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Effect of Animation Package on Academic Performance of Secondary School Biology Students towards Ecological Concepts in Kaduna South, Nigeria

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Abstract

This study entitled, Effect of Animation Package on Academic Performance of Secondary School Biology Students towards Ecological Concepts in Kaduna South, Nigeria was guided with four research questions and four corresponding research hypotheses. The study employed a quasi-experimental research design, specifically utilizing a pre-test post-test non-equivalent control group experimental design, given the use of intact classes. The study population comprised 699 SS II Biology students from Government Secondary Schools in Kaduna South LGA, with a sample size of 212 students randomly selected from two schools and an additional 150 students purposively selected from two other schools. Assessment of students' performance was conducted after they received instruction using both an animation package and conventional teaching methods. The assessment instrument used was the Ecology Performance and Retention Test (EPRT), comprising 30 items with response options A, B, C, and D, each item allocated 2 marks, resulting in a total score of 60. Validation of the EPRT was performed by two senior lecturers from Federal College of Education, Zaria, experienced in educational test and measurement. The reliability of the EPRT was assessed using the test-retest technique, yielding a reliability coefficient of 0.79 using Kuder-Richardson Formula 20. Data analysis was carried out using mean and t-test at a significance level of 0.05. The findings revealed differences in the mean performance scores of students taught ecology concepts using animation package and those taught without, as well as differences in the mean retention scores of students taught Biology concepts using animation package and those taught without it. Additionally, there were differences in the mean performance scores of male and female students taught ecology concepts using animation package, while no significant difference was observed in the mean retention scores of male and female students taught biology concepts with the use of animation package. Based on these findings, the study recommends that educational institutions prioritize the integration of animation packages into biology curricula to enhance student learning outcomes, among other suggestions.

Keywords: Animation Package, Academic Performance, Ecological Concepts, Kaduna South, Nigeria.

Introduction

As the primary means by which people obtain the knowledge and skills necessary for both individual and group growth, education is the cornerstone of society progress (UNESCO, 2015). As part of the larger educational framework, science education plays a crucial role in developing students' scientific literacy and critical thinking abilities, which equips them to

take on and solve complex real-world problems (Hofstein & Lunetta, 2004). Within the field of science, biology is a fundamental study that focuses on investigating the complexities of living organisms and their interactions with their surroundings. The study of ecology, which examines the intricate interactions between living things and their environments, is central to biology education. Ecological studies provide light on the delicate balance that keeps life on our planet alive by addressing a wide range of subjects, such as ecosystems, biodiversity, and conservation initiatives (Tomanek & Montplaisir, 2004).

With cutting-edge resources to improve comprehension and student engagement, the incorporation of technology into educational environments has revolutionised teaching and learning methodologies in recent years. Specifically, animation packages have become adaptable digital learning tools that can successfully convey difficult scientific ideas (Wu et al., 2020). Animation packages give students immersive learning experiences that help them understand and remember scientific concepts by utilising dynamic visual representations (Ainsworth & Loizou, 2013). Animation packages facilitate better learning and conceptual clarity by providing students with opportunity to explore complex concepts in a concrete and approachable way through interactive images and simulations (Beetham & Sharpe, 2013). Additionally, studies indicate that animation packages might boost students' enthusiasm and engagement, which would improve their overall learning results (Akçayır & Akçayır, 2018). Animation packages can enhance academic performance and information acquisition by drawing students in and encouraging active engagement in the learning process by using the captivating qualities of multimedia content (Mayer, 2019).

Students' academic achievement is a key determinant of both educational quality and learning efficacy (OECD, 2013). Beyond merely mastering content, academic achievement includes critical thinking, problem-solving techniques, and the application of knowledge in practical settings (Kizilcec et al., 2017). Within the field of biology education, a student's academic performance in relation to ecological concepts is a comprehensive evaluation of their comprehension of ecological principles, their capacity to analyse intricate ecological phenomena, and their ability to suggest workable solutions to environmental problems. Academic performance is important as a gauge of how effective education is, according to research by the OECD (2013), which also highlights how important it is for assessing students' cognitive capacities and higher-order thinking abilities. Furthermore, Kizilcec et al. (2017) stress the significance of evaluating students' critical thinking and problem-solving abilities because these proficiencies are necessary for success in both academic and professional settings. Academic performance with regard to ecological concepts in the context of biology education offers insights into students' understanding of ecological principles, their capacity to apply scientific knowledge to environmental issues, and their aptitude for formulating solutions to ecological challenges.

Additionally, research conducted by Saldaña et al. (2016) and Loureiro et al. (2020) highlights the significance of ecological literacy in promoting sustainability and environmental stewardship. Students' ecological literacy is gauged by how well they do academically in relation to ecological ideas. This includes how well they comprehend

ecosystem dynamics, biodiversity conservation, and the relationship between human activity and the natural environment. Teachers can determine how well-prepared their pupils are to deal with current environmental concerns and support sustainable development initiatives by evaluating their understanding of ecological principles. In the context of biology education, students' comprehension, analytical capabilities, and problem-solving abilities are all included in the comprehensive construct of academic performance towards ecological topics. Teachers can learn more about their students' ecological literacy and readiness to deal with environmental concerns in a meaningful and informed way by assessing their performance in this area.
In light of this, examining the impact of animation packages on students' academic achievement with regard to ecological concepts is an important field of study in science education research. Through the analysis of animation packages' effects on learning outcomes for students, such as understanding, involvement, and recall of ecological concepts, researchers and educators can obtain important knowledge about how well technologically enhanced learning resources support students' development of scientific literacy and environmental consciousness. This research aims to expand our knowledge of the possible advantages and restrictions of animation packages in influencing students' academic performance in biology instruction through empirical investigations and meticulous analysis. In the end, this research offers implications for curriculum creation, educational policy, and instructional practice that will improve the processes of teaching and learning in science education.

Statement of the Problem

The study's main issue is whether or not animation programmes may help secondary school biology students in Kaduna South, Nigeria, perform better academically when it comes to ecological concepts. There is little empirical data about the effects of technology on student learning outcomes in the particular context of biology education and ecological ideas, even though technology is being used in education more and more, especially when it comes to the usage of animation packages as teaching aids. Because of this knowledge gap, it is necessary to find out whether using animation packages improves students' comprehension, recall, and application of ecological concepts, which in turn affects their academic performance in secondary school biology. To better inform evidence-based initiatives for enhancing scientific education in the area, the project also aims to investigate any potential obstacles or hurdles to the successful application of animation packages in the educational context of Kaduna South, Nigeria.

Objectives

Objective of the study are to;

i. Examine the effect of animation package on the academic performance of students taught ecology in Kaduna South.

ii. Investigate the effect of the use of animation package on the retention ability of students taught ecology in Kaduna South.
iii. Find out the gender-related effect of animation package on academic performance of biology students in Kaduna South.
iv. Determine the gender-related effect of animation package and retention ability among Biology students in Kaduna South.

Research Questions

The following questions guided the study:

i. What is the effect of animation package on the academic performance of students taught ecology in Kaduna South?
ii. What is the effect of the use of animation package on the retention ability of students taught ecology in Kaduna South?
iii. What is the gender-related effect of animation package on academic performance of biology students in Kaduna South?
iv. What is the gender-related effect of animation package and retention ability among Biology students in Kaduna South?

Research Hypotheses

Ho_1: There is no significant difference in the mean performance scores of students taught ecology concepts using animation package and those taught without.

Ho_2: There is no significant difference in the mean retention scores of students taught Biology concepts using animation package and those taught same concepts without the package.

Ho_3: There is no significant difference in the mean performance scores of male and female students taught ecology concepts using animation package.

Ho_4: There is no significant difference in the mean retention scores of male and female students taught biology concepts with the use of animation package.

Methodology

The research design employed in this study was quasi-experimental, specifically utilizing a pre-test post-test non-equivalent control group experimental design due to the use of intact classes. The study population consisted of 699 SS II Biology students from Government Secondary Schools in Kaduna South LGA, with a sample size of 212 students randomly selected from two schools and an additional 150 students purposively selected from two other schools. Assessment of students' performance was conducted after they received instruction using both an animation package and conventional teaching methods. The assessment instrument used was the Ecology Performance and Retention Test (EPRT), comprising 30 items with response options A, B, C, and D, each item allocated 2 marks, resulting in a total score of 60. Validation of the EPRT was performed by two senior lecturers from Federal College of Education, Zaria, experienced in educational test and

measurement. The reliability of the EPRT was assessed using the test-retest technique, yielding a reliability coefficient of 0.79 using Kuder-Richardson Formula 20. Data analysis was carried out using mean and t-test at a significance level of 0.05.

Results

Research Questions One: What is the effect of animation package on the academic performance of students taught ecology in Kaduna South?

Table 1: Students' difference in academic performance scores of students taught ecology using animation package and those taught without.

Group	Pre-test			Post-test		
	N	Mean	St. Dvt	N	Mean	St. Dvt.
Control	75	37.21	11.86	75	41.2	11.72
Experimental	75	36.32	11.90	75	52.4	9.90

Table 1 displays the computed mean scores for students' performance in the two groups based on the pre and posttest assessments. The results indicate that there was little disparity in students' performance on the pre-test, with no significant difference between the groups, suggesting that the test items were equally suitable for both. However, on the post-test, the experimental group exhibited a higher mean score of 52.4 with a standard deviation of 9.90, while the control group had a mean score of 41.2 with a standard deviation of 11.72. This discrepancy suggests that the experimental group outperformed the control group on the post-test, indicating a significant improvement in performance following the intervention. This improvement in the experimental group's performance may be attributed to the utilization of the animation package in the teaching of Biology, highlighting its potential efficacy as an instructional tool.

Research Question Two: What is the effect of the use of animation package on the retention ability of students taught ecology in Kaduna South?

Table 2: The mean scores of students for retention in experimental and control groups

Study Groups	N	Mean	Std. Dev	Mean Difference
Experimental	75	33.02	5.46	
				9.74
Control	75	23.28	3.75	

The findings presented in Table 2 indicate a significant difference in the mean retention scores of students who were taught using an animation package compared to those who were taught without it. Specifically, the mean retention score for students exposed to the animation package was 33.02, while for those exposed to conventional teaching methods,

it was 23.28, resulting in a mean difference of 9.74 between the two groups in favor of the experimental group. This suggests that students who were exposed to the animation package retained the ecological concepts taught to them more effectively compared to their counterparts in the control group who were taught without the animation package.

Research Questions Three: What is the gender-related effect of animation package on academic performance of biology students in Kaduna South?

Table 3: Difference between effect of animation package on academic performance of male and female Biology students in Kaduna State

Option	N	Mean	St. dev
Male	35	43.7	10.01
Female	40	35.7	9.32

The data presented in Table 3 illustrates the mean performance scores of students based on gender. It indicates that male students achieved a mean performance score of 43.7 with a standard deviation of 10.01, whereas female students attained a mean performance score of 35.7 with a standard deviation of 9.32. These findings suggest that male students outperformed their female counterparts in terms of academic performance.

Research Questions Four: What is the gender-related effect of animation package and retention ability among Biology students in Kaduna South?

Table 4: The mean scores of male and female biology students' performances in the experimental group

Study Groups	N	Mean	Std. Dev	Mean Difference
Male	35	29.90	5.25	
				0.45
Female	40	30.35	5.62	

The descriptive statistics presented in Table 4 highlight a distinction in the mean scores of male and female students who were exposed to teaching with animation package. Specifically, the mean scores for male and female students using the instructional material are 29.90 and 30.35, respectively, resulting in a mean difference of 0.45 between them. This marginal mean difference of 0.45 between male and female students suggests that the impact of teaching with the animation package on the academic achievement of both genders is nearly equivalent.

Hypotheses Testing

Ho_1: There is no significant difference in the mean performance scores of students taught ecology concepts using animation package and those taught without.

Table 5: Summary of t-test analysis of mean academic performance of experimental and control groups

Study Groups	N	Mean	Std	Df	Tcal	T value	P value	Remark
Experimental	75	52.82	11.22					
				191	2.721	2.021	0.001	Sig.
Control	75	40.7	9.61					

Significant at P ≤0.05

The findings presented in Table 5, derived from the independent samples t-test analysis, reveal a significant p-value of 0.001, which falls below the predetermined threshold of p ≤ 0.05 for hypothesis acceptance or rejection. This result indicates a notable difference in the mean academic performance of students who were exposed to teaching with the animation package compared to those instructed without it. Consequently, the hypothesis asserting no significant difference in the mean performance scores of students taught ecology concepts using the animation package versus those taught without it is rejected in favor of the experimental group.

Ho_2: There is no significant difference in the mean retention scores of students taught Biology concepts using animation package and those taught same concepts without the package.

Table 6: Summary of t-test Analysis on Difference in the Performance scores between Male and Female Students Exposed to teaching with Animation Package

Gender	N	Mean	Std	Df	Tcal	T value	P value	Remark
Male	35	43.7	10.01					
				121	2.73	2.064	0.01	Sig.
Female	40	35.7	9.23					

Significant at P ≤ 0,05

In Table 6, the calculated t-value of 2.73 exceeds the p-value of 0.01. This outcome signifies a statistically significant difference in the performance of male and female students exposed to the animation package. Consequently, the hypothesis positing no significant difference in the mean retention scores of students taught Biology concepts using the animation package compared to those instructed without it is rejected.

Ho_3: There is no significant difference in the mean performance scores of male and female students taught ecology concepts using animation package.

Table 7: Summary of t-test analysis of mean retention scores of experimental and control groups

Study Groups	N	Mean	Std. Dev	df	t-cal	P	Decision
Experimental	75	33.02	5.46				
				216	12.46	0.00	Significant
Control	75	23.28	3.75				

Significant at P ≤ 0.05

In Table 7, the independent samples t-test yielded a p-value of 0.00, which is below the threshold of 0.05 typically used for hypothesis acceptance or rejection. This finding indicates a significant difference in the mean retention ability of students exposed to teaching with improvised instructional material compared to those taught without instructional material. Consequently, the hypothesis suggesting no significant difference in the mean performance scores of male and female students taught ecology concepts using the animation package is rejected in favor of students in the experimental group.

Ho_4: There is no significant difference in the mean retention scores of male and female students taught biology concepts with the use of animation package.

Table 8: Summary of t-test statistics on difference in the mean retention scores of male and female students when exposed to animation package

Study Groups	N	Mean	Std. Dev	Df	t-cal	p	Decision
Male	35	29.90	5.25				
				159	0.52	0.60	Not Sig.
Female	40	30.35	5.62				

Not significant at P ≥ 0.05

The summary of the independent samples t-test presented in Table 8 reveals a p-value of 0.64, exceeding the predetermined significance level of 0.05. This outcome suggests that there is no significant difference in the mean retention scores of male and female students exposed to the animation package. Consequently, the hypothesis asserting no significant difference in the mean retention scores of male and female students taught biology concepts with the use of the animation package is upheld. This indicates that both male and female students retain the concepts taught from the treatment, underscoring the animation package's gender-neutral efficacy.

Discussion of Findings

The findings of the study reveal several significant differences in the academic performance and retention scores of students taught ecology concepts using animation packages compared to those taught without. Firstly, there is a significant difference in the mean performance scores between students taught with animation packages and those taught without. This suggests that the use of animation packages positively influences students' academic performance in ecology concepts, aligning with research by Wu et al. (2020) and Ainsworth & Loizou (2013), which emphasize the effectiveness of dynamic visual representations in enhancing comprehension and retention of scientific knowledge. Similarly, the significant difference in the mean retention scores supports the notion that animation packages contribute to better retention of biology concepts among students, as demonstrated by the study.

Moreover, the findings indicate a significant difference in the mean performance scores of male and female students taught ecology concepts using animation packages. This suggests that the impact of animation packages on academic performance may vary based on gender. While this finding may seem surprising, it aligns with research by Ajiboye and Oluwabukola (2020), who emphasize the need for nuanced teaching approaches to address gender differences in learning outcomes. However, further research may be needed to explore the underlying factors contributing to these gender differences in the effectiveness of animation packages.

Conversely, the study finds no significant difference in the mean retention scores between male and female students taught biology concepts with the use of animation packages. This finding contradicts the previous result and suggests that gender may not play a significant role in the retention of biology concepts when utilizing animation packages. However, it is essential to interpret this result cautiously and consider potential limitations of the study design, such as sample size or instructional variations.

Finally, the findings highlight the significant effect of animation packages on students' academic performance and retention of ecology concepts. While gender differences in the effectiveness of animation packages were observed in terms of academic performance, no such differences were found concerning retention scores. These findings contribute to the existing body of literature on technology-enhanced learning and underscore the importance of considering gender-specific instructional strategies in science education. Further research is warranted to explore the underlying mechanisms driving these observed differences and to inform evidence-based instructional practices tailored to diverse student populations.

Conclusion

The findings of this study underscore the significant impact of animation packages on students' academic performance and retention of ecology concepts in biology education. The use of animation packages resulted in notable improvements in both performance and retention scores, highlighting their effectiveness as a pedagogical tool for enhancing

learning outcomes. While gender differences were observed in the effectiveness of animation packages on academic performance, no such disparities were found concerning retention scores. These findings emphasize the importance of integrating technology-enhanced learning tools like animation packages into science education to promote student engagement, comprehension, and retention. Moving forward, educators should consider gender-specific instructional strategies and continue to explore innovative approaches to foster inclusive and effective learning environments in biology education. By leveraging the potential of animation packages and adapting instructional practices to meet the diverse needs of students, we can cultivate a more vibrant and enriching learning experience that empowers students to thrive in their academic pursuits and beyond.

Recommendations

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

1. Educational institutions should prioritize the integration of animation packages into biology curricula to enhance student learning outcomes.
2. Teachers should adopt gender-inclusive instructional strategies when implementing animation packages in the classroom.
3. Teachers and instructional designers should engage in ongoing professional development to effectively utilize animation packages in biology education.
4. Government and educational stakeholders should conduct continuous evaluation and assessment of the implementation of animation packages in biology education.

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