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EFFECT OF AI-BASED VIDEO SIMULATION USING HOOK MODEL ON MOTIVATION AND PERFORMANCE IN CIRCULATORY SYSTEM AMONG SECONDARY SCHOOL STUDENTS IN ZAMFARA STATE

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ABSTRACT

This study investigated the effect of AI-based video simulation (AIBVS) using hook model on secondary school students' motivation and performance in human circulatory system (HCS) in Zamfara State, Nigeria. The study adopted quasi experimental using pre-test, post-test, control group design. The population of the study was 25,335 SS2 biology students with a sample size of 125. Purposive sampling technique was used in selecting two schools for the study. Circulatory System Motivation Questionnaire (CSMQ) and Circulatory System Performance Test (CSPT) was used for data collection, which was validated by four experts. Pilot testing was conducted for both research instruments using test-retest and split half methods and reliability coefficient of 0.84 and 0.89 were obtained using PPMC and Spearman Brown corrected coefficient respectively. Three research questions were answered using mean and standard deviation and three null hypotheses were tested using Analysis of Covariance (ANCOVA) at 0.05 level of significance. Result of the study reveals that, the instructional use of AIBVS using Hook model significantly improves students' motivation and performance at post-test than lecture method, with a p value of 0.001. The Result also indicated that, gender does not influence students' academic performance in HCS when taught with AIBVS, with a p-value of 0.70. Hence, gender friendly. Based on the findings of this study it was concluded that, use of AIBVS is more effective in improving students' Motivation and performance than lecture method without significant gender effect. It was therefore recommended that, AIBVS using Hook model should be integrated into teaching biology.

Keywords: AI-Video Simulation, Hook Model, Motivation, Performance and Human Circulatory System.

1.0 INTRODUCTION

Recent advances in digital instructional technologies have transformed teaching and learning across the world. Modern science and technology continue to evolve rapidly, influencing nearly all spheres of human activity. A major outcome of technological progress is the development of Information and Communication Technology (ICT), which has revolutionized human interaction and learning processes. One of the most significant innovations that emerged from ICT is Artificial Intelligence (AI), defined as the capacity of machines to adapt to new situations, solve problems, answer questions, plan, and perform tasks requiring human like intelligence (Mubarik *et al.,* 2024). In education, AI has played a significant role in providing effective and efficient learning process (Fitri and Dilia, 2024).

Biology, is a subject characterized by abstract concepts and complex structures, which greatly benefits from AI driven tools. AI technologies provide opportunities for visualization of simulations, and interactive learning, helping students understands the intricate biological processes such as cell division, photosynthesis, pollination, and the circulatory system (Lasaiba, 2023; Telaumbanua, 2025). These tools are particularly useful in schools with poor or lacking laboratory facilities and other learning tools, as they enable students to conduct

virtual experiments and access high-quality instructional simulation videos (Telaumbanua, 2025). However, existing research on AI in education has focused largely on technical capabilities rather than integrating AI tools with established learning theories and models such as the Cognitive Theory of Multimedia Learning or behavior based models like the Hook Model. This gap highlights the need for AI tools that are not only technically efficient but also pedagogically grounded.

Biology, described by Aniaku and Loretta (2024) as the study of living and non-living organisms, is foundational for careers in medicine, nursing, radiology, and allied health fields (Isma'il and Lukman, 2022). Its broad scopes such as anatomy, physiology, microbiology, molecular biology, genetic engineering and biotechnology makes it both important and challenging (Sari *et al.,* 2025). National policy mandates that biology education should promote scientific literacy and environmental awareness, and contribute to technological advancement (Federal Republic of Nigeria, 2013). Within the biology curriculum, the human circulatory system is a critical yet difficult concept for students, typically taught at the SS2 level (Saratu *et al.,* 2020). It involves studying the mechanisms regulating oxygen transport, nutrient distribution, hormonal communication, and waste removal (Gregorcis and Torkar, 2022).

However, students struggle with the circulatory system largely because of its abstract and microscopic nature. Gregorcis and Torkar (2022) noted that low motivation and abstract complex subtopics make it difficult for learners to mentally imagine visualize and understand circulatory processes. Celik *et al.* (2020) similarly identified widespread misconceptions among students and even pre-service teachers, with many of them unable to accurately explain the concept of blood circulation, heart structure, or vessel arrangement in simple and comprehensible manner. The limited time available before major examinations such as the SSCE further worsens these challenges and contributed to persistent poor academic performance. Moreover, abstract concepts such as genetics, evolution, and the circulatory system have been shown to reduce student motivation and academic performance in biology (Isma'il and Matazu, 2024).

A major factor contributing to these learning difficulties is the predominance of traditional lecture methods in Nigerian secondary schools especially a low resource settings like Zamfara state. Although lecture teaching method help teachers cover large volumes of content over a short period of time, however, they tend to be teacher centered and limit students' participation, engagement, and critical thinking, leading to low motivation and poor academic performance (Olanrewaju *et al.,* 2024). Reports from WAEC Chief Examiners (2014-2024) and NECO (2024) consistently show poor performance in biology nationwide, with Zamfara State ranking among the lowest-performing states (Daily Trust E-Paper, 2024). Numerous studies including those by Telaumbanua (2025); Akram *et al.* (2024); Banda and Nzabahimana (2024); Cheruiyot *et al.* (2023); Rone *et al.* (2023); Alsarayreh (2021); Yilmaz and Korur (2021); Filgona *et al.* (2020); have reported that, students taught through conventional methods exhibit low motivation, poor participation, and poor academic performance. The combination of outdated teaching methods, abstract curriculum content, and lack of innovative learning resources continues to hinder students' motivation and academic performance in biology.

1.3 Aim and Objectives

The main aim of the study is to determine the effect of AI-Base Video Simulation (AIBVS) using hook model on motivation and academic performance in circulatory system among senior secondary school students in Zamfara State. Specifically, the objectives of this study are to;

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1. determine the motivation level of students taught human circulatory system using AIBVS by exploring hook model and those taught using LM in Senior Secondary Schools in Zamfara State;
2. determine the performance mean scores of students taught human circulatory system using AIBVS by exploring hook model and those taught using LM in Senior Secondary Schools in Zamfara State;
3. determine the performance mean scores of male and female students taught human circulatory system using AIBVS by exploring hook model in Senior Secondary Schools in Zamfara State;

1.1 Research Questions

This study provide answers to the following research questions:

1. Is there any difference in the mean motivation scores of students taught HCS using AIBVS by exploring hook model and those taught using LM?
2. Is there any difference in the mean performance scores of Senior Secondary School students taught HCS using AIBVS by exploring hook model and those taught using the LM?
3. Is there any difference in the mean performance scores of male and female students taught HCS using AIBVS by exploring hook model?

1.2 Null Hypotheses (H_0)

The following hypotheses were formulated and tasted at 0.05 level of significance;

Ho_1.There is no significant difference in mean motivation scores of students taught HCS using AIBVS by exploring hook model and those taught using LM;

Ho_2: There is no significant difference in mean performance scores of students taught HCS using AIBVS by exploring hook model and those taught using LM;

Ho_3: There is no significant difference in mean performance scores of male and female students taught HCS using AIBVS by exploring hook model.

2.0 The Conceptual Framework: This study was built and grounded in David McClelland's Achievement Motivation Theory, who describes the uniqueness regarding the needs of each individual showing that the individuality of people makes each person have a different perception of reality and, therefore, need to satisfy different emotional needs. Mayer's Cognitive Theory of Multimedia Learning (CTML), emphasizes that learners absorb and process information more effectively when presented in both visual and auditory elements, this made AIBVS a powerful tool for enhancing students' motivation and academic performance. Cognitive load theory (Sweller, 1988) supports this by emphasizing the need to manage cognitive demands, ensuring students focus on essential learning content, therefore, too much information can overload the learner's cognitive capacity, this support the idea of hook model through its cyclical process of Trigger (AlShaikh *et al*., 2024).

3.0 METHODOLOGY

The study adopt quasi-experimental, specifically, pre-test post-test, control group design. The target population of the study comprised of 25,335 (16,395 males & 8,940 females) SS2 students offering Biology in Zamfara State, who were sampled using multistage sampling technique. Out of the four educational zones two were purposively selected, then at the second stage two local governments were similarly selected from each of the selected zones. At the third stage, two Co-Educational Public Senior Secondary Schools, one from each of the selected local government were purposively selected. Hence, two schools were used as sampled schools with a total sample size of 125 students. Finally, two intact classes were then selected using simple random sampling technique and used as experimental and control group respectively. A 30 questions Circulatory System Performance Test

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(CSPT) and Circulatory System Motivation Questionnaire (CSMQ) which contained twenty (20) statements and the scorings was in the form of four-point likert scale ranging from Highly Motivated (HM), Moderately Motivated (MM), Low Motivated (LM) and Not Motivated (NM) respectively, was used as instrument used for data collection. The content validation of the research instruments was carried out by a panel of experts comprising the following: one professor and one associate professor from science education department, one associate professor from biological sciences department and one associate professor in Research Measurement and Evaluation from the Department of Educational Foundations. In order to ensure the reliability of the research instrument, the research instruments (CSPT & CSMQ) were pilot tested using 30 SS 2 biology students (15 males; 15 females) through test-retest and Split half methods respectively. The Data obtained were correlated using the statistical tools of PPMC (for CSPT) & Spearman Brown Corrected Coefficient (for CSMQ), which yielded a reliability indices of 0.84 & 0. 89 respectively.

Pre-test and pre-motivation questionnaire was administered to students in the two groups in order to determine the equivalence in ability of students in the two groups. Students in the experimental group were taught Human Circulatory System (HCS) using AI-based video simulation (AIBVS) by exploring hook model while students in the control group were taught the same concept using lecture method (LM). At the end of the four weeks treatment, a post-test and post-motivation questionnaire was administered to both groups. Data collected was analysed and research questions were answered using mean and standard deviation while the hypotheses ware tasted using analysis of co-variance (ANCOVA).

4.0 RESULTS

4.1 Research Question One:

Table 4.1 Mean Total Motivation Scores of Biology Students in AIBVS and LM.

Group	N	Pre-motivation		Post-motivation		Mean Gain	Mean Diff	Remark
		Mean	SD±	Mean	SD±			
AIBVS	64	26.98	4.214	74.06	6.416	47.08	9.11	Diff Exist
LM	61	30.92	4.514	64.95	9.997	34.03		

Table 4.1 Shows that students who were expose to AIBVS had a mean motivation score of 74.06 **±**6.41 at post-test and mean gain of 47.08. While the students in the control group had mean score of 64.95 **±**9.99 at post-test, with a mean gain of 34.03.

4.2 Research Question Two:

Table 4.2 descriptive statistics of Pre-test and Post-test Scores of Biology Students in both Experimental and Control Group.

Group	N	Pre-test Scores		Post-test Scores		Mean Gain	Mean Diff	Remark
		Mean	SD±	Mean	SD±			
AIBVS	64	4.30	1.487	24.55	1.754	20.25	6.55	Diff Exist
LM	61	4.21	1.473	18.00	2.582	13.79		

Table 4.2 Shows that, the student taught HCS using AIBVS exploring Hook model had a mean post-test score of 24.55**±**1.754 and mean gain of 20.25. While students taught using lecture method (LM) had a mean post-test score of 18.00**±**2.582, with a mean gain of 13.79. This implies that, students taught using AIBVS by exploring hook model had achieved higher mean post-test score compared to students taught using LM.

4.3 Research Question Three:

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Table 4.3 descriptive statistics of Pre-test and Post-test Scores of Male (M) and Female (F) Biology Students Taught Human Circulatory System using VAS (Experimental Group).

Group	Gender	N	Pre-test Scores		Post-test Scores		Mean Diff	Remark
			Mean	SD±	Mean	SD±		
AIBVS	M	37	4.35	1.495	24.16	1.788		Diff Exist
	F	27	4.22	1.502	25.07	1.591	0.91	

Table 4.3 The result in the table reveals that, the mean academic performance scores of male and female biology students expose to HCS using AIBVS by exploring hook model at post-test were 24.16 **±**1.788 and 25.07**±**1.591 respectively. This indicated that little difference exist between the mean performance scores of male and female students, with female students achieving slightly higher post-test scores with a mean difference of 0.91. .

4.4 Hypothesis One:

Table 4.4: Analysis of covariance (ANCOVA) for the effect of AIBVS exploring Hook model and LM on students Motivation Scores after treatment (at $p \leq 0.05$) level of significance.

Source	Type III Sum of Squares	Df	Mean Squares	F-value	P-Value	η^2p
Corrected model	2864.115a	2	1432.058	20.910	.000	.216
Intercept	9724.362	1	9724.362	141.988	.000	.514
Pre-motivation Total	271.149	1	271.149	3.959	**.069**	.031
Group	2827.272	1	2827.144	41.282	**0.00***	.253
Error	8355.453	122	68.487			
Total	617018.000	125				
Corrected Total	11219.568	124				

[a.] **R Squared** = .255 (Adjusted R squared = .243). *Statistically Significant

Table 4.4 revealed that the AIBVS had a statistically significant effect on students' motivation level, F (1,122) = 41.282, p =0.001 (<0.05). Therefore, since the p-value of 0.001 is less than 0.05, null hypothesis one (**Ho_1**) is therefore rejected. This indicated that AIBVS using Hook model significantly enhanced students' motivation compared to lecture method.

4.5 Null Hypotheses Two:

Table 4.5: analysis of Covariance (ANCOVA) for the effect AIBVS using hook model and LM on academic Performance Scores of Students taught HCS.

Source	Type III Sum of Squares	Df	Mean Squares	F-value	P-Value	η^2p
Corrected model	1338.815[a]	2	669.407	137.558	.000	.693
Intercept	5962.182	1	5962.182	1225.180	.000	.909
Group	1336.727	1	1336.727	274.686	**.000***	.692
Pre-test (covariate)	.162	1	.162	.033	**.856**	.000
Error	593.697	122	4.866			
Total	58921.000	125				
Corrected Total	1932.512	124				

[a] **R Squared** = .693 (Adjusted R squared = .688, * Statistically Significant

Table 4.5 The ANCOVA result reveals a statistically significant difference on academic performance of students taught HCS using AIBVS exploring Hook mode compared to LM, F (1, 122) = 274.686, p = 0.00 (<0.05) with a partial eta squared (η^2) of .692, indicating a very large effect size. This implies that approximately 69.2% of the difference in students' academic performance scores at post-test can be attributed to the effectiveness of AIBVS. Therefore, since the p-value of 0.001 is less than 0.05, null hypothesis 3 is therefore rejected.

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This indicated that AIBVS using Hook model is significantly more effective in enhancing students' academic performance than lecture method.

4.6 Null Hypothesis Three

Table 4.6: Post-test Analysis of Covariance (ANCOVA) for Gender effect on Academic Performance Scores of students taught HCS with AIBVS using hook model.

Source	Type III Sum of Squares	Df	Mean Squares	F-value	P-Value	η^2p
Corrected model	13.123a	2	6.561	2.215	.118	.068
Intercept	4045.997	1	4045.997	1365.555	.000	.957
Pretest_Exp (Covariate)	.142	1	.142	.048	**.827**	.001
Gender	13.074	1	13.074	4.413	**.070**	.067
Error	180.73	61	2.963			
Total	38757.000	64				
Corrected Total	193.859	63				

[a] **R Squared= .068 (Adjusted R Squared = -.037)**

Table 4.6 shows that the effect of gender on post-test scores was not statistically significant, F (1, 61) = 4.413, p = 0.07, η^2 = 0.067. The observed partial eta squared (η^2) of 0.067 reveals a very small effect size. Since the p-value is greater than 0.05 (p = 0.07), therefore, the null hypothesis 3 is hereby retained. The result therefore, indicated that gender did not have significant effect on students' academic performance in the experimental group.

5.0 DISCUSSIONS OF THE FINDINGS: The findings in Table 4.1 revealed a notable difference in the mean total motivation scores of students taught HCS using AIBVS, with increased in motivation level of students from low motivated to a highly motivated compared moderately motivated in students taught with LM, the difference in motivation level as indicated by the ANCOVA result was statistically significant, indicating that, AIBVS is more effective in improving students' motivation level as compared to LM. This could be attributed to the idea behind Hook model, which focuses on triggering curiosity and sustained engagement, thereby helped reduce boredom and passive learning, which are common in abstract biology concepts like circulatory system. As a result, students not only stay attentive but were also more motivated to learn. The findings of this study align with the result of Habibi *et al.* (2024), Banda and Nzabahimana (2023), Talan (2021) who reported a significant difference in motivation level of students' expose to video simulation as an instructional strategy. Telaumbanua (2025) also found that, AI-generated 3D models enhanced understanding and its adaptive questioning feature effectively maintained motivation for students of all ability levels.

Table 4.5 the findings of one way ANCOVA indicated a statistically significant difference in mean academic performance scores of students taught with AIBV compare to students taught using LM. This implies that the instructional use of AIBVS in teaching HCS is more effective in improving overall students' academic performance than LM. This can be attributed to the interactive and engaging nature of AIBVS, which help simplify complex processes of HCS, enabling students to grasp difficult concepts with greater ease. This could also be attributed to the effectiveness of AIBVS in mitigating extraneous load by simplify complex processes of HCS in a structured manner

allowing for interaction and engagements of students enabling them to grasp difficult concepts with greater ease. The findings highlighted above are in agreements with the findings of Fabeku and Enyeasi (2024), Habibi *et al.* (2024), Kanvaria and Gunjan (2024), Konadu *et al*. (2024), Banda and Nzabahimana (2023), Hussaini *et al.* (2023), Lasisi *et al.* (2021), Ndihokubwayo *et al.* (2021), Saratu *et al*. (2020) who all reported a statistically significant difference in the mean academic performance scores of students instructed using video simulation tools than those instructed using the conventional methods. However, the result of this study contrast to the findings of Augustine and Chinyere (2025) who reported no statistically significant difference in the mean performance scores of students taught using computer simulation and those taught using lecture method. These contradicting finding suggest that contextual or methodological variations can influence the effectiveness of instructional strategies.

On gender and academic performance, the female students recorded slightly higher mean post-test scores than their male counterpart as shown in table 4.6. However, the ANCOVA result revealed no statistically significant difference in academic performance between male and female students in the AIBVS group. This implies that the use of AIBVS was equally effective across genders. This result is consistent with that of Augustine and Chinyere (2025) and Hussaini *et al.* (2023), who reported that gender did not significantly influence students' performance when expose to Simulation based strategies such as AIBVS. The finding indicates that, when provided with equal learning opportunities, both male and female students can perform equally well.

6.0 CONCLUSION:

Based on the findings of this study it was concluded that the instructional use of AI-based video simulation exploring hook model was found to significantly improve students' motivation and academic performance than lecture method without significant gender effect, hence gender friendly.

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