JOURNAL OF RESEARCH IN INDUSTRIAL TECHNOLOGY & EDUCATIONAL STUDIES (JRITES)

Homepage: http://Journals.unizik.edu.ng/index.php/jrites

e-ISSN 3122-0436

Vol 2 Issue 2 (2026) 1-8

Effect of 4MAT Learning Strategy on Students' Performance in Animal and Crop Breeding in North-East Nigerian Universities

Barka Newton[1*], Abubakar S. Garba[2], Maryam I Danburam[1] & Victor Ayuba[3]

[1]Department of Vocational Education
Modibbo Adama University, Yola

[2]Department of Vocational Education
Abubakar Tafawa Balewa University, Bauchi

[3]School of Secondary Education (Business)
Federal College of Education (Technical) Gombe

Corresponding author

Abstract: This study investigated the effectiveness of the 4MAT learning strategy on the academic performance of agricultural education students in animals and crops breeding in North-East Nigerian universities. The study adopted a quasi-experimental design involving 106 of 300-level undergraduate students from two purposively selected universities. Data were collected using the Animals and Crops Breeding Cognitive Performance Test (ACBCPT). Pre-test and post-test scores were analyzed using descriptive statistics and Analysis of Variance (ANOVA) to determine differences between the experimental 4MAT group and the control group taught using conventional methods. The study found that the 4MAT learning strategy significantly improved students' academic performance in the post-test, while pre-test scores showed no significant difference, indicating equivalence at the baseline. The instruments used were valid and reliable, with Cronbach alpha coefficients above the recommended thresholds. The findings suggest that learner-centered, innovative teaching strategies enhance understanding, engagement, and mastery of complex agricultural concepts.

Keywords: Agricultural Education, Animal and Crop Breeding, Academic Performance, 4MAT Learning Strategy, Quasi-Experimental Design, North-East Nigeria.

INTRODUCTION

Agricultural education is one of the vocational education programme in tertiary institutions in Nigeria. It is a programme of instruction available to students desiring to learn about the plant and animal production and/or about the environmental and natural resources systems. Agricultural education is currently taught through a three-component model that includes classroom instruction, experiential learning and practical approaches. The three-component model is a guide for a complete approach to formal agricultural education by having each of the three components being equal in size and overlapping, emphasizing the connectivity (Shoulders & Toland, 2017). The programme is designed on training of students and allied professionals as agricultural education practitioners and experts in agricultural education sector. This programme is meant to provide students with knowledge and skills of

Corresponding author: newtonbarka@mau.edu.ng

agriculture as well as pedagogical approaches for learning delivery. One of the courses offered in agricultural education in Nigerian universities is animals and crops breeding.

Animals and crops breeding is one of the core courses in agricultural education programme in tertiary institutions in Nigeria. The course was geared towards providing students with the knowledge and skills required for the techniques of breeding crops and animals in order to produce animals and crops with superior qualities. The course focuses on principles and practices of genetics and genomics in animals, selective breeding for desired traits, artificial insemination and embryo transfer, cross breeding and hybridization (Bello & Mohammed, 2022). The author stressed that animals and crops breeding expose students to the influence of economic and environmental factors in animals and crops breeding that will enable for analysing policies and market dynamics related to agribusiness.

Despite the importance of animals and crops breeding to agricultural education students in Nigeria, studies conducted across the geo-political zones in Nigeria has consistently shows the performance of students in the course is not encouraging. For instance, studies conducted in the North-Central zone by Adeyemi and Ogundele (2020) disclosed that the average grades of students that sat for animals and crops breeding in 2018 and 2019 were significantly low, with over 60% of the students had carried over in the course. Okafor *et al.* (2021) revealed widespread low performance of students in crop growth and development. Similarly, in the South-West, the study of Adebayo and Ogunleye (2019) reported that less than 40% of students that offered animals and crops breeding in 2017 passed the course. The authors stressed that, the retention ability of students in course was also low.

To address these challenges, studies conducted by some scholars have recommended adopting innovative that prioritize active learning and practical engagement. The authors defined 4MAT learning strategy as the approach that is used to address the diversified learning styles of the learners through four quadrants (experiencing, conceptualizing, applying, and refining). The approach emphasizes experiential learning, linking new knowledge to existing frameworks, and applying skills to practical contexts. Oladipo and Adejumo (2020) reported that 4MAT model enhance students' understanding and retention in soil science and geography

Statement of the Problem

The academic performance, interest and retention of agricultural education students in animals and crops breeding is not encouraging based on the researcher survey in some universities in the study area. The course is allocated three credit unit but it has constituted a serious problem to students as performance and interest in the course keep declining consistently. The poor performance and interest in the course are worrisome; a survey in three examination and record offices in the Universities of study area by the researcher showed dwindled performance trends of students. In 2021/2022 academic session for instance, in one University in North-East Nigeria**,** 150 students sat for the exam on the course only 28.00 % passed while 72.00% of students failed the course.

Similarly, another survey in the examination and record office in another University in North-East Nigeria showed dwindled performance trends of students. In 2022/2023 academic session for instance, 39 students sat for the exam on the course only 46.54 % passed while 53.46% of students failed the course. Another survey in the examination and record office in another University in North-East Nigeria showed poor performance trends of students. These trends indicate that a significant number of agricultural education students struggle to grasp the concepts and practical applications in animals and crop breeding. The repeated low performance across multiple universities suggests systemic challenges in the teaching and learning of the course. Factors such as traditional lecture-based methods, limited practical engagement, and insufficient alignment with students' learning styles may be contributing to

poor retention and understanding. This situation not only affects students' academic outcomes but also threatens the development of skilled professionals in the agricultural sector.

Given the critical role of animals and crop breeding in agricultural education and the broader agribusiness industry, it is imperative to explore instructional strategies that can enhance students' comprehension, engagement, and academic performance. Innovative, learner-centered approaches, such as the 4MAT learning strategy, have shown potential in other educational contexts to improve understanding and retention. Therefore, investigating the effectiveness of such strategies in North-East Nigerian universities is necessary to identify solutions that can bridge the performance gaps and foster better learning outcomes in this core agricultural education course.

Objectives of the Study

The objectives of this study are to:

1. Determine the difference in the pre-test mean performance of agricultural education students in animals and crops breeding in the experimental 4MAT and control groups in North-East Nigerian Universities.
2. Determine the difference in the post-test mean performance of agricultural education students in animals and crops breeding in the experimental 4MAT control groups in North-East Nigerian Universities.

Research Questions

The following research questions were formulated to guide this study:

1. What is the difference in the pre-test mean performance of agricultural education students in animals and crops breeding in the experimental 4MAT control groups in North-East Nigerian Universities?
2. What is the difference in the post-test mean performance of agricultural education students in animals and crops breeding in the experimental (4MAT control groups in North-East Nigerian Universities?

Null Hypotheses

Based on the objectives, the following null hypotheses were formulated and tested at significant level of 0.05.

H_{01}: There is no significant difference between the pre-test mean performance of agricultural education students in animals and crops breeding in the experimental 4MAT control group in North-East Nigerian Universities.

H_{02}: There is no significant difference in the post-test mean performance of agricultural education students in animals and crops breeding in the experimental 4MAT control groups in North-East Nigerian Universities.

METHODOLOGY

The study adopted quasi-experimental design. The choice of the design was based on the suggestion of Imam (2019) who stated that quasi-experimental design should be adopted when a study involves finding out the effect(s) of a treatment(s) on a group(s) of people. The area of the study is North-East geopolitical Zone. The zone is made up of 6 States which include: Adamawa, Taraba, Gombe, Bauchi, Yobe and Borno States. The zone lies between latitude 11^0 32' and 11^0 4' North and longitude 13^0 32' and 13^0 25' east and located between the Sudan Savannah and Sahel Savannah vegetation zones. North-East zone of Nigeria lies between the vast arid expanse of the Sahara and the dense tropical rain forest along the Guinea Coast. This geographical area constitutes the largest zone in Nigeria since the state's creation in1996. It has a total of 103,639 square miles, representing 29.1 per cent of the total area of Nigeria. The study is conducted in Universities in North-East Nigeria because there is a need to investigate

the effectiveness of 4MAT learning-strategy in animals and crops breeding in addressing a knowledge gap in the existing literature. The population of the study consist of (106) 300 level undergraduate agricultural education students in Universities in the North East Nigeria in 2024/2025 academic session.

Table 1: Breakdown of the Population for the Study

S/N	List of Universities in North-East Nigeria	No of Students
1.	Modibbo Adama University, Yola	56
2.	Taraba state University, Jalingo	50
	Total	106

Source: Examination Office, (2024)

The sample for the study comprises two intact classes which were drawn from two universities in North East Nigeria. Both the two universities and the classes used for the study were selected purposively. There was no randomization in selecting the agricultural education students as intact classes were used. The researcher employed the service of research assistant who randomly selected two papers from the container. The used of intact classes is considered suitable because it help in controlling extraneous variables and minimizing disruption to the normal classroom environment that may be disallowed by the universities authority. The sample of the study is presented in table 2.

Table 2: Summary of the Sample Size for the Study

Universities	Learning Strategies	Groups	No of Students
Modibbo Adama University, Yola	4MAT	Ex	56
Taraba state University, Jalingo	Conventional	Control	50
TOTAL			**106**

Source: Examination Office, (2024)

Animals and Crops Breeding Cognitive Performance Test (ACBCPT) was used to collect data on performance of students. The ACBCPT consist of 40 multiple-choice questions from previous examination in the course from 2019 to 2025 sessions. The ACBCPT is divided into three (pre-test and post-test). The first phase of the ACBCPT is the pre-test. The ACBCPT was used to determine the entry level of the students prior to the treatment. The second phase of the ACBCPT was post-test. The ACBCPT was used to determine the academic performance of the students after the experiment.

The data collected from the pre-test and post-test was analysed using descriptive and inferential statistical tools. The Mean and Standard Deviation was used to answer the research questions. The decision rule was based on mean difference. The Analysis of Variance (ANOVA) was used to test the hypotheses at 0.05 level of significance. In testing the null hypotheses, where the *p*-value is greater than .05 ($p > .05$), the null hypothesis was accepted and where *p*-value is less than or equal to .05 ($p \leq .05$), the null hypothesis was rejected. Statistical Package for Social Sciences (SPSS) was used in carrying out the analysis.

The choice of ANOVA was because it's a suitable statistical tool for comparing three or more groups of data, to gain information about the relationship between the dependent and independent variables (Kenton, Walters and Li (2022). It helps to identify whether there are significant differences between the groups, which is essentially in determining the effectiveness of each learning strategy. While the decision rule of the Interest Inventory in

Animal and Crop Breeding (IIACB) questionnaire was on interval scale adopted from Umar (2018) who pronounced that the mean score of four point scale should be > 2.50 as such the decision are as follows: 1.0-1.49, Strongly disagreed (SD); 1.50-2.49, Disagreed, (D), 2.50-3.49, Agreed, (A); 3.50-4.00 Strongly Agreed, (SA).

RESULTS

Research Questions

Difference in the pre-test mean performance scores of agricultural education students in animals and crops breeding

Table 3: Descriptive statistics of the mean performance of agricultural education students in animal and crop breeding

Group	N	Mean	Std. Deviation
4MAT	28	26.29	4.206
Control group	23	25.91	4.728

Source: Field Study (2025)

Descriptive statistic was conducted to examine differences in the mean performance of agricultural education students in animal and crop breeding across the experimental group 4MAT and the control group. The results presented in Table 3 below revealed slight differences in mean scores at the pretest stage: 4MAT (M = 26.29, SD = 4.206) and the control group (M = 25.91, SD = 4.728). These findings indicate that the performance levels of students across the two groups were nearly equivalent in animal and crop breeding prior to the experiment.

Difference in the post-test mean performance scores of agricultural education students in animals and crops breeding

Table 4: Descriptive statistics of the post-test mean performance of agricultural education students in animals and crops breeding

Group	N	Mean	Std. Deviation
4MAT	28	68.00	2.694
Control group	23	49.43	4.357

***Source**: Field Study (2025)*

Descriptive statistics were conducted to examine the post-test mean performance of agricultural education students in animal and crop breeding across the experimental groups 4MAT and the control group. The results presented in Table 4 revealed clear differences in performance: 4MAT (M = 68.00, SD = 2.694) and the control group (M = 49.43, SD = 4.357). These findings indicate that students taught using the 4MAT learning strategy outperformed their counterparts in the control group. The result implies that the use of innovative learning strategy enhances students' learning outcomes in agricultural education, particularly in animal and crop breeding. The superior performance of the experimental groups reveals that learner-centered models such as 4MATpromote good understanding, better engagement, and improved mastery of subject matter compared to traditional teaching methods. Specifically, the 4MAT model, which recorded the highest mean score, appears to be the most effective in improving academic performance. This suggests that adopting such models in agricultural

education could bridge performance gaps, promote higher-order thinking, and better prepare students with the competencies required for real-life agricultural practices.

Test of Null hypothesis

$H_0$1: There is no significant difference between the pre-test mean performance scores of agricultural education students in animals and crops breeding

Table 5: One-way Analysis of Variance for difference between the pre-test mean performance of agricultural education students in animals and crops breeding

	Sum of Squares	Df	Mean Square	F	Sig.	Decision
Between Group	93.629	3	31.210	1.775	.157	Accepted
Within Group	1793.249	102	17.581			
Total	1886.877	105				

***Source**: Field Study (2025)*

An analysis of variance (ANOVA) was conducted to test the difference in the pre-test mean performance of agricultural education students in animal and crop breeding across the experimental groups 4MAT and the control group. The results presented in Table 5 indicate that there was no statistically significant difference in the pre-test mean performance among the groups, F (3, 105) = 1.775, p = .157. Consequently, Hypothesis One was retained. This outcome suggests that the students in all two groups were statistically equivalent at the beginning of the study, confirming that they came from the same population in terms of prior performance in animal and crop breeding.

$H_0$2: There is no significant difference in the post-test mean performance scores of agricultural education students in animals and crops breeding

Table 6: One-way Analysis of Variance for difference in the post-test mean performance of agricultural education students in animals and crops breeding

	Sum of Squares	Df	Mean Square	F	Sig.	Decision
Between Group	4416.147	3	1472.049	145.077	.000	Rejected
Within Group	1034.957	102	10.147			
Total	5451.104	105				

***Source**: Field Study (2025)*

An analysis of variance (ANOVA) was conducted to examine differences in the post-test mean performance of agricultural education students in animal and crop breeding across the experimental group 4MAT and the control group. The results presented in Table 6 revealed a statistically significant difference in post-test mean performance scores among the groups, F (3, 105) = 145.077, p < .001. Consequently, Hypothesis Three was rejected.

DISCUSSIONS OF FINDINGS

Based on the findings of the study, it is concluded that both Animals and Crops Breeding Cognitive Performance Test (ACBCPT) are valid, reliable and acceptable for this study. The Cronbach Alpha coefficient is rated excellent (Cronbach's Alpha 0.88), (Hair & Alamer, 2022). Additionally, split-half method was used to determine the reliability of the performance score and the result revealed the reliability coefficient of 0.73. This indicated the instrument was reliable (Hair *et al.,* 2022). The analysis of pre-test scores revealed no significant difference between students in the 4MAT experimental group (M = 26.29, SD = 4.206) and the control group (M = 25.91, SD = 4.728), confirming that both groups had comparable prior knowledge. However, post-test analysis showed a substantial improvement in the 4MAT group (M = 68.00,

SD = 2.694) compared to the control group (M = 49.43, SD = 4.357), demonstrating the effectiveness of the 4MAT strategy in enhancing learning outcomes. ANOVA confirmed these results, showing no significant difference in pre-test scores ($F = 1.775$, $p = .157$) but a highly significant difference in post-test performance ($F = 145.077$, $p < .001$). Reliability and validity analyses indicated that the instruments used were appropriate, with acceptable difficulty and discrimination indices for the ACBCPT and Cronbach alpha above .70 for both instruments. The study also observed operational challenges during the pilot study, such as low motivation among research assistants and delays in questionnaire retrieval, which were addressed in the main study through better incentives and streamlined procedures. Overall, the results indicate that 4MAT, as a learner-centered instructional model, significantly improve students' understanding, retention, and performance in animals and crops breeding.

RECOMMENDATIONS

The researcher recommended that agricultural education lecturers adopt the 4MAT learning strategy in teaching animals and crops breeding to enhance students' engagement, comprehension, and performance. Tertiary institutions should provide training and resources to lecturers on learner-centered teaching methods to bridge existing performance gaps. Research assistants and instructors should be adequately incentivized and supported to ensure effective administration of academic assessments. Additionally, curriculum planners should integrate innovative and experiential learning approaches across agricultural education courses to promote higher-order thinking and practical competencies in students. Finally, regular monitoring and evaluation of instructional strategies should be conducted to sustain improvements in academic performance and interest in complex courses such as animals and crops breeding.

REFERENCE

Adebayo, F. A., & Ogunleye, I. K. (2019). "Performance Trends in Animals and crops breeding Education in South-West Nigeria." Nigerian Journal of Agricultural Education, 22(4), 45-59.

Adeyemi, M. O., & Ogundele, T. T. (2020). "Challenges in Animals and crops breeding Education in Nigeria's North-Central Region." *Journal of Agricultural Studies, 18(2),* 67-75.

Bello, Y., & Mohammed, U. (2022). "Crop Improvement Strategies for Enhanced Productivity in Nigeria." *Nigerian Journal of Crop Science, 14(3),* 121-135.

Kenton, W., Walters, T & Li, T. (2022). Analysis of Variance(ANAOVA) Explanation, Formula and Applications. https://www.investopedia.com/terms/a/anova.asp.

Umar, Y. M., Kabiru F., & Ibrahim, A. A. T., (2023) the effects of 5Es learning strategy on student academic performance in biology among senior secondary school in Zamfara State, Nigeria. *International Journal of Advanced Academic and Educational Research,* 2360-9909, 13(7), 21 - 30 DOI: 2726145223711372 https://arcnjournals.org.

Shoulders, C. W., & Toland, H. (2017). Millennial and non-millennial agriculture teachers' current and ideal emphasis on the three components of the agricultural education program. *Journal of Agricultural Education, 58(1),* 85-101.

Okafor, N. D., Eze, J. O., & Amadi, L. C. (2021). "Analysis of Students' Performance in Animals and crops breeding in South-East Nigeria." *International Journal of Agricultural Education and Development, 14(3),* 89-101.

Oladipo, T. J., & Adejumo, A. S. (2020). "Evaluating the Impact of 4MAT Model in Soil Science Education." *Nigerian Journal of Soil Studies, 8(4),* 89-102.

Mahjabeen, W., Alam, S., Hassan, U., Zafar, T., Butt, R., Konain, S., & Rizvi, M. (2019). Difficulty index, discrimination index and distractor efficiency in multiple choice questions. *Annals of PIMS-Shaheed Zulfiqar Ali Bhutto Medical University*, *13*(4), 310-315.

Hair, J., & Alamer, A. (2022). Partial Least Squares Structural Equation Modeling (PLS-SEM) in second language and education research: Guidelines using an applied example. *Research Methods in Applied Linguistics*, *1*(3), 100027.