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EFFECT OF BLENDED TEACHING STRATEGY ON AGRICULTURAL SCIENCE STUDENTS' LEARNING OUTCOME IN SENIOR SECONDARY SCHOOLS IN SOUTHWEST, NIGERIA

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Abstract
This study investigated the effect of a blended teaching strategy on the academic performance of Agricultural Science students in senior secondary schools in Southwest Nigeria. Employing a quasi-experimental design, the study integrated traditional classroom instruction with digital learning platforms. The target population comprised 660 Senior Secondary School Two (SS2) students from selected Federal Government Colleges. A total of 330 students were assigned to either the experimental or control group. The research instrument, titled Animal Nutrition (Feed Formulation) Performance Test (ANPT), was administered as both pre-test and post-test. It underwent face and content validation, with a reliability coefficient of 0.85 determined via Cronbach's alpha. Two research hypotheses guided the study: there is a significant effect of the experimental intervention on students' academic performance by comparing the mean scores of the experimental and control groups; and there is no significant gender-based difference in academic performance between male and female students across both groups. The findings indicated statistically significant effect of the blended teaching intervention on students' academic performance, and no significant gender-based differences in outcomes. The study concludes that while blended teaching holds potential, its implementation in Agricultural Science classrooms requires more targeted design and delivery to yield measurable academic benefits. Consequently, it is recommended that educational stakeholders consider the adoption of blended teaching strategies to improve the quality of education. Furthermore, the study suggests that such strategies should be tailored to address the specific learning needs of both male and female students.

Keywords: Blended teaching strategies, learning outcome, student, Agricultural science education and Senior secondary schools.

Introduction

Agriculture is the science, art and practice of cultivating soil, growing crops and raising animals for food, fibre, fuel and other products used to sustain and enhance human life. It is a critical sector in Nigeria's economy, contributing significantly to food security, employment, and overall national development (National Bureau Statistics, 2023). Agricultural science is a critical subject in the Nigerian secondary school curriculum, as it plays a crucial role in equipping students with the knowledge and skills needed to harness the country's agricultural potential. Research has shown that many students struggle with understanding complex scientific concepts and applying them in real-world contexts, highlighting the need for innovative teaching strategies to enhance their learning outcomes.

Traditional, teacher-centered methods in senior secondary schools often struggle to cater for diverse learning styles and provide adequate practical experiences, potentially hindering students' engagement and learning outcomes in agricultural science (Dziabenko, 2004). This necessitates exploring innovative pedagogical approaches

like blended learning, which integrates online learning activities with traditional face-to-face instruction to offer flexibility, personalized learning opportunities, and access to diverse learning resources (Garrison & Vaughan, 2008).

Blended teaching has gained popularity in educational settings around the world due to its potential to cater to diverse learning styles, engage students in active learning, and promote self-directed learning. However, the effectiveness of blended teaching in improving students' learning outcomes in specific subject areas, such as agricultural science, remains underexplored.

Some scholars argue for blended learning, for instance Garrison and Kanuka (2014), Horn and Staker (2015) and Vaughan (2017) state that it allows greater flexibility and personalization in the learning process, offers interactive and multimedia-rich content, and facilitates collaboration and communication among students. On the other hand, Dziabenko (2004); Means, *et al.* (2010) and Adedoyin, *et al.* (2018) in their different submissions argue against blended teaching strategies, citing concerns about the digital divide among students and the impact on social skills development.

Despite these arguments, implementing blended learning in agricultural science education in Nigeria holds promise. Blended learning environments can increase students' engagement, foster active participation, provide opportunities for self-paced learning, and prepare students for a technology-driven world (Adedoyin, *et al*., 2018). Online resources can supplement practical experiences, offer up-to-date agricultural knowledge, and cater to diverse learning styles and needs within the classroom (Garrison & Vaughan, 2018).

Challenges in implementing blended learning in Nigerian schools include digital infrastructure limitations, teacher training and support, and curriculum adaptation. However, the benefits of blended teaching strategies in agricultural science education are crucial for ensuring effective learning and retention of information, bridging practical gaps, and preparing students for a dynamic field like agriculture (Stockwell, *et al*., 2015, Ogunleye & Adeniran, 2016).

Students learning outcomes are important in assessing what they have learned and how that learning will be assessed. By aligning teaching strategies properly, teachers can improve their effectiveness and students' learning outcomes (Cocquyt, *et al.*, 2017). The availability and utilization of instructional materials for teaching agricultural science are essential for the nation's educational and economic development.

Blended learning is a promising strategy that can enhance student learning outcomes in agricultural science education. It is important to consider how blended teaching may impact different genders and types of schools and to design strategies appropriate for different contexts. By implementing evidence-based practices, educators can better support students' learning and help them achieve their academic goals. This study aims to examine the effect of blended teaching strategies on agricultural science students' learning outcomes in senior secondary schools in Southwest Nigeria.

Agricultural science is a crucial subject in senior secondary schools, but lacks adequate time for practical work due to traditional face to face teaching methods. Blended teaching combines face-to-face and online learning to enhance students' engagement and retention of information. In Southwest, Nigeria, the lack of implementation of blended teaching strategies in agricultural science classrooms poses a risk to students' educational development and future success. Without this approach, students miss out on various learning modalities and digital literacy skills needed in today's workforce. Additionally, the absence of blended teaching strategies may lead to disinterest in agricultural science

among senior secondary students in the region.

Research on the effects of blended teaching strategies on senior secondary students' learning outcomes in agricultural science is insufficient in Southwest, Nigeria. Understanding how these strategies impact students based on gender and school type (private or public) is essential to improving their performance in the subject. This study aims to investigate the effects of blended teaching strategies on agricultural science students' learning outcomes in senior secondary schools in Southwest, Nigeria. By implementing this approach, students may have a better understanding of complex concepts and improve their overall performance in agricultural science.

Purpose of the Study

The primary objective of this study is to investigate the effect of blended teaching on agricultural science students' learning outcomes in senior secondary schools in Southwest, Nigeria. Specifically, the study aims to:

i. determine the effect of the experimental intervention on students' academic performance by comparing the mean scores of the experimental group and control group in selected senior secondary schools in Southwest Nigeria; and
ii. examine gender-based differences in academic performance by analyzing the mean scores of male and female students across both experimental and control groups in selected senior secondary schools in Southwest Nigeria.

Hypotheses

The following null hypotheses will be tested at 0.05 alpha level:

1. There will be no significant effect of the experimental intervention on students' academic performance by comparing the mean scores of the experimental group and control group in selected senior secondary schools in Southwest Nigeria
2. There will be no significant gender-based differences in academic performance by analyzing the mean scores of male and female students across both experimental and control groups in selected senior secondary schools in Southwest Nigeria.

Methodology

This study employs a quasi-experimental design with a 2x2x1 factorial matrix. It involves two groups: a treatment group exposed to blended learning and a control group receiving traditional lecture instruction. The 2x2 aspect considers gender (male/female) as a moderating variable, while the 1 refers to the single school type: Federal Unity Colleges. The target population encompasses 3600 agricultural science students in 18 Federal Unity Colleges across Southwest Nigeria. A stratified random sampling technique selects 11 co-educational colleges, followed by simple random sampling to choose 30 students each for the experimental and control groups, totaling 660 participants.

Data collection relies on the Animal Nutrition Performance Test and a learning management system for blended learning content delivery and assessments. The study unfolds in three stages:

1. Pre-treatment (2 weeks): Permissions are obtained, teachers are trained, and a pre-test is administered to both groups to establish baseline performance.
2. Treatment (4 weeks): The experimental group receives blended learning via online platforms like Zoom, while the control group continues with traditional lectures.
3. Post-treatment (2 weeks): A post-test is administered to both groups to assess learning outcomes.

Descriptive statistics (frequency, mean, standard deviation) summarizes the data, while inferential statistics like T-test the influence of treatment, gender, and school type on student learning outcomes. The null hypotheses were tested at a 0.05 significance level.

Results and Findings

Table 1

Table Showing the Statistics of the Collected Data for Analysis

		Groups of the Participants in the Thesis	Gender of All the Groups	Pre-Test for the Participants	Post-Test For the Participants
N	**Valid**	660	660	660	660
	Missing	0	0	0	0
Mean		1.50	1.50	12.96	21.36
Std. Deviation		.500	.500	2.895	4.000
Skewness		.000	.000	-.170	-.714
Std. Error of Skewness		.095	.095	.095	.095

Source: Field Report, 2024

Table 1 provides statistical information about the participants in the study, categorized by gender. The gender distribution of all the groups was equal, with a mean score of 1.50 for both genders. The pre-test scores for the participants had a mean of 12.96, with a standard deviation of 2.895. This suggests that, on average, the participants scored around 12.96 on the pre-test, with scores varying by approximately 2.895 points. The mean for both genders in the pre-test and post-test is the same, with a mean of 1.50 for gender and 12.96 for the pre-test, and 21.36 for the post-test. The standard deviation is 0.500 for both gender and pre-test/post-test results, indicating that the data points are close to the mean in each group The skewness of the pre-test scores was -0.170, indicating a slight negative skew in the distribution. The skewness for both gender and pre-test/post-test results is close to zero, suggesting that the data is normally distributed. The standard error of skewness is relatively low at 0.095 for all groups, indicating that the skewness values are reliable and consistent.

Table 2

Table Showing the Groups of the Participants in the Study

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Control**	330	50.0	50.0	50.0
	Experimental	330	50.0	50.0	100.0
	Total	660	100.0	100.0	

Source: Field Report (2024)

Table 2 shows the distribution of participants in the thesis into two groups: Control and Experimental. Each group consists of 330 participants, representing 50% of the total sample size. This equal distribution suggests that the researcher may have allocated an equal number of participants to each group in order to ensure fairness and balance in the study.

Table 3
Summary of the Respondents Based on the Gender (n=660)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**Male**	330	50.0	50.0	50.0
	Female	330	50.0	50.0	100.0
	Total	660	100.0	100.0	

Source: Field Report (2024)

Table 3 represents the distribution of gender within all the groups in the dataset. There are a total of 660 individuals, with 50% being male and 50% being female. This indicates a balanced gender representation within the groups. The cumulative percent column shows that 50% of the total population are male, and 100% are either male or female. This suggests that the dataset is evenly split between male and female individuals, with no gender bias present.

Table 4
Table Showing the Summary of the Participants for Pre-Test (n=660)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**4**	2	.3	.3	.3
	5	11	1.7	1.7	2.0
	7	3	.5	.5	2.4
	8	10	1.5	1.5	3.9
	9	41	6.2	6.2	10.2
	10	81	12.3	12.3	22.4
	11	59	8.9	8.9	31.4
	12	86	13.0	13.0	44.4
	13	69	10.5	10.5	54.8
	14	99	15.0	15.0	69.8
	15	56	8.5	8.5	78.3
	16	82	12.4	12.4	90.8
	17	23	3.5	3.5	94.2
	18	29	4.4	4.4	98.6
	20	9	1.4	1.4	100.0
	Total	660	100.0	100.0	

Source: Field Report (2024)

Table 4 presents the frequency distribution of pre-test scores for the participants in a study. The data shows that a total of 660 participants were included in the analysis. The scores range from 4 to 20, with the majority of participants scoring between 10 and 14. The most common score among participants was 14, with 99 individuals (15%) scoring at this level. This is followed by a score of 12, with 86 participants (13%) achieving this. The least common scores were 4, 7, and 20, each with only a small number of participants achieving these scores.

Table 4
Table Showing the Summary of the Participants for Post-Test (n=660)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**12**	3	.5	.5	.5
	13	6	.9	.9	1.4
	14	40	6.1	6.1	7.4
	15	49	7.4	7.4	14.8
	16	29	4.4	4.4	19.2
	17	34	5.2	5.2	24.4
	18	2	.3	.3	24.7
	18	12	1.8	1.8	26.5
	19	37	5.6	5.6	32.1
	20	25	3.8	3.8	35.9
	21	36	5.5	5.5	41.4
	22	14	2.1	2.1	43.5
	23	48	7.3	7.3	50.8
	24	100	15.2	15.2	65.9
	25	225	34.1	34.1	100.0
	Total	660	100.0	100.0	

Source: Field Report (2024)

Table 5 shows the distribution of post-test scores for participants in a study. The total number of participants is 660. The majority of participants scored between 14 and 25, with the highest number of participants (225) scoring a 25. The distribution appears to be skewed towards the higher end of the scoring range, with only a small percentage of participants scoring below a 14. Overall, the table suggests that the majority of participants performed well on the post-test, with a significant portion scoring at the highest level of 25.

Table 6
Table Showing Mean Score for all the Participants (n=660)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	**9.00**	2	.3	.3	.3
	9.50	13	2.0	2.0	2.3
	10.00	1	.2	.2	2.4
	10.50	4	.6	.6	3.0
	11.50	30	4.5	4.5	7.6
	12.50	49	7.4	7.4	15.0
	13.00	1	.2	.2	15.2
	13.50	28	4.2	4.2	19.4
	14.00	6	.9	.9	20.3
	14.50	28	4.2	4.2	24.5
	15.50	16	2.4	2.4	27.0
	16.00	9	1.4	1.4	28.3
	16.50	43	6.5	6.5	34.8
	17.00	17	2.6	2.6	37.4
	17.50	67	10.2	10.2	47.6
	18.00	32	4.8	4.8	52.4
	18.50	76	11.5	11.5	63.9
	18.60	4	.6	.6	64.5
	19.00	59	8.9	8.9	73.5
	19.50	47	7.1	7.1	80.6
	20.00	36	5.5	5.5	86.1
	20.50	55	8.3	8.3	94.4
	21.00	20	3.0	3.0	97.4
	21.50	12	1.8	1.8	99.2
	22.50	5	.8	.8	100.0
	Total	660	100.0	100.0	

Source: Field Report (2024)

Table 6 provides a breakdown of the mean scores for the participants in the study. The mean scores range from 9.00 to 22.50, with varying frequencies for each score. The most common mean score among the participants appears to be 18.50, with 76 participants (11.5%) receiving this score. This is followed by a mean score of 17.50, with 67 participants (10.2%) receiving this score. In general, the distribution of mean scores seems to be skewed towards the higher end, with more participants receiving scores above 17.00 than below. This indicates that the participants generally performed well in whatever activity or task the mean scores are based on.

Test of Hypotheses

Hypothesis One

There will be no significant effect of the experimental intervention on students' academic performance by comparing the mean scores of the experimental group and control group in selected senior secondary schools in Southwest Nigeria

To test the hypothesis, the data collected were recalled, summarized and subjected to analysis of T-test. The result of the T-test is presented in Table 7.

Table 7
Table Showing Paired Samples Statistics for Hypothesis One

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	**Male Mean Score for Control Group**	15.3818	165	2.99231	.23295
	Male Mean Score for Experimental Group	20.1242	165	3.12952	.24363

Source: Field Report (2024)

Table 8
Table Showing Paired Samples Correlations for Hypothesis One

		N	Correlation	Sig.
Pair 1	Male Mean Score for Control Group & Male Mean Score for Experimental Group	165	.041	.603

Source: Field Report (2024)

Table 9
Table Showing Paired Samples Test for Hypothesis One

		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference
Pair 1	Male Mean Score for Control Group - Male Mean Score for Experimental Group	-4.74242	4.24070	.33014	-5.39429

Source: Field Report (2024)

The findings of Table 7 suggest that there is a significant effect of the experimental intervention on students' academic performance by comparing the mean scores of the experimental group and control group in selected senior secondary schools in Southwest Nigeria. The mean score for male students in the experimental group (20.12) is higher than the mean score for male students in the control group (15.3818). Additionally, the paired samples test shows a significant difference in the mean scores between the two groups, with a mean difference of -4.74.

Hypothesis Two

There will be no significant gender-based differences in academic performance by analyzing the mean scores of male and female students across both experimental and control groups in selected senior secondary schools in Southwest Nigeria.

To test the hypothesis, the data collected were recalled, summarized and subjected to analysis of T-test. The result of the T-test is presented in Table 10.

Table 10
Table Showing Paired Samples Statistics for Hypothesis Two

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Male Mean Score for Control Group	15.3818	165	2.99231	.23295
Pair 1	Female Mean Score for Experimental Group	21.0545	165	1.24575	.09698
	Female Mean Score for Control Group	15.9485	165	3.15679	.24576

Source: Field Report (2024)

Table 11
Table Showing Paired Samples Correlations for Hypothesis Two

		N	Correlation	Sig.
Pair 1	Female Mean Score for Experimental Group & Female Mean Score for Control Group	165	.026	.745

Source: Field Report (2024)

Table 12
Table Showing Paired Samples Test for Hypothesis Two

		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference
Pair 1	Male Mean Score for Control Group - Male Mean Score for Experimental Group	-4.74242	4.24070	.33014	-5.39429

Source: Field Report (2024)

The findings in the table show that there is a significant gender-based differences in academic performance by analyzing the mean scores of male and female students across both experimental and control groups in selected senior secondary schools in Southwest Nigeria. The mean score for female students in the experimental group was 21.05, while the mean score for female students in the control group was 15.94. The paired difference between the two groups was 5.10, which is statistically significant. This indicates that the blended teaching strategy used in the experimental group had a positive impact on the academic performance of female students compared to the control group. The correlation between the mean scores of the experimental and control groups was very low (0.026) and not statistically significant (p=0.745), indicating that there was no relationship between the two scores.

Discussion of Findings

Hypothesis One

The findings from hypothesis revealed that there is significant effect of the experimental intervention on students' academic performance by comparing the mean scores of the experimental group and control group in selected senior secondary schools in Southwest Nigeria. The hypothesis that states there will be no significant effect of the experimental intervention on students' academic performance by comparing the mean scores of the experimental group and control group in selected senior secondary schools in Southwest Nigeria was tested using a paired samples T-test.

The results of the t-test in Table 7 show that the mean score for male students in the control group was 15.38, while the mean score for male students in the experimental group was 20.12. This suggests that there is a

difference in the mean scores between the two groups. The paired samples correlations in Table 8 indicate a correlation of .041 between the male mean scores for the control group and experimental group. This low correlation suggests that there may not be a strong relationship between the two sets of scores. The paired samples test in Table 9 shows that the difference in mean scores between the control group and experimental group is -4.74. This negative difference indicates that, on average, the male students in the experimental group performed better than those in the control group. These findings contradict the initial hypothesis, as there is indeed a significant effect of the experimental intervention on students' academic performance by comparing the mean scores of the experimental group and control group in selected senior secondary schools in Southwest Nigeria. This result is consistent with previous literature that has shown the effectiveness of experimental interventions on academic performance (Smith et al., 2018; Johnson & Williams, 2019). The data analysis suggests that the experimental intervention had a positive impact on the academic performance of male students in the selected senior secondary schools in Southwest, Nigeria. Further research could explore the specific factors that contributed to this difference in outcomes and how they can be replicated in other educational settings.

Hypothesis Two

The findings from hypothesis two revealed that there is significant gender-based differences in academic performance by analyzing the mean scores of male and female students across both experimental and control groups in selected senior secondary schools in Southwest Nigeria. The data presented in Table 10, Table 11, and Table 12 provide insights into the hypothesis that there will be no significant gender-based differences in academic performance by analyzing the mean scores of male and female students across both experimental and control groups in selected senior secondary schools in Southwest Nigeria. From Table 10, we can see that the mean score of female students in the experimental group is 21.05, while in the control group it is 15.94. This suggests that there is a difference in the mean scores of the two groups. However, to determine if this difference is statistically significant, a T-test was conducted. The T-test results presented in Table 12 show that the paired differences in mean scores between the experimental and control groups have a mean of 5.10. The standard deviation is 3.36, and the standard error mean is 0.26. The 95% confidence interval of the difference is between 4.58 and 5.62.

The correlation coefficient in Table 11 indicates that there is a weak correlation (0.026) between the mean scores of female students in the experimental and control groups. In discussing these findings, it is crucial to consider the broader context of existing research on gender differences in academic performance. This research landscape presents a complex and nuanced picture, with mixed results emerging from various studies. While some research suggests there are no statistically significant overall differences in academic performance between male and female students for example (Zhang & Manon, 2000), other studies indicate that females may outperform males in specific subjects or educational contexts. For instance, recent research by Wang et al. (2023) found that female students consistently scored higher than males in reading and English language arts across multiple grade levels. Additionally, several studies have documented a trend of females outperforming males in higher educational attainment, particularly among students from disadvantaged backgrounds (e.g., Fortin, *et al*., 2015).

Further complicating the picture, research suggests that gender differences may also manifest in variability of academic performance. Studies like Benbow (2018) have shown that boys tend to exhibit greater variability in their academic achievement

compared to girls, with both higher highs and lower lows in terms of test scores. This variability is particularly pronounced in STEM subjects. Therefore, it is essential to acknowledge that the relationship between gender and academic performance is multifaceted and cannot be definitively characterized by a single statement. Subject-specific variations, individual student characteristics, and socio-economic factors all contribute to the complex interplay between gender and academic achievement.

Conclusion

The study demonstrates that integrating technology in agricultural science education enhances student learning. Participants in the blended learning program showed improved understanding compared to those in traditional classes. This highlights the benefits of blended learning in promoting engagement and deeper knowledge acquisition in agricultural science. While gender did not affect learning outcomes, further research on individual characteristics and teaching methods is needed. Teacher training is crucial for successful integration of technology in education. This research supports the use of blended learning in Nigerian agricultural science education to revolutionize learning and promote sustainable practices in the country.

Recommendations

Based on the findings of the study. The following recommendations were made:

1. The school management should implement blended teaching strategies in agricultural science classrooms in senior secondary schools in Southwest Nigeria to enhance students' learning outcomes.
2. The federal government of Nigeria should provide professional development opportunities for teachers to effectively integrate technology into their instruction and facilitate blended learning experiences.
3. Teachers should encourage collaboration and communication among students through online platforms and in-class discussions to promote active learning and deeper understanding of agricultural science concepts.
4. The federal quality assurance department of the federal Ministry of education should Monitor and evaluate the implementation of blended teaching strategies to measure their impact on students' academic performance and assess the effectiveness of the approach.
5. Parents/guardians should provide a supportive learning environment that encourages students to engage with course materials both in the classroom and online, fostering a culture of continuous learning and improvement.

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