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Effects of Computer Animation on Students' Achievement in Learning Alternating Current Electricity in Technical Colleges in Nsukka Education Zone

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ABSTRACT

Candidates have shown a lack of understanding of alternating current electricity, as many either steered clear of these questions or tackled them with little success. This fascinating area of physics introduces concepts that can truly captivate students if well handled using specific innovative teaching method like computer animation method. However, some researchers highlights challenges and a lack of motivation during lessons on this physics topic, primarily because traditional teaching methods often keep students passive, merely listening to lectures. This can lead to poor retention of material as some researchers did point out that inadequate teaching methods might prevent students from grasping abstract physics concepts fully. Therefore, this study investigated the effect of instructional computer animation on Technical college students'achievement in alternating current electricity in Nsukka Education Zone. Two research questions guided the study and two null hypotheses were tested. The study adopted a quasi experimental design. Population of the study consisted of all the 2120 Year three physics students in the public technical colleges in Nsukka Educational Zone. The sample consisted of 120 Year 3 physics students drawn from some of the technical colleges in the Education Zone. Alternating current electricity Achievement Test (ACEAT) was the instruments used to collect data for the study. The reliability coefficient of ACEAT was established to be 0.85 using Kuder Richardson (KR-20) after trial-testing of the instrument. Mean and standard deviation were used to answer the research questions while Analysis of Covariance was used to test the null hypotheses at 0.05 level of significance. The result revealed that instructional computer animation had significant effect on students' achievement in alternating current electricity. Female students performed better than the male students taught using instructional computer animation.

Keywords:
Alternating Current,
Computer Animation,
Students' Achievement.

INTRODUCTION

Physics is a field of study that seeks to understand natural phenomena using quantitative measurement and experimental observation. Immense contributions from this field of science have been made toward resolving issues the modern society encounters (Mamuda et al. , 2023). In the sectors of communication, agriculture, healthcare, security, and energy, the study of physics has helped Nigeria's economy grow (Adekoya et al. , 2024; Barau et al. , 2025 & Oniku et al. , 2025). Understanding of exploration geophysics resulted in the discovery, extraction, and refining of crude oil, which has been the main source of income for the Nation. Despite the great advantages of physics for the country, physics students' academic performance has not been satisfactory (Onah et al. , 2020; Ugwuanyi et al. , 2020 & Offordile et al. , 2021). Inadequate understanding of physics could explain students' poor academic results. Wieman (2023), blames the low understanding on instructors' use of methods unable to materialize the abstractness of physical ideas. Students' examination results could suffer if they cannot recall what they have studied or learned. According to Adonu et al. (2021), if the students did not develop an intact storage system, information retrieval could be impaired and hence could lead to inadequate performance. Examining certain themes helps to provide

more insight on students' performance in physics. Candidates showed poor grasp of alternating current electricity, as noted in the WAEC Chief Examiners' report (2020 and 2021), a sizeable number of candidates either skipped such questions or answered them inadequately.

Macuácua et al (2021), Wieman (2023) and others observed some problems and lack of enthusiasm among students during 2021 lessons on this topic as teachers mostly use traditional teaching methods which merely make students sit silently in the classrooms while the teacher delivers the lesson. According to Noreen & Rana (2019), the students' primary physical activity is either note-taking or waiting to answer any teacher-posed inquiry. Because alternating current electricity is abstract, students often misunderstand it. Makiyah (2019) pointed out alternating current electricity's misconceptions that could be mitigated by a properly designed teaching approach. López-Segovia et al. (2023) advised that it is vital to use several teaching strategies because a completely traditional approach impede students' grasp of the basic physical principles of alternating current electricity. While teaching alternating current electricity, teachers must compare ideas to what can be readily grasped by students in order to guarantee that students have a correct understanding (Mustu & Sen, 2019). Teaching requires the use of personal skill and inventiveness, therefore it has an artistic dimension. This is why it involves several methods and approaches. Many ICT-related teaching techniques, including computer animation, aim to correct the limitations that might result from exclusively applying the traditional approach of instruction. According to Nwoye &amp, 2019 and Okeke, 2019, Students' attention and motivation to learn seem to be boosted by computer animation, which is defined as the quick succession of still images to produce the illusion of movement. Teachers using this approach deliver instructions via graphics, text, audio, and visual files, then animations connected to the ideas taught. Computer animation seems to engage students and increase their willingness to participate in learning. Many students are motivated by computer animation every day; Nwoye and Okeke, 2019 discovered that our lesson should include it. Computer animation's instructional method is for the instructor delivering lessons using visual tools, text, audio, and graphics (Nwoye & Okeke, 2022). Presentation of the relevant animation depicting explained concepts will help to clarify following the completion of each instructional topic, therefore improving learning effectiveness (Nwoye & Okeke, 2019); Hanaysha et al. , 2023).

Researchers have demonstrated that including multimedia components and animation into teaching can greatly enhance student retention and performance. For instance, secondary school physics students in Nigeria who used animation along with written content experienced significant performance improvements, (Eguabor & Adeleke, 2017). Ameen et al. Research from 2023 shows that, contrary to conventional approaches, multimedia courseware enhanced students' capacity to solve word-problem math puzzles. The scientists noted as well that women showed increased retention. Especially in light of the complex factors affecting academic success, score categorization helps to clarify students' proficiency levels. Dividing students into high, medium, or low achievement groups those with varying levels of proficiency in specific topics score level provides a means of classification (Akanmu et al. , 2014). This classification was also affected by how quickly one learned and how well one could adjust to fresh content. The educational system gauges students' progress through a range of assessments, including exams and tests. Furthermore, Abdulwahab (2014) claimed that teachers apply score levels to assess how well various strategies of instruction and solutions improve students' academic performance.

Another factor researchers have found as a potential impact on the academic performance of students from the use of creative teaching techniques is gender. According to Acar (2019), gender is the natural attribute of a person that allows classification into male and female; gender roles are the responsibilities assigned by society to genders. A major discussion topic lately is gender since it influences society responsibilities, education, jobs, salaries, and healthcare. Science education researchers whose gender as a moderating variable has been tested for impact have had different results.

Statement of the Problem

Lack of acceptance of modern techniques such computer animation instructional strategy among other computer-aided instructional approaches was blamed for students' inability to answer questions on alternating current electricity, and thereby unsatisfactory external qualification performance as stated in the Chief WASSCE Examiners' reports of 2020 and 2021. Several causes contributed to this poor performance included inefficient teaching techniques (Macuácua et al. , 2021; Wieman, 2023), unqualified and inexperienced instructors managing the subject (Assem et al. , 2023), inappropriate use of suitable and successful media resources among other things, learners' retention ability. Actions based on many kinds of study to solve the unsatisfactory performance of physics students have proved ineffective. Physics students' performance lately suggests the problem still is not solved. To improve the academic performance of secondary school students in physics, other teaching techniques such the computer animation instructional approach, if applied, might help to solve the underlying problem. Consequently, this study primarily aims to investigate how computer animation instructional method affects performance and

retention in alternating current electricity among senior secondary school students in Nsukka Education Zone of Enugu State.

Objectives of the Study

The goal of the study was to examine how computer animation instructional approach affected alternating current electricity in senior secondary school students' performance in Nsukka Education Zone, Nigeria. The research purpose is specifically to find

i. Difference in the performance of Technical College Year 3 physics students taught alternating current electricity using computer animation instructional strategy (CAIS) and those taught using conventional teaching method (CTM)
ii. Technical College Year 3 physics students taught alternating current electricity using CAIS whether gender had an impact on their performance.

Research Questions

The following research questions were posed.

i. Do Technical College Year 3 physics students instructed alternating current electricity using CAIS differ in performance from those taught alternating current electricity using CTM?
ii. Will male and female students instructed alternating current electricity using CAIS show variances in performance?

Hypotheses

The following hypotheses were tested:

H01: Performance of Technical College Year 3 physics students taught alternating current electricity using CAIS and those taught alternating current electricity using CTM is not significantly different.

H02: Male and female students instructed alternating current electricity via CAIS show no appreciable difference in performance.

MATERIALS AND METHODS

The investigator employed a pre-test, post-test design with a non-randomized, non-equivalent control group. One group employed computer animation; another used a traditional teaching approach. While gender is another moderating variable of two categories (male and female). The dependent variable is performance in alternating current electricity of year 3 students. Below is the research design outline.

Table 1: Research Design Outline

Group	Pre-test	Treatment	Post-test
Control	O_1	X_1	O_2
Experimental	O_1	X_2	O_2

(O_1: Pre-Test, O_2: Post-Test, X_1: Treatment for the Control Group, X_2: Treatment for Experimental Group)

Targeting SSIII physics students, the target population consists of year 3 students from Nsukka Education Zone, Enugu State of Nigeria. Given that alternating current electricity is included in the SSIII curriculum, the choice of the SSIII students was deemed suitable for the investigation. Using multi-stage sampling methods taking into account computer amenities and gender balance, two co-educational institutions were chosen. For this study, one research instrument was used to gather data which was achievement test. The instruments included two sections, A and B. While B included 40 multiple-choice questions, Section A gathered bio-data of the respondents. Every question has four possibilities (A-D), one of which is the correct choice. For each of the pretest and post-test, included the same questions but arranged in different fonts and reordered. This is to get legitimate data, free of the effects of memory and familiarity, and correctly represent the participants' real learning or change in knowledge. AVACE are alternating current electricity film. The video was downloaded so that the students could view them. The individual creators of the animation videos granted clearance to use them. Lesson plans for control and experimental groups, respectively covered the topics of alternating current electricity to be taught and how they were to be delivered. In both the control and experimental classes, these two tools outlined the process of lesson delivery. For the experimental group and traditional teaching approaches for the control group, the instrument was purposely created to mirror computer animation.

RESULTS AND DISCUSSION

Research Question 1

Does the performance of year 3 physics students taught alternating current electricity using computer animation instructional approach differ from that of those taught alternating current electricity using traditional teaching approaches? The performance data collected on table 1 shows year three students taught alternating current electricity employing computer animation instructional technique and those taught alternating current electricity using the traditional teaching approach.

Table 2: Pre-Test and Post-Test Mean Scores for Experimental and Control Groups

Group	N	Pre-Test Mean	SD	Post-Test Mean	SD	Mean Gain	MD
Experimental	50	8.47	2.72	28.38	1.16	19.90	9.00
Control	70	7.34	2.40	18.25	1.57	10.90	

Table 2 indicates some difference in the achievement of senior school physics students in alternating current electricity with computer animation instruction as opposed to those taught with conventional methods. Students within the experimental group achieved a mean gain score of 19.90 while those in control group obtained 10.90. Significantly, there was a mean gain score difference of 9.00 whereby the experimental group had a higher mean gain score.

Hypothesis 1

The performance of year 3 physics students taught alternating current electricity using computer animation instructional approach alternately does not differ significantly from those taught using traditional teaching approaches.

Table 3: Summary of Analysis of Covariance of Significant Difference in the Performance of Experimental and Control Group

Source	SS	Df	MS	F	p-Value
Corrected Model	4553.225[a]	2	2276.613	1097.358	.000
Intercept	8999.579	1	8999.579	4337.920	.000
COVARIATES	1159.172	1	1159.172	558.737	.000
GROUPS	4112.487	1	4112.487	1982.275	.000
Error	360.986	117	2.075		
Total	41434.162	120			
Corrected Total	4914.211	119			

a. R Squared = .926 (Adjusted R Squared = .925)

Table 3 shows that the main effects of the group (computer animation instructional strategy vs conventional teaching method) are significant ($F_{(1,117)} = 1982.275$, $p < 0.05$, suggesting that there is indeed a significant difference in the performance of students in the experimental and control groups in the favour of the experimental group.

Research Question 2

Will differences exist in the performance of male and female students taught alternating current electricity using computer animation instructional strategy?

Table 4: Pre-Test and Post-Test Mean Scores for Male and Female Students in the Experimental Group

Group	N	Pre-Test Mean	SD	Post-Test Mean	SD	Mean Gain Score	Mean Difference
Male	22	8.96	2.19	28.30	0.95	19.31	0.40
Female	28	8.70	3.23	28.47	1.34	19.71	

From Table 3, it can be seen that there is a difference in the performance of male students and female students taught alternating current electricity using computer animation instructional strategy. The mean gain score of male students in the computer animation instructional strategy group is 19.31 while that of female students is 19.71, resulting in a mean difference of 0.40.

Hypothesis 2

There is no significant difference in the performance of male and female students taught alternating current electricity using computer animation instructional strategy.

Table 5: The t-test Analysis of the Performance of Male and Female Students in the Experimental Group

Group	No	Mean	S D	t-value	df	p-value
Male	22	19.32	2.18			
				0.633	48	0.527
Female	28	19.75	3.22			

p>0.05

The results of the t-test in Table 4 revealed that there is no significant difference in the performance of male and female students when both were taught using the CALS, $t(48) = 0.633$, $p > 0.05$. Therefore, the null hypothesis was rejected.

Discussion

Students taught alternating current electricity using Computer Animation Instructional Strategy (CAIS) showed markedly different performance than those taught using the Conventional Teaching Method (CTM). The average gain scores showed that CAIS group students exceeded those in the CTM group, therefore implying that CAIS could provide a more successful means of teaching difficult physics concepts. This resonates with results from Eguabor and Adeleke (2017), who similarly found notable gains in student performance when animated-based teaching techniques were employed in which Retention rates varied significantly; CAIS group students showed higher mean gain scores than CTM group members. This implies that CAIS helps to retain physics ideas beyond initial learning as well as enables first learning. These study results coincide with those of Ameen et al, 2023. Students exposed to multimedia courseware outperformed those taught using conventional.

Similarly, female students earned somewhat better mean gain scores in performance. Still, it's crucial to highlight that CAIS benefited both male and female students.

CONCLUSION

In essence, this research offers compelling data that CAIS (Computer Animation Instructional Strategy) improves the performance and retention of senior secondary students in alternate current electricity. The findings showed that students instructed using CAIS surpassed those taught with the Conventional Teaching Method (CTM) in retention level as well. Moreover, this research revealed that females improved a little more instantaneously with the CAIS. However, both male and female students gained from using the CAIS, therefore showing its effectiveness apart from gender. Furthermore, learners of varied levels of academic ability exhibited similar gains when instructed using CAIS, therefore demonstrating its versatility and effectiveness throughout various student bodies. These results highlight the potential of computer animation as a useful teaching instrument in physics education especially in areas like Nsukka Education Zone, Nigeria. Using CAIS in physics classes can help students become more engaged, understand more complex scientific ideas better, and retain more of that material over time, which would lead to better academic performance and scientific literacy among year 3 physics students. Following the results of this study, these suggestions are made: Curriculum designers and educational policymakers should include Computer Animation Instructional Strategy (CAIS) into physics syllabuses for Technical Colleges. Teachers stand to improve the learning environment and increase student mastery of alternating current electricity by integrating CAIS into lesson plans and instructional resources. To effectively apply CAIS in their classes, teachers must get extensive instruction and professional development opportunities. Through workshops, seminars, and online courses among other varied learning environments, instructors can obtain the necessary abilities and information to successfully apply computer animation tools, therefore creating a dynamic and interesting classroom environment for students. One has to make sure that within school, technology and digital resources are equally available. Enough computer systems and infrastructure will help CAIS to be seamlessly integrated into schools, hence giving all students, irrespective of socioeconomic level, chance to gain from improved learning experiences. Continuous assessment and evaluation of the effectiveness of CAIS application is absolutely essential. Regular evaluations should be conducted by educational authorities and school administrators to gauge physics student performance and retention. A complete grasp of the effect of CAIS on learning results will be made possible by use of a combination of quantitative and qualitative evaluation approaches.

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