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EFFECTS OF COMPUTER ANIMATION PACKAGE ON STUDENTS' LEARNING OUTCOME IN GEOGRAPHY IN SENIOR SECONDARY SCHOOLS IN OYO STATE, NIGERIA

Adetunmbi L. Akinyemi and Israel Oluwatobi Afolabi
Department of Science and Technology Education
University of Ibadan

ABSTRACT

The research investigated the effects of a computer animation package on students' academic achievement in Geography in senior secondary schools in Oyo State, Nigeria. The pretest-posttest control group quasi-experimental research design was adopted. The instruments employed for data collection were Geography Achievement Test (r = 0.72) and Technology Proficiency Questionnaire (r = 0.73). Three hypotheses were tested at 0.05 level of significance. Data were analysed using descriptive statistics, Analysis of Covariance, and Estimated Marginal Means. The results indicated that the treatment had a significant effect on students' achievement in Geography ($_F(1, 56) = 56.38$, $p < 0.05$, partial $\eta^2 = 0.50$). Also, technological proficiency significantly influenced students' Geography Achievement Test scores ($_F(1, 56) = 17.91$, $p < 0.05$, partial $\eta^2 = 0.39$). However, gender had no significant effect on students' achievement scores ($_F(1, 56) = 0.11$, $p > 0.05$, partial $\eta^2 = 0.00$). The findings demonstrate that incorporating instructional computer animation enhances the teaching and understanding of abstract concepts. It was recommended that educators and curriculum planners prioritise innovative strategies such as computer animation. Furthermore, students should receive training on leveraging technology for learning and actively engaging in lessons. Schools should also ensure the provision of adequate technological resources to boost students' proficiency and learning outcomes.

Keywords: Computer animation, Achievement in Geography, Technological proficiency.

Introduction

Geography as a school subject is vital in providing a solid knowledge-base about the environment, while developing positive attitudes and hands-on skills in preserving the beauty of it. It equips students with the ability to analyze spatial patterns, understand the interdependence of human and natural systems, and address pressing environmental challenges. Beyond fostering environmental literacy, Geography contributes to the intellectual development and personal growth of learners, opening pathways to diverse professions such as urban planning, environmental management, cartography, and climate science (Abidoye and Ogunniyi, 2012). Despite its significance, Geography often faces challenges in classroom delivery, particularly in topics that involve abstract concepts and complex processes such as hydrological cycles,

climate systems, and geomorphology. Traditional teaching methods, which rely heavily on rote learning and static visuals, often fail to engage students or stimulate their curiosity. Consequently, many students find the subject less appealing, leading to declining performance and interest.

In a similar vein, Liu et al. (2022) described Geography as a subject that empowers students with broad knowledge, enhancing their functionality and relevance in a rapidly evolving world. Recognised for being versatile, expressive, and intellectually stimulating, Geography transcends traditional boundaries of teaching and research. In recent years, its graduates have secured roles beyond academia in fields such as town planning, meteorology, journalism, climate change consultancy, surveying, environmental advocacy, and even engineering. The significance of Geography as a school subject cannot be over-emphasized because it is a subject that teaches the interaction of man with his physical environment. It is useful as a school subject that a potential student of tertiary institution can combine with others to pursue professional and academic disciplines. Its interdisciplinary nature can provide a holistic approach to teaching environmental education (EE) and Environmental Sustainable Development (ESD) as stipulated by UNESCO (2009). Extensive nationwide research has not been adequately carried out on students' views about geography, there is evidence that students appreciate the value of geography for everyday living, nevertheless, as an academic subject, geography lacks popularity among secondary school students (Okpala, 2015).

Despite the significance of geography to human development and societal progress, its teaching and learning are hindered by several challenges. Recent reports by the West African Examinations Council (WAEC) highlight the poor performance of students in geography at the Senior Secondary School Certificate Examination (WAEC Chief Examiners' report, 2021, 2022). The 2022 WAEC Chief Examiners report identifies key factors contributing to students' poor performance in geography, including inadequate demonstration of geographical knowledge, difficulties in understanding exam questions, lack of qualified teachers, insufficient preparation of students for examinations, and students' inability to cover the extensive syllabus content (WAEC, 2022).

However, over the years, student's performance in the subject in Nigeria has not been encouraging, and this menace is not unconnected to the insufficient number of geography teachers in schools and the old-fashioned lecture method of teaching, which is unexciting, unappealing and teacher-centred (Eze, 2021; Falode et al., 2016). These issues have been identified as significant contributors to the overall poor academic achievement observed in geography.

Recent studies have investigated various strategies to enhance students' academic achievement, with a particular focus on the effectiveness of computer animation in educational settings. Notably, Salas-Rueda (2022) conducted a study on the use of computer animation in teaching descriptive statistics, which revealed a significant improvement in students' achievement after utilizing this approach. Similarly, Oladimeji et al. (2021) examined the impact

of computer animation on students' learning outcomes in electrical installation and maintenance work in technical colleges in Niger state, Nigeria. Their findings showed a substantial difference in the achievement and retention of students who received instruction through computer animation video tutorials compared to those who received audio and text-based instruction in a computer animation classroom setting.

Furthermore, other studies have also explored the potential of computer animation to improve student learning outcomes. For instance, a study by Kim et al. (2022) investigated the effectiveness of computer animation in teaching geometry to high school students, and found that students who received computer animation instruction outperformed those who received traditional instruction. Additionally, a study by Patel et al. (2022) examined the use of computer animation in teaching programming concepts to college students, and found that students who received computer animation instruction showed improved understanding and retention of the material.

However, in spite of the ongoing innovations in pedagogy geared towards enhancing students' academic achievements, it has come to light that academic achievement among senior secondary school students remains low. Despite concerted efforts to implement various teaching strategies, a persistently low level of academic achievement persists. An alternative avenue worth exploring to ameliorate students' proficiency in the subject is the integration of computer animation as an instructional tool. The utilization of computer animation holds promise as a supplementary method to engage students and foster a more interactive and dynamic learning environment. By leveraging the visual and interactive aspects of computer animation, educators can potentially captivate students' interest and enhance their comprehension of complex concepts, ultimately contributing to improved academic outcomes in the subject. Therefore, while traditional teaching methodologies have been employed to address the issue, the incorporation of Information and Communication Technology emerges as a novel strategy that warrants further consideration in schools to elevate students' academic achievements in senior secondary education.

The use of Information and Communication Technology (ICT) tools such as computer has made the process of teaching and learning more enjoyable and interesting. Today, such tools provide both students and teachers with more opportunities in adapting learning and teaching to individual needs and the society at large (Mikre, 2011). Interestingly, the use of ICT in the classroom has proven to be effective in the teaching and learning of sciences (Owolabi, Babatunde and Gambari, 2019).

Integrating computers into the classroom will help to broaden and deepen the students' knowledge as well as to expose students' difficulties in conceptualization, and engage students actively in the learning process (Falode, Sobowale, Saliu, Usman and Falode, 2016). This is because it offers new, creative and the most engaging ways of teaching. Falode, et al., (2016); Bello, (2014); in separate studies submitted that the use of computer as instructional tool in science lesson has made the process of teaching and learning not only enjoyable,

interesting and more meaningful to the learner but also enables the learner acquire a wide range of skills in Information and Communication Technology.

The advent of information and communication technology especially the product aspect has influenced both the content as well as methods of teaching. The use of ICT provides an enabling environment through which different types of learners (visual, audio, kinaesthetic etc) learn. Most of the developed countries have exploited the potentials of ICT to transform their educational landscape at the tertiary, secondary and even primary school levels particularly the instructional process. Computer Animation is ICT based teaching and learning methods that has proven to aids students understanding of difficult concepts (Yisa and Ojiaku, 2016). In line with using technology to harness constructive learning experiences, one of the tools which can be used to achieve this is Animation.(Famaye et al., 2020). An integral part of ICT is Computer Animation which is an electronic device or object of instruction in a physical world of matter through a machine with moving objects of many characteristics (graphic, pictures, shape etc.) indicating action, reactions, skills results, product in learning process (Yisa and Ojiaku, 2016).

Computer Animations are techniques, which aim to provide the learner with a highly simplified reproducible part of a real or imaginary world. Animations are considered one of the most effective ways to promote deep conceptual understanding of the real world (Falode et al., 2016). Technology such as Computer Animation instructional packages makes teaching effective as learning is enhanced with images, video and sound. Computer animation, which is basically a form of pictorial presentation, has become the most prominent feature of technology-based learning environments. It refers to simulated motion pictures showing movement of drawn objects. Recently, educational computer animation has greatly increased since the advent of powerful graphics-oriented computers. Computer animation instructional packages are tools that have the capacity to improve quality learning. It seeks to arouse learners' interests, stimulates thinking and concretizes knowledge that could otherwise be explained in abstract terms (Bamidele and Yoade, 2017).

This aspect of multimedia learning supports student-centered strategy whereby learners take responsibility in learning process. Computer animation is a subset of computer program which literally connotes the animation of concepts that are abstract in nature. Bamidele and Yoade (2017) reported that computer animations have the potentials of increasing the probability that students will learn more, retain better and even improve students' performance of the skills students are expected to develop.

Computer animation instructional packages are learner-centered strategies and a learning environment in which when employed can promote interaction, interest and attentiveness etc. Yisa and Ojiaku (2016) studies shows that students who learn from computer animation have greater achievement and motivation. The studies also show that students retain information and the ability to sustain the learning process increases.

Owolabi and Oginni (2014) emphasized the use of computers for education purposes, which have become increasingly common. The application of dynamic visualization such as animation is potentially well suited for learning contents and is not easily affordable in classroom settings. Such teaching can be made real through multimedia in such a way that instruction would be simplified and appreciated (Owolabi and Oginni, 2014). Students' proficiency with technology could moderate the effectiveness of computer animation packages. Those who are more technologically skilled may benefit more from the use of such tools.

Technological proficiency influences the interaction between students' prior knowledge in geography and the use of computer animation packages. Students with higher technological proficiency may leverage these tools more effectively, potentially mitigating the impact of variations in prior knowledge on academic achievement. Moreno and Mayer's (2019) cognitive load theory underscore that students with higher technological proficiency may manage the cognitive demands of multimedia learning more effectively, potentially influencing the efficiency of information processing and, consequently, academic achievement.

Bolkan et al. (2017) suggest that students with higher technological proficiency may be more motivated by the interactive and dynamic nature of animated content, leading to a more positive impact on academic achievement compared to their less technologically proficient peers. Individual differences in motivation and engagement with the learning material could moderate the effects of computer animation. Highly motivated students might benefit more from interactive and visually stimulating content. The impact of technological proficiency on the interaction between students' prior knowledge in geography and the use of computer animation packages may be moderated by gender differences. Research has indicated that gender can play a role in technological proficiency, with studies suggesting varying levels of comfort and engagement with technology between male and female students.

Gender has been linked with the performance of students in several studies without any definite conclusion (Gambari, et al., 2014). Several studies have shown that gender is a pertinent issue in science subjects, and it is prominent among the factors identified as being responsible for learners' poor learning outcomes. Gender in science is the classification of the role of males and females (Nireti, et al., 2014). Some findings indicated that significant differences existed between the performance of male and female students while other findings showed that gender factor had no influence on students' performance (Yusuf and Afolabi 2010). For instance, Okwuduba, et al. (2018) reported that there was no significant difference in students' achievement due to gender. Therefore, this study aimed at investigating the effects of Computer Animation on students learning outcome in Geography in senior secondary schools.

According to the findings of Aksoy (2012), who examined the effect of animation technique on the 7th Grade Science and Technology Course, it was reported that animation technique is more effective than traditional teaching methods in terms of

enhancing students' achievement. Also, Dziedzic, Barszcz, Paśnikowska-Łukaszuk and Jankowska (2015), in discussing the role of computer animation in teaching technical subjects, found out that in the teaching process, computer animation has a positive effect on memorization of knowledge by students. Use of computer animations together with teaching methods and techniques and having the students actively participate in the process ensure the provision of effective and efficient education (Daşdemir and Doymuş, 2012; Karaçöp, 2010). Therefore, this study aimed at investigating the effects of Computer Animation on students learning outcome in Geography in senior secondary schools.

Hypotheses

i. There is no significant effect of computer animation package on students' academic achievement in geography

ii. There is no significant effect of technological proficiency on students' use of computer animation package in learning geography

iii. There is no significant effect of gender on student achievement in geography

Methodology

This study utilised the pretest-posttest control group quasi-experimental design to examine the impact of a computer animation package on senior secondary school students' learning outcomes in Geography. The participants were 69 students from two co-educational schools, selected through purposive sampling. The participants were randomly assigned to either an experimental group, which received Geography instruction enhanced with computer animations, or a control group, which was taught using traditional methods. Data collection involved administering two instruments: the Geography Achievement Test, which measured academic performance, and the Technology Proficiency Questionnaire, which assessed students' technological skills. The reliability coefficients for these instruments were 0.72 for the Geography Achievement Test and 0.73 for the Technology Proficiency Questionnaire, indicating acceptable reliability. The data analysis employed descriptive statistics, Analysis of Covariance and interaction effects assessment to determine the effect of the intervention on students' learning outcomes.

RESULTS

Table 1

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	502.337[a]	12	41.861	25.422	0.000	0.845
Intercept	507.838	1	507.838	308.402	0.000	0.846
Pretest	10.032	1	10.032	6.092	0.017	0.098
Treatment	92.833	1	92.833	56.376	*0.000	0.502
Gender	.183	1	.183	.111	0.740	0.002
Proficiency	58.982	2	29.491	17.909	*0.000	0.390
Treatment * Gender	.013	1	.013	.008	0.929	0.000
Treatment * Proficiency	130.145	2	65.073	39.518	*0.000	0.585
Gender * Proficiency	9.392	2	4.696	2.852	0.066	0.092

Treatment * Gender * Proficiency	5.195	2	2.598	1.577	0.216	0.053
Error	92.214	56	1.647			
Total	13840.000	69				
Corrected Total	594.551	68				

Table 1 revealed that there is significant main effect of treatment (Computer animation package) on students' Geography Achievement Test scores in ($F_{(1;56)} = 56.38$; $P< 0.05$, partial $\eta^2 = 0.50$). The effect size is 50%. This indicates that 50% of the variation in students' achievement is as a result of the significant main effect of the treatment. Thus, hypothesis 1 was rejected. In order to determine the magnitude of the significant main effect across treatment groups, the estimated marginal means of the treatment groups was calculated and the result was presented in Table 2.

Table 2: Estimated Marginal Means for Post-test by Treatment (Control and Experimental group)

			95% Confidence Interval	
Treatment	Mean	Std. Error	Lower Bound	Upper Bound
Control (Conventional Strategy)	12.045	.260	11.524	12.565
Experimental (Computer Animation package)	14.990	.253	14.484	15.496

Table 2 revealed that the students in Experimental group (Computer Animation package) had the highest adjusted post-Geography Achievement Test mean score (14.99), while the Control group (Convention Strategy) had the least adjusted post- Geography Achievement Test mean scores (12.05).

Hypothesis 2: There is no significant effect of technological proficiency on students' achievement in Geography

Table 1 also revealed that there is significant effect of technological proficiency on students' Geography Achievement Test scores in ($F_{(1;56)} = 17.91$; $P< 0.05$, partial $\eta^2 = 0.39$). The effect size is 39%. This indicates that 39% of the variation in students' achievement is as a result of the significant main effect of students' technological proficiency. Thus, hypothesis 2 was rejected. In order to determine the magnitude of the significant main effect across the groups, the estimated marginal means of the proficiency groups (high, medium, low) was calculated and the result was presented in Table 2

Table 3: Estimated Marginal Means for Post-Achievement by Technological proficiency

			95% Confidence Interval	
Technological Proficiency	Mean	Std. Error	Lower Bound	Upper Bound
High	14.231	.292	13.647	14.815
Medium	14.210	.289	13.631	14.790
Low	12.110	.285	11.539	12.682

Table 3 revealed that the students with a high level of technological proficiency had the highest adjusted post-achievement mean score (14.23) while students with a medium level had (14.21) and students with a low level of technological proficiency had the least post achievement mean score of (12.11). Therefore, there is a significant effect of technological proficiency on students' academic achievements in geography.

Table 4: Estimated Marginal Means of Treatment and Proficiency on Students' post Achievement score

	Technological			95% Confidence Interval	
Treatment	Proficiency	Mean	Std. Error	Lower Bound	Upper Bound
Control	High	10.686	.494	9.696	11.675
	Medium	13.773	.444	12.883	14.663
	Low	11.676	.321	11.032	12.320
Experimental	High	17.777	.325	17.126	18.427
	Medium	14.648	.446	13.755	15.542
	Low	12.545	.475	11.594	13.496

From Table 4, it can be deduced that the higher the level of technological proficiency in the experimental groups, the higher the mean scores. Students with a low level of proficiency in the experimental group have a mean score of (12.55), students with the medium level have a higher mean score of (14.65) and students with the high level have the highest mean score of (17.77). While in the Control group, student with the medium level of proficiency have the highest mean score of (13.77), followed by students with the low level (11.68) and students with the high level of proficiency have the lowest mean score of (10.68). The interaction is ordinal. In order to disentangle the interaction effect, figure 1 presents the interaction in line graph

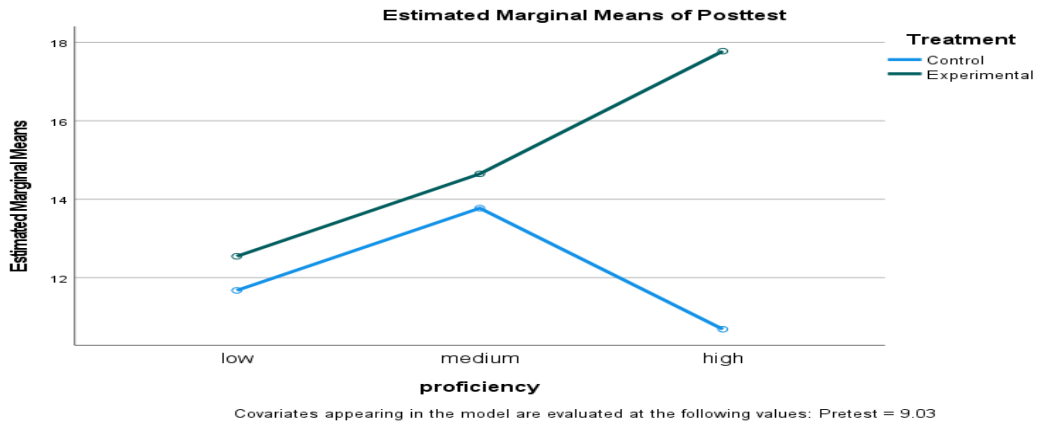


Fig 1 Interaction In-line graph of treatment and Technological proficiency on students' academic achievement in Geography

Fig.1 revealed that the interaction is ordinal; this implies that the students with higher level of technological proficiency performed better only in the experimental group. The implication of this is that the level of proficiency favours the experimental group than the control group.

Hypothesis 3: There is no significant effect of gender on students' achievement in Geography

Table 1 shows that there is no significant effect of gender on students' Geography Achievement Test Scores ($F_{(1;56)} = 0.11$, $p>.05$, partial $\eta^2 = 0.00$). The effect size is 0%, this means that gender has no significant effect on the mean post Achievement Test scores of students in Geography. Thus, hypothesis 3 was not rejected.

Discussion

The findings of the study revealed significant differences in the achievement scores of students in the experimental and control group. Students exposed to computer animation had higher achievement scores than students in the control group. The findings showed that the experimental strategy (using computer animation package) is more effective than the conventional teaching strategy in improving students' academic achievement in Geography. The integration of computer animation has positive effects on student engagement, comprehension, cooperative learning, inquiry-based learning, and teacher-student interaction. which therefore shows in the academic performances. The result is in support of the findings of (Wang et al., 2023; Zhang et al., 2023; Li et al., 2022 and Famaye et al., 2020), who reported that consistent evidence supporting the positive and significant effects of computer animation on student engagement, learning retention, and academic achievement. It was found that computer animation significantly increased students' interest and understanding of complex geological processes, leading to improved academic performance. Their results also showed that students who participate in these activities demonstrate

higher critical thinking skills, problem-solving skills, and conceptual understanding.

The result of the findings proves that using Computer animation provides teachers with visual tools to explain complex concepts and promotes more meaningful interactions with students. It can also facilitate group discussions, as students can view and discuss animated simulations together, thus increasing the level of cooperation and knowledge building.

The study is also in support of Chen et al. (2020). Their study showed that students who were exposed to computer animations depicting complex scientific phenomena showed a better ability to understand and visualize these phenomena compared to traditional static images. This indicates that Computer animation in science classrooms can improve students' understanding and visualization of abstract science concepts. From the findings of this study, it can therefore be concluded that the use of instructional strategies such as computer animation which actively involve the learners and engages them can be used to improve the academic achievements of students in Geography.

Also, the findings of the study revealed significant effect of technological proficiency on the achievement scores of students in geography. The findings showed that the level of technological proficiency had a positive influence on the academic achievement of students in geography while making use of computer animation package. This supports the findings of (Bolkan et al., 2017; Ertmer et al., 2015). These studies showed that higher levels of technological proficiency corresponded to increased performance. Students with higher technological proficiency may be more motivated by the interactive and dynamic nature of animated content, leading to a more positive impact on academic achievement compared to their less technologically proficient peers.

The findings of the study revealed no significant interaction effect between treatment and gender on students' academic achievements in Geography. This indicates that the use of computer animation as an instructional tool does not affect male and female students differently. Consequently, educators can confidently integrate computer animation into their teaching strategies, knowing it is equally effective for all students, regardless of gender (Adegoke, 2022).

Conclusion

The results of the study have shown that instructional computer animation is more effective in enhancing students' level of achievement in Geography than the conventional method. Based on the result of the study, the incorporation of instructional computer animation will ensure that abstract concept is well taught and understood. Computer animation makes learning more interesting and brings geography from an abstract world to what the student can visualize properly and be able to identify with, it also facilitates group discussions, as students can view and discuss animated simulations together, thus increasing the level of cooperation and knowledge building. The integration of computer animation has positive effects on student engagement, comprehension, cooperative learning, inquiry-based learning, and teacher-student interaction.

Recommendations

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

1. Teachers taking Geography in secondary schools should adopt this instructional delivery method in teaching Geography.
2. To achieve the above, seminars and workshops should be organized by the school management to train teachers on the use of instructional computer animation.
3. Curriculum planners and developers for Geography in secondary school in Nigeria should emphasize the need to continuously use innovative strategies such as instructional computer animation
4. Students should be trained on the use of technologies for learning and they should be actively involved whenever this strategy (computer animation) is used.
5. Adequate and good technological facilities and equipment should be provided and made available in schools to improve students level of technological proficiency.

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