INDONESIAN JOURNAL OF CURRICULUM
AND EDUCATIONAL TECHNOLOGY STUDIES
2024, Vol. 12, No. 2, 83-95, DOI: https://doi.org/10.15294/ijcets.v12i2.15312

Effects of blended learning and peer tutoring on genetics achievement among Agricultural Education students in North Central Nigeria

Jimoh Saidu Bolakale,[1] Afolabi Kayode Ojo,[2] Shuaib Suleiman Bature,[3] WAdesanya Emmanuel Olorunleke[4]

[1, 2, 3, 4] Department of Science Education, Faculty of Education, University of Ilorin, Ilorin, Kwara State, Nigeria.

Abstract

This study examined the effects of Blended Learning (BL) and Peer Tutoring (PT) on student achievement in genetics among agricultural education students in North Central Nigeria. Using a quasi-experimental design, 167 students from three education colleges were divided into experimental and control groups. The Genetics Achievement Test (GAT) and the Genetics Blended Learning Package (GBLP) assessed learning outcomes. Pre- and post-test results showed that students taught with BL and PT outperformed traditional methods, with BL being the most effective. Gender differences were also observed, with male students performing better across all methods. The study concludes that both BL and PT enhance learning and recommend their adoption. Additionally, schools should integrate innovative teaching methods and ICT tools to improve instruction in complex subjects.

ARTICLE HISTORY

Received 15 September 2024
Accepted 27 October 2024

KEY WORDS

Blended learning, Colleges of Education, genetics, peer tutoring, student achievement

INTRODUCTION

As a developing nation, Nigeria strives for self-sufficiency across various sectors to transition into a developed country. Agriculture remains a cornerstone of the Nigerian economy, providing livelihoods for most of its population. According to Jamie, Collins, David, and Mamadou (2017), approximately 70% of Nigeria's population depends on agriculture for employment. Ogbalubi and Wokocha (2013) further emphasised that agriculture is crucial in ensuring food security and nutritional balance for households while also serving as a significant source of income and employment for farmers and those engaged in agro-allied businesses.

Given its importance, improving agriculture through advancements in science and technology is essential, particularly with the need for well-qualified teachers to drive Nigeria's scientific, technological, and economic growth. The Nigerian educational system, particularly within colleges of education, continues to prioritize high-quality education aimed at achieving these goals. Graduates of vocational agricultural education programs are expected to be self-sufficient, self-employed, and self-reliant, applying the skills and competencies they have acquired in school (Usman, 2012).

Teaching is central to this process. Oladosu (2001) defined teaching as an activity that fosters meaningful learning through methods that are pedagogically and morally sound. However, Ngwu (2015) noted that in developing nations like Nigeria, traditional methods of instruction—commonly referred to as "chalk and talk"—are still widely used, even though they may not be the most effective for facilitating learning. According to Kendra (2022), learning involves a permanent change in behaviour resulting from experience, encompassing the acquisition of new information, knowledge, and skills. This multi-step process involves attention, coordination of new information with existing knowledge, retention, and application.

✉Corresponding author: jimoh.bs@unilorin.edu.ng

The attainment of educational objectives relies heavily on effective teaching and learning, particularly within teacher training institutions like Colleges of Education. These institutions play a crucial role in producing motivated, highly skilled teachers who are prepared to contribute to the advancement of Nigeria's education system. Their mission includes promoting both personal and professional discipline, while also preparing teachers to deliver high-quality education, particularly at the foundational education level (National Commission for Colleges of Education, 2021). To achieve successful teaching and learning outcomes, a qualified teacher must utilize a variety of strategies. Learning can take different forms, including independent, collaborative, and cooperative approaches (Meador, 2016).

Cooperative learning is an instructional approach that encourages students to work together, helping them develop important interpersonal skills. It involves small groups of learners collaborating to achieve a common goal (Jamie, 2023). Research has shown that aligning teaching strategies with students' learning preferences can significantly influence academic performance. Over the past few decades, advancements in Information and Communication Technology (ICT) have transformed teaching and learning environments, particularly in developed nations where online learning has been combined with conventional teaching, bringing about the emergence of blended learning. In today's information and communication technology-driven era, much of resource sharing, collaboration, content development, and learning are conducted digitally. Saleh, Bakry, and Asfor (2010) highlighted how ICT has revolutionised education, while Olagunju (2012) noted its profound impact on various aspects of human life. Nwosu and Esoswo (2010) observed that the introduction of ICT into tertiary institutions has led to changes in educational delivery, enabling distance learning and fostering better collaboration between institutions. This shift has also created new pedagogical models where students take a more active role in their education, which has given rise to the blended learning approach. Students also learn more actively when they collaborate with their peers, become challenged, participate and grasp better. Teaching methods and learners' preparedness significantly impact learning outcomes, underscoring the importance of exploring alternative strategies like blended learning and peer tutoring.

As defined by Mayadas and Picciano (2007), blended learning combines traditional instruction with online media to enhance the learning experience. Al-Ani (2013) described it as integrating classroom-based and online learning approaches. Peer tutoring, another instructional strategy, involves students serving as temporary tutors for their peers, which has been shown to affect academic performance and social skills positively. Peer tutoring can be structured in various ways, such as pairing students by ability level or age, and has been widely researched as an effective method for fostering students' engagement and success (Yashvinder & Sujatha Malini, 2018).

Genetics is a foundational science crucial in many fields, including medicine, agriculture, pharmacy, and biochemistry. Ambuno, Egunyomi, and Osakwe (2008) defined genetics as the branch of biology concerned with transmitting genetic traits from one generation to the next. It is a vital course within the NCE II vocational agriculture curriculum, laying the groundwork for understanding advanced topics like animal breeding and crop improvement. Mastery of genetics is essential for addressing challenges related to food insecurity, unemployment, and poverty in Nigeria. Despite the critical importance of genetics to human life and other living organisms, the persistent increase in failure rates highlights the need for a reassessment of instructional methods. Cimer (2012), Chifwa (2015), and Paul (2018) all reported that genetics remains a challenging subject for both students and teachers. It is perceived as difficult to teach and learn by the teacher and learner respectively, due to its abstract nature, which leads to misconceptions that hinder students' understanding of the subject matter.

Ahmed (2007) documented a consistent decline in the performance of NCE II students in genetics at a college in Ilorin from 2002 to 2006. Students attributed their poor results to factors such as teaching methodology, lecturer attitudes, and limited exposure to practical work. While numerous studies have identified strategies to address these challenges, such as Computer Assisted Instruction, the use of text structures, pre-teaching mathematical components (Paul, 2018;

Alabi, 2016; Buseri, 2014; and Gbigbadua, 2020), and clarifying terminology in genetics, these efforts have only led to marginal improvements in recent times and average academic achievement , though no study known to this researcher has been carried out on the use of online or blended learning in recent time

Achievement refers to the level of academic content a student has successfully learned over a given period. Barowski and Carter (2023) described achievement as the quantity and quality of learning, often measured through assessments, examinations, and comprehension tests. Ultimately, achievement reflects a student's ability to meet short-term or long-term academic goals and is influenced by various instructional strategies and teaching methodologies. This study was prompted in part by the recognition that classroom management practices, which are vital to effective instruction, are influenced by teachers' characteristics, including their teaching methods. Equipping teachers with effective pedagogical training alone may not be sufficient to create a positive, conducive learning environment. Therefore, there remains a need to explore innovative teaching strategies that can improve student achievement and enhance the teaching and learning of genetics. Consequently, this study aims to investigate the effects of Blended Learning and Peer Tutoring Strategies on the achievement of Agricultural Education students in genetics at Colleges of Education in North Central Nigeria.

This study aimed to assess the impact of blended learning and peer tutoring on the achievement of Agricultural Education students in Genetics at Colleges of Education in North Central Nigeria. Specifically, it sought to (i) compare the achievement in Genetics of students exposed to blended learning versus traditional instruction, (ii) compare the achievement of students exposed to peer tutoring versus traditional instruction, (iii) assess the combined effect of blended learning, peer tutoring, and traditional instruction on achievement, (iv) examine the influence of gender on achievement in Genetics with blended learning and traditional instruction, and (v) explore the influence of gender on achievement with peer tutoring versus traditional instruction.

Furthermore, this study tested the following hypotheses: (i) no significant difference in achievement between blended learning and traditional instruction; (ii) no significant difference in achievement between peer tutoring and traditional instruction; (iii) no significant difference in achievement among students exposed to blended learning, peer tutoring, and traditional instruction; (iv) no significant gender differences in achievement with blended learning versus traditional instruction; and (v) no significant gender differences in achievement with peer tutoring versus traditional instruction.

Theoretically, this research contributes to the growing body of knowledge on the effectiveness of blended learning and peer tutoring in higher education, offering a deeper understanding of how these methods can influence academic achievement in specialized fields. It also explores the role of gender in academic performance within these instructional settings, adding a crucial dimension to the debate on equitable learning environments. Practically, the study has significant implications for curriculum design and teaching strategies in Colleges of Education. It offers educators and policymakers evidence-based recommendations on how to integrate blended learning and peer tutoring to foster more effective and inclusive learning environments. Moreover, the findings could inform teacher training programs, ensuring that future educators are equipped with the skills necessary to implement innovative teaching methods that cater to diverse student needs and learning styles.

LITERATURE REVIEW

Learning is a lifelong process that starts from birth until the death of an individual. Most theorists agree that the conditions necessary for learning are contiguity, reinforcement and repetition. For continuity and reinforcement, the importance of reward (i.e., positive reinforcement) immediately following a student's correct response to a problem in a learning situation should be utilised. Based on repetition, theorists agreed that repeated occurrences of the response followed

by reinforcement are necessary for learning and retention. The theoretical framework of this study is hinged on two theories: Piaget's theory and Anchored Instruction's (Bransford, Cognition & Technology Group at Vanderbilt) theory.

Clements and Baptista (1990) revealed two key Piagetian principles for teaching and learning, as learning is an active process: direct experience, making errors, and looking for solutions, which are vital for assimilating and accommodating information. This gives a view into the framework of the study in which new concepts, ideas, objects or events are introduced into learning and can also be inculcated online. Piaget explained the learning process by schemes (the organisation of information on how things work), assimilation (the placing of new information schemes) and accommodation (transforming existing schemes or creating new ones). The significance of this theory to the study is that it helps the students to apply their learning experiences in genetics better in the concepts of crop and animal breeding.

Bransford *et al.* (1990) introduced the Anchored Instruction Educational Model, which emphasizes using an "anchor" material or piece of media, typically a video, to create a shared learning experience among students. This anchor serves as a starting point for further exploration of a topic, fostering a deeper understanding through engagement and interaction. The key idea behind this model is that the anchor material provides a context or framework that students can relate to, ensuring that their learning experience is grounded in something tangible and relevant. This model encourages learners to actively participate in their learning process by connecting the anchor material with real-world contexts and problem-solving scenarios, which enhances critical thinking and retention.

This theory can be particularly beneficial when applied to the creation and use of software video applications (media) as co-instruction tools for learners. In the context of teaching genetics, these video apps can serve as powerful anchors, offering students visual and interactive experiences that are more engaging than traditional instructional methods. By using videos or simulations that illustrate genetic concepts, students are not only introduced to complex topics in a dynamic and accessible way, but they are also given an opportunity to interact with the material, reinforcing their understanding through active engagement. These video apps can present genetics-related content, such as genetic inheritance, DNA structure, and gene expression, in easier to grasp and more memorable ways than textbook-based instruction alone.

In the specific context of this study, applying Bransford *et al.*'s Anchored Instruction Model to the pedagogy of genetics aligns seamlessly with the principles of blended learning. Blended learning combines traditional classroom methods with online and digital resources, allowing for a more flexible and personalised learning experience. By incorporating software video apps as part of a blended learning strategy, instructors can create a more interactive and engaging learning environment. These video apps can be used both in and out of the classroom, enabling students to learn at their own pace while providing visual, auditory, and kinesthetic engagement that enhances understanding, especially in complex scientific fields like genetics. This approach supports diverse learning styles and encourages deeper learning, as students have multiple opportunities to revisit and interact with the material, leading to better retention and comprehension of the subject matter.

METHOD

The study employed a quasi-experimental design to measure students' achievement in genetics in North-Central Nigeria. The population consisted of all NCE II Agricultural Education students enrolled in Colleges of Education in the region. Three Colleges of Education were randomly selected for the study: Federal College of Education, Kontagora (Niger State), Kwara State College of Education, Ilorin (Kwara State), and Kogi State College of Education, Ankpa (Kogi State). The sample size included 167 NCE II Agricultural Education students, purposively selected from the three colleges. These students were divided into two experimental groups and one

control group: 73 students from Federal College of Education, Kontagora, in experimental group one; 58 students from Kwara State College of Education, Ilorin, in experimental group two; and 36 students from Kogi State College of Education, Ankpa, in the control group.

Two instruments were developed in this research: the Genetics Blended Learning Package (GBLP), which was a set of adopted video content obtained online. At the same time, the Genetics Achievement Test (GAT) was researchers-designed test questions that aligned with the course content. The GAT, a parallel test, was administered as a pre-test and post-test after rearranging the question items to assess students' achievement. The GAT consisted of 50 multiple-choice questions, each with four options (A-D), with one correct answer. Each question was worth 2 marks, and the instrument included two sections: Section A contained demographic information (school name and gender), and Section B contained the test items. The GAT was administered to experimental and control groups as a pre-test before instruction.

The Genetics Achievement Test (GAT) instrument was administered as a pretest to both the experimental and control groups before teaching genetics concepts. This initial assessment was crucial in establishing a baseline for comparing the students' performance after exposure to different teaching methods. In the first experimental group (blended learning), the GBLP was used to supplement traditional teaching by providing online video materials for students to study at their convenience. In the second experimental group (peer tutoring), after the lecturer had taught the students for one and a half hours, they (students) were paired for 20-minute sessions to share their learning experiences and teach each other the concepts. Pairings were based on students' strengths, with one student acting as the tutor and the others as tutees. The tutor explained the concepts while the lecturer monitored and corrected as necessary. The control group received instruction through the traditional teaching method only.

The study lasted eight weeks, after which the post-test (GAT) was administered to the experimental and control groups to determine their achievement. The research questions were addressed using mean scores and standard deviations, while the research hypotheses were tested using ANCOVA at a 0.05 significance level.

RESULT AND DISCUSSION

This section presents the mean and standard deviation of the results of the data obtained from the achievements of students in genetics in both experimental and control groups.

A. Analysis of research questions

Research Question 1: What is the difference between the genetic achievement of NCE Agricultural Education students exposed to blended learning and traditional instruction?

Table 1 Mean score of achievement of NCE Agricultural Education students exposed to blended learning and those exposed to traditional instruction

GROUPS	N	$\bar{x}$	Std. Deviation
blended	58	69.42	7.502
control	36	49.94	4.84
Total	94	61.96	11.57

Table 1 revealed the mean score of achievement of participants in the study. The mean score of NCE Agricultural Education Students taught genetics using blended learning was 69.42, with a standard deviation 7.50. In contrast, those taught with traditional instruction had a mean score of 49.94 with a standard deviation of 4.84. This result implies that blended learning enhances students' achievement more than traditional instruction.

Research Question 2: What is the difference in the genetic achievement of NCE Agricultural Education Students exposed to peer tutoring and those exposed to traditional instruction?

Table 2 Mean score of achievement of NCE agricultural education students exposed to peer tutoring and those exposed to traditional instruction

GROUPS	N	$\bar{x}$	Std. Deviation
peer tutoring	73	56.22	5.202
control	36	49.94	4.84
Total	109	54.14	5.868

Table 2 revealed the mean score of achievement of participants in the study. The mean score of NCE Agricultural Education Students who were taught genetics with the use of peer tutoring was 56.22, with a standard deviation of 5.202. In contrast, those taught with traditional instruction had a mean score of 49.94 with a standard deviation of 4.84. This result implies that blended learning enhances students' achievement more than traditional instruction.

Research Question 3: What is the difference between the genetic achievement of NCE Agricultural Education students exposed to blended learning and peer tutoring and those exposed to traditional instruction?

Table 3 Mean score of achievement of NCE agricultural education students exposed to blended learning, peer tutoring and those exposed to traditional instruction

GROUPS	N	$\bar{x}$	Std. Deviation
blended	58	69.42	7.502
peer tutoring	73	56.22	5.202
control	36	49.94	4.840
Total	167	59.44	9.740

Table 3 revealed the mean achievement score of participants in the study. The mean score of NCE Agricultural Education Students who were taught genetics with the use of blended learning was 69.42 with a standard deviation of 7.50; those taught with the use of peer tutoring was 56.22 with a standard deviation of 5.202, while those taught with traditional instruction had a mean score of 49.94 with the standard deviation of 4.84. This result implies that the blended learning strategy improved students' achievement in genetics compared to peer tutoring or traditional instructionts.

Research Question 4: What is the influence of gender on NCE Agricultural Education Students' achievement in genetics when exposed to blended learning and those exposed to traditional instruction?

Table 4 Mean score of achievement of NCE agricultural education students taught using blended learning and those exposed to traditional instruction based on gender

GROUPS	GENDER	N	$\bar{x}$	Std. Deviation
blended	male	31	74.32	5.344
	female	27	63.78	5.358
	Total	58	69.42	7.502
control	male	22	52.28	3.966
	female	14	46.28	3.750
	Total	36	49.94	4.840
Total	male	53	65.16	11.964
	female	41	57.80	9.684
	Total	94	61.96	11.57

Table 4 shows the mean achievement scores of male and female participants in the study. The mean score of male NCE Agricultural Education Students who were taught genetics with the use of blended learning was 74.32 with a standard deviation of 5.34, while the female students had a mean score of 63.78 and a standard deviation of 5.36; also, the mean score of male NCE Agricultural Education Students that were taught genetics taught with traditional instruction was 52.28 with the standard deviation of 3.97 while the female students had a mean score of 46.28 with a standard deviation of 3.75. The mean score of male students in blended learning and traditional instruction was higher than that of their female counterparts. It enhanced the achievement of students in favour of males.

Research Question 5: What is the influence of gender on NCE Agricultural Education Students' achievement in genetics when exposed to peer tutoring and those exposed to traditional instruction?

Table 5 Mean score of achievement of NCE agricultural education students taught using peer tutoring and those exposed to traditional instruction based on gender

GROUPS	GENDER	N	$\bar{x}$	Std. Deviation
Peer tutoring	male	46	58.44	4.540
	female	27	52.44	3.974
	Total	73	56.22	5.202
Control	male	22	52.28	3.966
	female	14	46.28	3.750
	Total	36	49.94	4.840
Total	male	68	56.44	5.216
	female	41	50.34	4.856
	Total	109	54.14	5.868

Table 5 shows the mean achievement scores of male and female participants in the study. The mean score of male NCE Agricultural Education students who were taught genetics using Peer Tutoring was 58.44, with a standard deviation of 4.54. In contrast, the female students had a mean score of 52.44 and a standard deviation of 3.97. Additionally, the mean score of male NCE Agricultural Education students taught genetics using traditional instruction was 52.28, with a standard deviation of 3.97, while the female students had a mean score of 46.28 and a standard deviation of 3.75. It is evident that the mean scores of male students were higher than those of their female counterparts in both the Peer Tutoring and traditional instruction groups, indicating a more remarkable achievement in favour of male students.

B. Hypotheses testing

This section presents the results and analysis of the formulated hypotheses using the Analysis of CO-Variance (ANCOVA) at 0.05 significance level.

H_{01}: There is no significant difference in the achievement of genetics among NCE Agricultural Education students exposed to blended learning and those exposed to traditional instruction.

The ANCOVA test output in Table 6 indicated the calculated F-value (14.06) computed at 0.05 significance level. The result of the analysis shows that the calculated sig. (0.000) is less than tabulated sig. (0.05). Hence, the hypothesis is rejected, implying a significant difference in the genetic achievement of NCE Agricultural Education Students exposed to blended learning and those exposed to traditional instruction. This finding favours blended learning with a mean score of 69.42, which is greater than the traditional method's mean score (49.94). Hence, students'

exposure to blended learning strategy improved their achievement in genetics compared to traditional instruction.

Table 6 Summary of analysis of covariance (ANCOVA) of mean score of achievement of NCE Agricultural Education students taught using blended learning and traditional instructions.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Remarks
Corrected Model	2168.143a	2	1084.072	104.523	.000	
Intercept	700.016	1	700.016	67.494	.000	
PRETEST	63.175	1	63.175	6.091	.015	
GROUPS	145.806	1	145.806	14.058	.000	S
Error	943.814	91	10.372			
Total	93322.000	94				
Corrected Total	3111.957	93				

a. R Squared = .697 (Adjusted R Squared = .690),

P < 0.05

H02: There is no significant difference in the achievement in genetics of NCE Agricultural Education Students exposed to Peer Tutoring and those exposed to traditional instruction.

Table 7 Summary of analysis of covariance (ANCOVA) of mean score of achievement of NCE Agricultural Education students taught using peer tutoring and traditional instruction.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Remarks
Corrected Model	291.615a	2	145.808	24.233	.000	
Intercept	737.960	1	737.960	122.647	.000	
PRETEST	54.298	1	54.298	9.024	.003	
GROUPS	221.389	1	221.389	36.794	.000	S
Error	637.797	106	6.017			
Total	80823.000	109				
Corrected Total	929.413	108				

a. R Squared = .314 (Adjusted R Squared = .301),

P < 0.05

The ANCOVA test output in Table 7 indicated the calculated F-value (36.79) computed at a 0.05 significance level. The result of the analysis shows that the calculated sig. (0.003) is less than tabulated sig. (0.05). Consequently, the hypothesis is rejected and implies a significant difference in the genetic achievement of NCE Agricultural Education Students exposed to Peer Tutoring and those exposed to traditional instruction. This finding is in favour of Peer Tutoring with a mean score of 56.22, which is greater than the mean score (49.94) of traditional method. Therefore, Peer Tutoring strategy improved students' achievement in genetics than the traditional instruction.

H03: There is no significant difference in the achievement in genetics of NCE Agricultural Education Students exposed to blended learning, Peer Tutoring and those exposed to traditional instruction.

Table 8 Summary of analysis of covariance (ANCOVA) of mean score of achievement of NCE Agricultural Education students taught using blended learning, peer tutoring and traditional instruction.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Remarks
Corrected Model	2546.700a	3	848.900	99.502	.000	
Intercept	1343.748	1	1343.748	157.505	.000	
PRETEST	103.483	1	103.483	12.130	.001	
GROUPS	318.621	2	159.311	18.673	.000	S
Error	1390.630	163	8.531			
Total	151490.000	167				
Corrected Total	3937.329	166				

a. R Squared = .647 (Adjusted R Squared = .640)

P < 0.05

The ANCOVA test output in Table 8 indicated a calculated F-value of 18.67, computed at the 0.05 significance level. The analysis shows that the calculated significance value (0.000) is less than the tabulated significance value (0.05). Therefore, the hypothesis is rejected, indicating a significant difference in the genetic achievement of NCE Agricultural Education students exposed to blended learning and peer tutoring from those exposed to traditional instruction. This finding favours blended learning, with a mean score of 69.42, followed by peer tutoring (56.22), which is higher than the mean score of traditional instruction (49.94). Hence, the blended learning strategy improved students' genetic achievement more than peer tutoring and traditional instruction.

Ho4: There is no significant difference in the genetic achievement of male and female NCE Agricultural Education Students when exposed to blended learning and those exposed to traditional instruction.

Table 9 Summary oof analysis of covariance (ANCOVA) of mean score of achievement of NCE Agricultural Education students taught using blended learning and traditional instruction based on gender.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Remarks
Corrected Model	2595.019a	4	648.755	111.694	.000	
Intercept	896.535	1	896.535	154.354	.000	
PRETEST	12.227	1	12.227	2.105	.150	
GROUPS	253.622	1	253.622	43.665	.000	
GENDER	329.026	1	329.026	56.648	.000	S
GROUPS * GENDER	26.628	1	26.628	4.584	.035	
Error	516.939	89	5.808			
Total	93322.000	94				
Corrected Total	3111.957	93				

a. R Squared = .834 (Adjusted R Squared = .826)

P < 0.05

The ANCOVA test output in Table 9 indicated the calculated F-value (4.58) computed at

0.05 significance level. The result of the analysis shows that the calculated sig. (0.035) is less than tabulated sig. (0.05). Consequently, the hypothesis is rejected and implies a significant difference between the achievement in genetics of male and female NCE Agricultural Education Students exposed to blended learning and those exposed to traditional instruction. This finding favours male students with a mean score of 65.16, which is greater than their female counterparts' mean score (57.80). Hence, this shows that male students achieved slightly better genetics than their female counterparts in blended learning and traditional instruction.

H05: There is no significant difference in the genetic achievement of male and female NCE Agricultural Education Students when exposed to peer tutoring and those exposed to traditional instruction.

Table 10 Summary of analysis of covariance (ANCOVA) of mean score of achievement of NCE Agricultural Education students taught using peer tutoring and traditional instruction based on gender.

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Remarks
Corrected Model	468.259a	4	117.065	26.401	.000	
Intercept	883.601	1	883.601	199.271	.000	
PRETEST	1.644	1	1.644	.371	.544	
GROUPS	214.927	1	214.927	48.471	.000	
GENDER	166.936	1	166.936	37.648	.000	S
GROUPS * GENDER	.041	1	.041	.009	.924	
Error	461.154	104	4.434			
Total	80823.000	109				
Corrected Total	929.413	108				

a. R Squared = .504 (Adjusted R Squared = .485)

P > 0.05

The ANCOVA test results presented in Table 10 showed a calculated F-value of 0.009, computed at the 0.05 level of significance. The analysis revealed that the calculated significance value (0.000) is lower than the tabulated significance value (0.05). As a result, the hypothesis is rejected, indicating a significant difference in the achievement in genetics between male and female NCE Agricultural Education students exposed to peer tutoring and those exposed to traditional instruction. The findings favor male students, with a mean score of 56.44, which is higher than the mean score of 50.34 for their female counterparts. This suggests that male students performed slightly better in genetics than female students in peer tutoring and traditional instruction settings.

C. DISCUSSION

The findings from this study indicate that students taught genetics using the blended learning strategy outperformed those taught using traditional instruction. This improvement may be attributed to the enhanced clarity and comprehensiveness of genetic terms in the video package, allowing students to link these concepts better and achieve meaningful learning. Thus, the blended learning strategy effectively improved students' achievement in genetics by aiding their comprehension of the subject matter. This result aligns with the findings of Yapici and Akbayin (2012), Abidoye (2015), and Kayii and Dambo (2018), which demonstrated that the blended learning model contributed significantly more to student achievement than traditional teaching methods. Their studies also revealed that students taught using blended learning achieved signi-

ficantly higher results than those in control groups.

Another key finding revealed that students taught genetics through peer tutoring also achieved better results than those taught through traditional methods. The influence of peer interactions likely played a substantial role in helping students grasp the genetic concepts. Peer tutors simplified the material, making it easier for tutees to understand. This finding is supported by Ali, Anwar, and Abbas (2015), who found that peer tutoring is a highly effective way for students to learn from each other. It not only benefits students academically but also help in developing communication and interpersonal skills. Zahoor (2017) similarly found that peer tutoring resulted in positive changes in student performance, particularly in mathematics, and concluded that this strategy increases the academic achievement of weaker and mediocre students.

The study also showed a significant difference in the achievement of students exposed to blended learning, peer tutoring, and traditional instruction. Blended learning was more effective in improving student achievement in genetics than peer tutoring and traditional instruction. This outcome is consistent with the findings of Adekoya and Olatoye (2011), which demonstrated the significant effect of instructional methods on student achievement in agricultural topics. They found that demonstration and peer-tutoring strategies were more effective than conventional methods in enhancing student performance.

Furthermore, the results indicated a significant difference in the achievement of male and female students exposed to blended learning compared to traditional instruction. This study supports the work of Mohammed (2000) and Mohammed (2004), who argued that gender differences can affect academic performance. Finally, the study revealed a significant difference in the achievement of male and female students exposed to peer tutoring compared to traditional instruction. This finding contradicts the research of Asogwa *et al.* (2016) and Iji, Ochu, Adikwu, and Atamomokhai (2017), who found no significant gender differences in student achievement.

CONCLUSION

In conclusion, this study found that blended learning and peer tutoring are highly effective strategies for teaching genetics. The results indicated that students taught using these methods achieved higher than those exposed to traditional teaching, with blended learning overall being the most effective strategy. Additionally, the study demonstrated that male and female students benefited from these approaches, although male students slightly outperformed their female counterparts in genetics across all teaching methods.

Based on these findings, it is recommended that teachers and students utilise blended learning and peer tutoring strategies to improve the teaching and learning of genetics and other agricultural subjects. Curriculum planners should encourage the adoption of innovative teaching strategies and integration of Information and Communication Technologies (ICT) into educational practices, as these approaches have proven effective in teaching genetics. Furthermore, Agricultural Science teachers should consider developing various blended learning resources tailored to teaching agricultural topics, particularly those with complex concepts, as this method has shown significant effectiveness in enhancing student understanding. These recommendations emphasise modernising teaching strategies to improve student engagement and academic performance in agricultural education.

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