique whereby a computer is used to present the instructional material and monitor the learning that takes place. Okundaye (2005) pointed out that in CAI, the students receive feedback from the computer and maintain some degree of control. This means that CAI is a strategy in which the topics to be taught are

carefully planned, written and programmed in a computer units and it allows each students to one computer terminal.

The instructions are also programmed in a computer disc (CD), this could be played in either audio or video system for student to learn the programmed instructions at their leisure and own pace. CAI can also be used to provide opportunities for student to learn (Mayer, 2009), using drill and practice, tutorial, games and simulation activities, animation, and many others.

Computer (2016) is of the view that animation is the illusion of movement created by showing a series of still pictures in rapid succession. Simple animation may be as basic as an animated GIF file with few frames in a row showing repeatedly to add life to a drawing or an object. A more complex animation could be of a human or alien face in a computer software game or animation of a space battle in a movie. It could also be seen as the process of displaying still images in a rapid sequence to create the illusion of movement.

CAI with animation seems to attract learners' attention and increase their motivation to learn. Researchers (Martindale, 2007; Yusuf & Afolabi, 2010; Nwoye & Okeke, 2019) ascertain that our instruction needs to contain computer animation since many students get stimulated on a daily basis by it. This is because computers offer exciting approaches to teaching that were not dreamt of many years ago. In this context, the animations are used to deliver lesson contents with planned instructions. This involves the teacher projecting and explaining the planned instructions in form of graphics, text, audio and visual files. At the end of each topic of instruction, the animation related to the concept(s) taught will be played to enhance internalization and meaningful learning. Students are meant to attempt the evaluation questions that follow before moving to the next topic. On the other hand, CAI with animation was readily available for the learner's use during the lessons for this study and after the study the package was made available to students to learn at their own convenient and pace. Animation as an attention gaining strategy may help to reduce the processing demands in Science, Technology and Mathematics (STM). As an elaborate strategy, CAI with animation may store information into long – term memory thus facilitates encoding and retrieval process. It may influence students' attitudes and interest towards physics which may positively affect their academic retention.

Retention which is the ability to reproduce the learnt concept when the need arises has been variously explained by many. In the view of Kundu and Totoo (2007), it is the preservative factor of the mind. Whatever touches consciousness leaves trace or impression and is retained in the mind in form of image. Psychologists believe that there are two types of retention: short–term

and long-term retention. Short-term retention is demonstrated when students hold information long enough for immediate use. For instance, attaining good performance in continuous assessment tests, mid –term tests or quizzes, remembering a customer's name and address until delivery is done.

When the outcomes of learning last in student's mind beyond the immediate occasion for their use, say from a few minutes right up to a lifetime, long-term retention is achieved. Long-term retention of behaviour is required in education for learning purposes.

In learning, the best way of improving retention is to give attention to what is learned initially and how this learning is organized, and to relate this to the kind of problem you are faced with. Relating this to teaching and learning activities, it means the act of remembering what has been taught in the classroom. Also, the more a subject is retained the more effective the condition or variable was in learning the task. Instructional strategies such as CAI with animation could be found to aid retention in physics by making topics that appear abstract to students clearer, easier, enjoyable and meaningful. Thus, the researchers sought to investigate the effectiveness of CAI with animation in enhancing secondary school students' retention in physics

The following research questions and hypothesis guided the study.

- What is the difference in mean retention scores of students taught physics concepts using CAI with animation and those taught using conventional method?
- What is the interaction effect of methods and gender on students' academic retention in physics?
- There is no significant difference between the mean retention scores of students taught physics concepts using CAI with animation and those taught using conventional method.
- There is no significant interaction effect of teaching methods and gender on students' academic retention in physics.

Method

Quasi-experimental design specifically, non-equivalent control group design was used for this study. The population consisted of 3,438 Senior Secondary one (SS 1) students from all the state government owned co – educational secondary schools in Awka Education Zone of Anambra state. The logic behind selection of co-educational secondary schools is to create the same study environmental condition for both genders. While SS 1 students were chosen because SS 1 is the foundation class for science students and if captured at that level the students might likely study physics in SS 2 and SS 3.

167 (77 males and 90 females) SSI students formed the sample. 30 multiple items questions on electric charge and electric field were used as data collection tool. After the classroom teachers who acted as research assistants had been adequately trained and had demonstrated competence in the successful implementation of the instructions, pretest was applied on groups a week before the actual teaching of the electric charge and electric field concepts.

Experimental groups were taught using CAI with animation. Conventional lecture method was used for the control groups. Posttests were administered to both groups one week after the treatments while retention tests were administered three weeks after the post test.

In analysis of data, descriptive and inferential statistics were used. ANCOVA was used for testing the hypotheses. In this case, post-test scores serve as covariate measures. In this study, steps below were observed with control and experimental groups in 5 weeks of process. At the end of pretest, subjects of electric field, types of charge, charge and charge interaction, charge as a quantity and production of charges were taught to both groups by their class teachers who served as research assistants in line with the lesson plan prepared by the researchers. Control groups were exposed to the physics concepts using conventional method. Experimental groups were taught using CAI with animation package produced by the researchers from the same field with the lesson plan. The package adopted the tutorial modes of CAI. After the treatment has been made, the same instrument was reshuffled and used as post-test while post-test was reshuffled and used as retention test. Retention test is the delayed post-test which was used to ascertain the extent concept of static electricity have been retained by the students. The interval between the administration of post-test and retention test was three weeks. According to Abakkar (2011), how much the student retained after the learning of a particular task can be determined by bringing the subject back at varying time periods usually days, weeks or months.

Results

Table 1: Mean and Standard Deviation Scores of Students' Retention Score by Method

		Post-test		Retention-test		
Method	**N**	**Mean**	**SD**	**Mean**	**SD**	**Gain in mean**
CAI with animation(E)	68	71.68	10.54	75.06	10.48	3.38
Conventional (C)	99	44.79	7.67	44.19	08.66	-0.6
Mean Difference		26.89		30.87		3.98

E= Experimental group; C= Control group

The results presented in Table 1 shows that those students who were taught physics concepts (ECEF) using CAI with animation had mean achievement score of 71.68 in the post-test and 75.06 in the test for retention. On the other hand, those who were taught ECEF using conventional method had mean achievement score of 44.79 in the post-test and 44.19 in the test for retention. Similarly, the standard deviations were 10.48 for experimental group and 08.66 for control group showing the homogeneity of the scores.

The high gain score in retention test for experimental group might be as a result of the computer assisted instruction with animation package which was made available for students to play and watch at their own leisure.

Table 2: Mean and Standard Deviation Scores of Students' Retention Score by Method and Gender

Teaching Method	**Gender**	**Retention-test N**	**Mean**	**SD**
CAI with Animation (E)	Male	37	74.92	8.54
	Female	31	75.23	12.56
Conventional (C)	Male	40	41.47	7.37
	Female	59	46.03	9.04

E= Experimental group; C= Control group

Table 2 shows that female retained more than male in both experimental and control groups. This is shown by the mean scores of 74.92 (for E) and 41.47 (for C) of males against 75.23 (for E) and 46.03 (for C) of females. The mean gain retention score of female students was slightly higher than the mean gain in retention score of male students irrespective of method of instruction. However, to determine if these observed differences were significant, hypotheses were tested at 0.05 level of probability.

Table 3: ANCOVA Test of Significant Difference between the Mean Retention Scores of students by Method

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Result
Corrected Model	45484.274[a]	4	11371.069	241.489.000		
Intercept	1128.135	1	1128.135	23.958.000		
Post-test	6579.938	1	6579.938	139.739.000		S.
Method	1626.047	1	1626.047	34.533.000		S.
Error	7628.145	162	47.087			
Total	591145.000	167				
Corrected Total	53112.419	166				

S= Significant at 0.05 probability level NS= Not Significant at 0.05 probability level

Table 3 shows that the value of the significance of F (34.533) on retention is 0.000 compare to P< 0.05. The null hypothesis was therefore rejected. This means that there is a significant difference between the mean retention scores of students taught ECEF concepts using CAI with animation and those taught using conventional method in favour of the experimental group. Hence, the use of CAI with animation is effective in enhancing students' retention in physics.

Table 4: ANCOVA Test of Interaction Effect of Methods and Gender on students' Retention Scores

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Result
Corrected Model	45484.274[a]	4	11371.069	241.4	89	.000
Intercept	1128.135	1	1128.135	23.9	58	.000
Method*Gender	9.729	1	9.729	.207	.650	NS.
Error	7628.145	162		47.087		
Total	591145.000	167				
Corrected Total	53112.419	166				

S= Significant at 0.05 probability level NS= Not Significant at 0.05 probability level

Table 4 indicates that the significant of F (0.207) is 0.650 which is higher than the P< 0.05 level of significance. The null hypothesis is upheld. This means that there is no significant interaction effect of the teaching method and gender on students' retention in physics. This shows that the retention of students in relation to teaching methods is not influenced by gender of the students.

Fig. 1 shows the graph of the interaction effect of the teaching method and gender as measured by the mean retention scores in Electric Charge and Electric Field Achievement Retention Test (ECEFART).

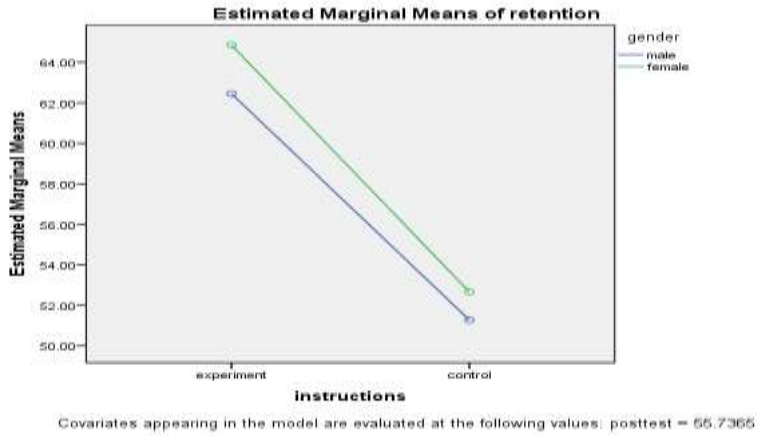

Fig. 1: Interaction Effects of Teaching Method and Gender on Students' Retention in Physics.

Discussion

Effect of CAI with Animation on Students' Retention in Physics

The findings of this study indicate that students in the experimental group obtained higher scores in the delay post ECEFAT (Table 1) than students in the control group. This shows that students exposed to physics concepts using CAI with animation appeared to retain the physics concepts taught more than those taught with conventional method. The difference in retention scores between the experimental and control groups is found significant at P< 0.05 level of significance in favour of the experimental groups as can be seen on Table 3.

This finding gave support to what was earlier found by Aminu (2015) and Gambari, Falode and Adegbenro (2014) that students' retention can be improved through the use of animated-media strategies in geography and mathematics respectively, hence the efficacy of CAI with animation in enhancing students' retention in physics concepts taught.

The high retention of the concepts shown by the experimental groups may have been affected by the fact that the tutorial mode adopted seem to enhance meaningful learning. Also, the mode of presentation of CAI with animation facilitated the encoding of the learnt concepts into memory. The constant review of both previous and present concepts adopted by the method is capable of causing overlearning which is found to cause remembering and enhances retention.

The result of the analysis of covariance on retention presented on Table 4 show that the significance of F in the two-way interaction is higher than the significant level of alpha set at P < 0.05. It implies that there is no significant interaction effect of methods of instruction and gender on students'

retention in physics. This means that the group difference is not sensitive of gender.

CAI with animation arouses the interest of the students thereby enhancing retention and serves as a motivation to the students irrespective of their gender. Through the CAI package, lessons are provided for better understanding through, animation, visual imagery, and tutorial. Students' ease in understanding a lesson serves as a driver for their sustained attention and retention in the subject. This will lead to their subsequent adoption of the subject as a career choice because of the simple method the lessons are presented through the CAI with animation.

Conclusion

Based on the findings of this study, the following conclusions were made. The result of this study provide empirical evidence that using Computer Assisted Instruction (CAI) with animation in teaching physics is more effective than teaching physics conventionally. This is noticed from the results of the findings that students taught using CAI with animation method of instruction were able to retain more than those taught using conventional method of instruction. The interaction effect of methods of instruction and gender on students' retention was not significant. In general, the use of CAI with animation has proved to be viable in enhancing meaningful teaching and learning of physics.

Recommendations

Based on the findings of this study, the following recommendations were made.

1. This study had shown that the use of CAI with animation enhances retention in physics. Therefore, the physics teachers should adopt it in teaching physics concepts in secondary schools.
2. Seminars and workshops should be organized by the Federal and State Ministries of Education where teachers, textbook authors and curriculum planners will be taught how to use CAI with animation for effective teaching and learning of physics in schools.
3. The textbook authors should be encouraged to work with programmers so as to put animation packages to their books using software CD for in-depth study.

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