

Computer-Animation on NCE Students' Academic Performance in Vertebrate Anatomy and Physiology in Colleges of Education

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Abstrak

Kemampuan mahasiswa yang kurang menyebabkan siswa kesulitan dalam memahami beberapa konsep Biologi. Selain itu, waktu yang diberikan untuk praktikum biologi juga masih terbatas. Tujuan penelitian ini yaitu menganalisis perbedaan performa mahasiswa Biologi ketika diajarkan VAP menggunakan paket animasi dan metode ceramah. Penelitian ini mengadopsi desain quasi-experimental. Populasi pada penelitian ini yaitu 60 siswa Biologi. Metode yang digunakan data mengumpulkan data yaitu observasi, kuesioner dan tes. Instrumen yang digunakan dalam mengumpulkan data yaitu kuesioner dan lembar soal. Teknik yang digunakan untuk menganalisis data yaitu analisis statistik inferensial. Hasil penelitian yaitu terdapat perbedaan yang signifikan antara kinerja siswa Biologi ketika diajarkan VAP menggunakan paket animasi dan metode ceramah mendukung kelompok eksperimen. Dengan demikian, penelitian ini menyimpulkan bahwa strategi animasi meningkatkan kinerja siswa Biologi di VAP. Implikasinya adalah bahwa strategi pembelajaran memainkan peran positif dalam pengajaran dan pembelajaran Biologi di perguruan tinggi pendidikan. Studi tersebut merekomendasikan agar dosen Biologi perguruan tinggi pendidikan harus didorong untuk memasukkan paket animasi ke dalam pengajaran Biologi.

Kata kunci: Animasi Komputer, Anatomi, Fisiologi Vertebrata, Prestasi

Abstract

The low ability of students causes students to have difficulty understanding some Biology concepts. In addition, the time given for biology practicum is still limited. The purpose of this study was to analyze the differences in biology students' performance when taught VAP using animation packages and lecture methods. This study adopts a quasi-experimental design. The population in this study was 60 Biology students. The method used to collect data is observation, questionnaires, and tests. The instruments used in collecting data were questionnaires and question sheets. The technique used to analyze the information is inferential statistical analysis. The study results showed a significant difference between the performance of Biology students when taught VAP using the animation package and the lecture method supporting the experimental group. Thus, this research concludes that the animation strategy improves Biology students' performance in VAP. The implication is that learning strategies play a positive role in the teaching and learning of Biology in higher education institutions. The study recommends that higher education Biology lecturers be encouraged to incorporate animation packages into Biology teaching.

Keywords: Computer Animation, Anatomy, Vertebrate Physiology, Achievement

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1. INTRODUCTION

Animation is the manipulation of electronic illustration to create an illusion of moving images with the assistance of computer. Animation is a rapid display of images to create an illusion of movement using computer device (Badmus, 2022; Yisa & Chika, 2016). Research in educational technology revealed that when learning is associated fun, students tend to understand better. This has scientifically proven that retention of information is higher when it is communicated using both visual and verbal communication (Adegoke, 2010; Suwarti et al., 2019; Winarto et al., 2020). The combination of illustration, caption, narration and even sound give an animation a unique status in advancing the level of education. The use of

animated media for instruction can significantly enhance students' learning if properly planned and executed (Fatimah & Santiana, 2017; Hapsari et al., 2019). Thus, computer animation is among the training media that offers diverse opportunities for accomplishing the educational needs of modern learners (Ahmed & Inti, 2021; Franklin et al., 2011; Werdiningsih et al., 2019). It is a gorgeous learning resource that attracts students' attention, engages and sustains their motivational status towards learning in school.

The use of animated video is paramount in Nigerian technical colleges and government should make effort in advancing research and development in the teaching and learning. Visual arts in the classroom and use of animated videos for teaching various concepts in visual arts theory and practical should be incorporated into the technical college and other vocational education curriculum. In relation to this assertion, posited that there are tremendous creative potentials of computer animation activities into school curriculum which assists in attaining the range of educational objectives in a specific level of education (Badmus, 2022; Rahayu et al., 2021). Base on previous study animations have been used in the school curricula and in the teaching of science subjects in particular to assist students understanding of complex scientific concepts (Akpinar & Ergin, 2008). The ability to animate the physical science subjects could help improve students' learning and facilitate better understanding of most of the science concepts.

Several researches had been conducted in relation to application of computer-animation into the teaching-learning Biology. However, the most closely related study to the present work were previous study who investigated the effects of animation and static cartoons on content retention in teaching cellular transport, protein synthesis and mitosis as concepts in Biology (Elangovan, 2018). Findings of this study showed an overwhelming interest in continued utilization of computer animation as a medium of instruction. Other study also examined the effects of computer-animations on high school students' performance and engagement in Biology (Rahayu et al., 2021). Their findings revealed that computer animations accompanied with traditional teaching increases the performance of high school Biology students and should be recommended to aid the teaching of biological concepts. However, the two studies focused on animation applications and their implication on students' academic performance. But none of the studies focused on its implication on college of education students' performance in vertebrate anatomy and physiology, which is the focus of this research.

Base on observation there is found students' learning difficulties in understanding certain Biology concepts and possible reasons behind these difficulties. Constitute difficulty in understanding the concepts in vertebrate anatomy and physiology asserts that the concepts involved memorization and lots of abstract thinking (Abimbola & Abidoeye, 2013; Yusuf & Afolabi, 2010). This is because students were not able to link biological concepts to real life situations. In support of this view, previous study claims that students' poor performance in Biology is due to the fact that Biology classes are too large and vary in term of ability levels (Yusuf & Afolabi, 2010). Moreover other study suggested that if vertebrate anatomy and physiology would be taught using relevant instructional media, students' success and overall understanding would not be judged on how well they memorize, rather demonstration and manipulation would be given high degree of preference (Chidimma, 2011; Damayanti et al., 2021). Teaching vertebrate anatomy and physiology involves a variety of learning tasks, such as exploration of themes and concepts in the laboratory and lecture for experimentation. Even though, students are not the same in terms of their ability to comprehend certain Biological concepts in school, but the actualization of instructional strategies will help improve students' learning and enhance academic performance positively (Ahmed & Inti, 2021; Ali et al., 2013; Owusu et al., 2010).

However, one observation that affects students' academic performance in Biology is the abstract and complex nature of some of the Biology concepts (Usman, 2010). Therefore, vertebrate anatomy and physiology is a complicated biological concept that requires the use of appropriate instructional methods and materials as these could enhance students' academic performance. There is convincing evidence that students' academic performance is affected by instructional media integration when it's come to the teaching and learning science subjects (Tekkaya et al., 2001; Usman, 2010; Yisa & Chika, 2016). Studies on Biology students' academic performance in the instructional process have been carried out with different instructional methods. For instance, previous study investigated the effects of cognitive constructivist model approach on students' performance in Biology (Galadima & Agbo, 2014). Their findings revealed that students exposed to treatment performed significantly higher than those exposed to lecture model. Generally, students exposed to multimedia instruction performed significantly better than their colleagues in the conventional instructional method. The purpose of this study is investigated the effects of computer-animation on NCE students' performance in vertebrate, anatomy and physiology in colleges of education in Bauchi State, Nigeria.

2. METHODS

This study employed a quasi-experimental design. The research type was a pretest posttest equivalent, non-randomized control group. The independent variables were the instructional techniques of treatment and conventional method, whereby the dependent variable was the students' performance in the posttest. The research design was represented schematically on Table 1.

Table 1. Research Design Layout

Groups	Pretest	Treatment	Posttest
Experimental Group	O ₁	X	O ₂
Control Group	O ₃	-----	O ₄

Base on Table 1, O₁ and O₃ represent means pretest score of experimental and control groups respectively; X = represents treatment for experimental group; O₂ and O₄ represent means posttest score of experimental and control groups respectively; ----- = represents non-randomized, equivalent subjects; --- = represents lecture method for control group. Thus, Table 1 represents assignment variables as used in this study. The experimental group was exposed to pretest prior to treatment of computer-animation strategy and subsequently followed with a posttest. Similarly, the control group was pretested prior to the application of no treatment using conventional lecture method and followed with a posttest.

The population for this study comprised 2,594 Biology students in the colleges of education in Bauchi State, Nigeria while the target population was 878 NCE 200 level Biology students in the colleges of education in Bauchi State, Nigeria. There are four NCE-awarding institutions in the State of which only two run Biology Education programme at the NCE level. The study also employed a purposive sampling technique to select two colleges of education in the State. Population, target population and sample size are show in Table 2.

Table 2. Population, Target Population, and Sample Size

Name of Institutions	Population	Target Population	Sample
	NCE I, II & III Biology Students	NCE II Biology Students	Sample Size
College A (Experimental)	1.910	671	42
College B (Control)	684	207	18
Total	2.594	878	60

A treatment instrument of computer-animation package that contained the multimedia contents of the selected Vertebrate, Anatomy and Physiology concepts in Biology was designed and developed by the researcher. The researcher made proper planning in coming up with the idea and wrote the script and storyboarding while an expert animator in the computer animation production performed all the necessary steps of the production including the narration. The animation-package was used for the purpose of instruction and assessment. Thus, the experimental group was exposed to treatment of animation-package that contained evaluation at the completion of every lesson. The second instrument was the lesson note that had been developed by the researcher and used to teach six different topics for the duration of six weeks of actual teaching. The objectives of each lesson treated were being taken into consideration. The third instrument was the Vertebrate Anatomy and Physiology Achievement Test (VAPAT), which was developed by the researcher based on the concepts taught during the study. In addition to that, the researcher adapted some of the previous questions papers of BIO 222 from the selected Colleges of Education in Bauchi State. The VAPAT was a thirty items multiple-choice objective test, four options (A-D) with the right answer attached to each item. The items were being constructed based on the concepts treated and the instructional objectives of the lessons designed. The test instrument had two sections- A and B. Section A elicited information on student's level, gender and name of the College only, while Section B elicited information on the performance of students in the chosen Vertebrate, Anatomy and Physiology concepts. On the scoring of the test items, a score of three marks awarded for each correct answer and zero for each wrong answer. Thus, the test instrument was scored over ninety.

Consequently, the three instruments were validated by expert and only the modified version of animation-package was pilot tested on 20 NCE II Biology students from non-participating college of education. The twenty randomly selected NCE II Biology students were assigned to experimental and control groups respectively. Both the groups were pre-tested prior to the application of treatment of animation-package and conventional instructional strategies in the first week. The six lessons were treated to both experimental and control groups in the second, third and fourth weeks. Thus, in each week, two lessons were being taught. The fifth week was meant for the administration of posttest using VAPAT. The data generated from the tests of the two groups were statistically analyzed using *t*-test. Thus, the result of the pilot study revealed that the animation-package strategy had a significant effect on students' performance. After the pilot study, a slight change was made on the animation-package for improvement. Consequently, this was replicated in the actual study in which Mean and Standard Deviation were used to answer the research question and *t*-test statistical analysis was used to test the only hypothesis at 0.05 level of significance.

3. RESULTS AND DISCUSSION

Results

A total of 60 NCE Biology students from colleges of education in Bauchi State, comprising of 18 students for the control group and 42 students in the experimental group made up the sample for this study. The 60 respondents were pretested with the test items, and eventually were available for the posttest amounting to 100.0% response rate. The sample size for this research was sufficient and representative.

Demographic Data

The respondents' demographic data are presented in [Table 3](#), [Table 4](#), and [Table 5](#).

Table 3. Respondents Data based on Gender

Gender	Frequency	Percent	Cumulative Percent
Male	30	50.0	50.0
Female	30	50.0	100.0
Total	60	100.0	

[Table 3](#) shows that male and female respondents formed equal percentage of the total sampled respondents with 30 (50.0%). This is also shown graphically in [Figure 1](#).

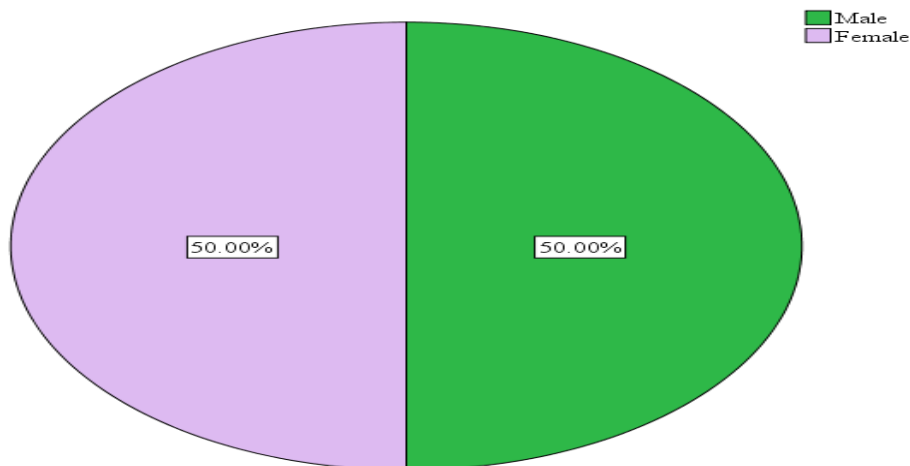


Figure 1. Chart on Respondents' Gender

The respondents' data based on the treatment group and the group taught using lecture method is showed in [Table 4](#).

Table 4. Distribution of Respondents by Groups

Groups	Frequency	Percent	Cumulative Percent
Control Group	18	30.0	30.0
Experimental Group	42	70.0	100.0
Total	60	100.0	

Base on [Table 4](#) indicated that 18 students were in the control group while 42 students made up the treatment group. The respondents' population in each of the control group and the experimental group was also displayed in [Figure 2](#).

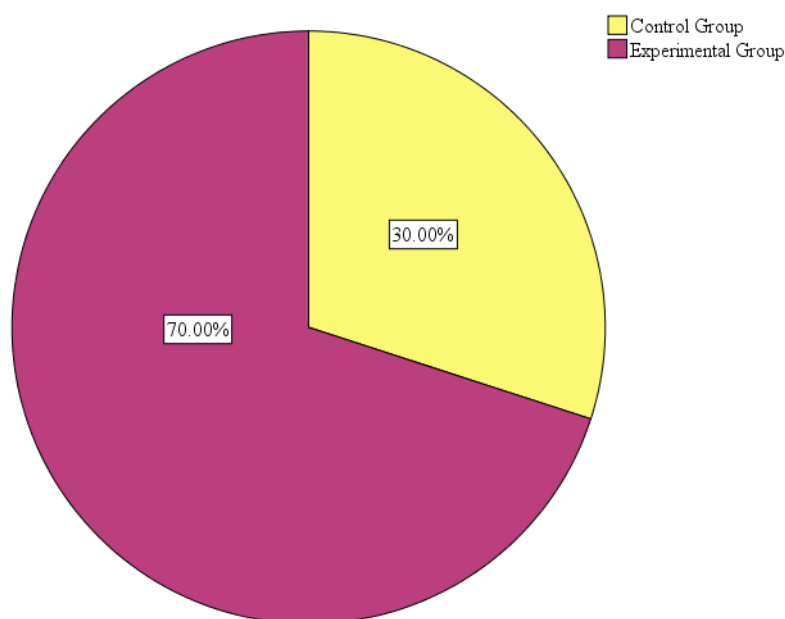


Figure 2. Chart on Respondents' Group

Results on Hypotheses

In hypothesis one, there is no significant difference between experimental and control group mean scores in Vertebrate, Anatomy and Physiology in colleges of education in Bauchi State, Nigeria. The analysis for testing this hypothesis is shown in Table 5 was *t*-test statistical tool.

Table 5. Summary of T-Test

Variables	Groups	N	Mean	Std. Deviation	Df	T	Sig. (2-Tailed)	Remarks
Pretest Scores	Control Group	18	21.1667	5.29428	58	-.505	0.615	Not Significant
	Experimental Group	42	21.8571	4.65163				
Posttest Scores	Control Group	18	50.1176	7.09650	58	-5.150	0.000	Significant
	Experimental Group	40	69.0513	14.35811				
Total		60						

Table 5 shows the difference in the performance of the control group and the experimental group taught the Vertebrate, Anatomy and Physiology in colleges using the animation-packages before and after treatment. The table established that there was no significant difference between experimental and control group pre-test mean scores in Vertebrate, Anatomy and Physiology prior to the application of treatment. Furthermore, the posttest result established that there was a statistically significant difference between experimental and control group mean scores in Vertebrate, Anatomy and Physiology in colleges of education in Bauchi State, Nigeria. This is because the stated null hypothesis was rejected since $t(58) = 5.15$ and $p = 0.00 < 0.05$. Thus, significant difference existed in the performance of those taught with lecture method and those taught with Animation-package.

In order to find out where the significant difference exists, mean gain analysis was computed as presented in Figure 3.

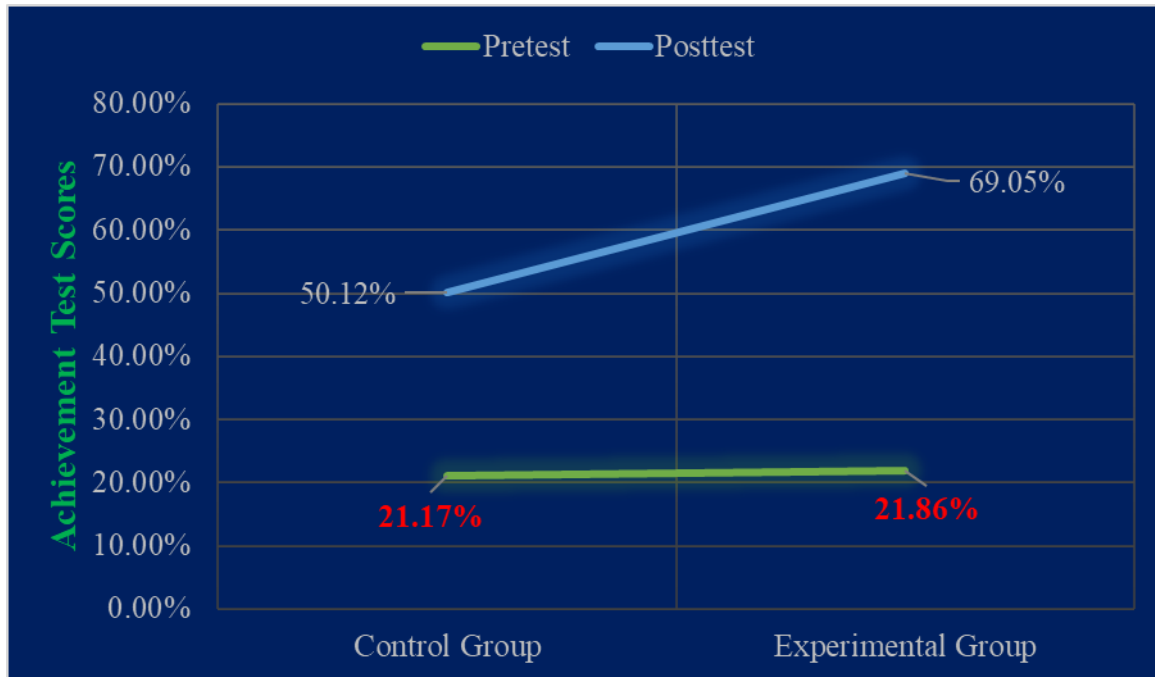


Figure 3. Chart Showing Mean Scores on Control and Experimental Groups

Base on [Figure 3](#), the mean gain analysis shows that, the mean scores of students in the experimental group (69.05%) were higher than those in the control group (50.12%) during posttest. The analysis further revealed that the mean scores were the same during pretest, which indicated that the two groups were equivalent before treatments.

Discussion

One of the important attributes of Animation-package is making learning real, permanent and most immediate. The results of the major findings had clearly indicated that students understand better when relevant and appropriate instructional media are used in teaching them. Animation-package is a step forward in this direction; it enables students see and hear sound. This corroborates with the findings of previous study which implied that there was significant difference between the mean score of the students who participated in CAIP and TIM groups and therefore indicated that CAIP group performed better than TIM group ([Sastradika et al., 2021](#); [Sriarunrasmee et al., 2015](#)). This view is supported by other study who made it clear that students are influenced by audio-visual stimuli than any other means of instructional delivery ([Marchetti & Cullen, 2015](#)). Thus, the animation-package enhanced students' performance in Vertebrate, Anatomy and Physiology in colleges of education in Bauchi State. The other study revealed that the students had higher academic achievement in auto braking system in the experimental group than that of the control group and suggested the replication of this study in the other field of studies ([Ahmed & Inti, 2021](#)).

Hypothesis one states that there is no significant difference between experimental and control group mean scores in Vertebrate, Anatomy and Physiology in colleges of education in Bauchi State, Nigeria. The findings of the study revealed that a statistically significant difference existed on students' performance when exposed to vertebrate, anatomy and physiology using Animation-package and Lecture method. However, mean gain analysis shows that students in the experimental group had the highest mean than those in the control group. This indicates that students in the Animation-package classroom setting performed significantly better than their counterparts in the conventional class. Therefore, the increase of students' participation in the learning activities and using relevant strategy that allows

students to learn by viewing, demonstration and guiding would have accounted for the better performance of students in the experimental group. In addition, the results revealed that the rejection of null hypothesis is a clear indication that Animation-package strategy is effective in enhancing students' academic performance.

This agreed with the findings of previous study who found a statistically significant difference in students' performance when taught Mathematics using animation and lecture method in favor of the experimental group (Sumarni et al., 2020). The results were in conformity with other study who found that Animation-package enhanced the process of learning complicated Biology concept (Riyanto et al., 2020). The results of their study revealed a positive outcome in favor of treatment group. Animation enhances students' academic performance as found by previous study whose study revealed a statistically significant difference in the performance of Creative Art students taught using Animation-package and Lecture method (Badmus, 2022). Students viewed animated concept in Microbiology scored significantly higher scores than non-viewers when assessing the effectiveness of three animated-tutorials (Saripudin et al., 2018; Sriarunrasmee et al., 2015).

Also, the study agreed with the findings of previous study who revealed that students taught Biology using computer-simulation performed significantly better than those in conventional teaching method (Gambari & Yusuf, 2017). In the same vein, previous study examined the effects of video-based multimedia instruction on secondary school students' achievement and retention and found no significant difference among the experimental groups (animation + narration, animation + on-screen text and narration + on-screen text) (Bustanil S et al., 2019). Generally, students from the multimedia groups performed significantly better than their colleagues in the conventional strategy. In contrast, other study found no significant difference on students' performance using Animation-package (Wang, 2018). Their findings further revealed that the use of Animation-package did not have a significant impact on students' performance when taught concepts of anatomy and physiology in a University in USA.

The implication of this study providing overview related to computer-Animation on NCE students' academic performance in vertebrate anatomy and physiology in colleges of education. This study can be used as reference for the application of computer-Animation in teaching biological subject. This study still has weakness; therefore, the researcher is suggested some recommendation, first colleges of education lecturers should employ computer-animation strategy as a tool for teaching abstract and complex concepts in different subject areas since it has roles in enhancing students' academic performance. Second, management of colleges of education should make provision for local/imported computer-animation packages for effective instructional delivery in their respective colleges of education. Third, curriculum planners should assist in designing strong minimum standards that support the integration of computer-animation in instructional process. And last, lecturers should be given professional training on design, production, improvisation, utilization, maintenance, storage and retrieval of animated-instructional media. This can be through conference, seminar and workshop attendance within and outside their educational districts.

4. CONCLUSION

There is no instructional strategy that has the capacity of replacing the teacher in the learning environment, rather an additional appetite to conventional approaches. But, in order to be technologically developed, lecturers in the colleges of education in Nigeria have to be technologically inclined with modern instructional methods for optimal performance in their job. Teaching and learning could be enhanced when instructor exposes learner through innovations in addition to conventional approaches of teacher dominated class. The use of

computer-animation in teaching vertebrate, anatomy and physiology is a step in this direction, in which the students were actively engaged in the instructional process.

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