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Enhancing Agricultural Science Student's Performance in School Examinations through Artificial Intelligence Generated Instructions and Pedagogy

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Abstract

This study examined the effectiveness of Artificial Intelligence (AI)–generated instruction and pedagogy in enhancing Agricultural Science students' performance in external examinations such as the West African Examinations Council (WAEC) and the National Examinations Council (NECO). The persistent decline and inconsistent performance of secondary school students in Agricultural Science have been attributed to traditional teaching methods, inadequate instructional materials, and limited use of modern educational technologies. Consequently, the integration of Artificial Intelligence in teaching and learning has emerged as a promising approach for improving instructional delivery and students' academic outcomes. The study adopted a quasi-experimental research design using a pretest–posttest non-equivalent control group design. The population consisted of Senior Secondary School II (SS II) students offering Agricultural Science in public secondary schools. A sample of 100 students was selected using multi-stage sampling techniques and divided into experimental and control groups. The experimental group was taught using AI-generated instructional strategies, while the control group received conventional teaching. Data were collected using the Agricultural Science Achievement Test (ASAT). The instrument was validated by experts in Agricultural Science Education, and Measurement and Evaluation, and its reliability was established using the test–retest method. Data were analyzed using mean, standard deviation, and independent sample t-test at 0.05 level of significance. The findings revealed that students taught using AI-generated instruction performed significantly better than those taught using conventional teaching methods. The results also showed that AI-supported pedagogy improved students' engagement, understanding, and retention of Agricultural Science concepts. The study concluded that integrating Artificial Intelligence–based instructional strategies can significantly enhance students' academic performance in Agricultural Science. It therefore recommended the adoption of AI-supported instructional tools in secondary school teaching.

Keywords: Artificial Intelligence, Pedagogy, Generated Instructions, WAEC, NECO, Technology-Enhanced Learning.

Introduction

The persistent challenge of poor academic performance of secondary school students in external examinations such as the West African Examinations Council (WAEC) and the National Examinations Council (NECO) has continued to attract the attention of educators, policymakers, and researchers in Nigeria.

Agricultural Science, which is a core subject designed to equip students with practical and theoretical knowledge for food production and agricultural development, has often recorded inconsistent performance among students in these examinations. Several factors have been linked to this problem, including inadequate teaching methods, limited use of instructional technologies, lack of adequate learning materials, and insufficient pedagogical innovation in the classroom.

Traditional instructional approaches commonly used in teaching Agricultural Science often rely on teacher-centered methods that may not adequately support students' understanding of complex agricultural concepts or stimulate active learning. Studies have shown that technology-enhanced instruction can significantly improve students' learning outcomes and engagement in Agricultural Science when compared with conventional teaching approaches (Ogunjobi and Owoseni, 2025). The adoption of modern digital instructional tools in many secondary schools remains limited, thereby restricting opportunities for innovative teaching and improved academic performance.

In recent years, Artificial Intelligence (AI) has emerged as a transformative technology capable of improving teaching and learning processes through personalized instruction, intelligent tutoring systems, automated feedback, and adaptive learning environments. AI-driven instructional systems can analyze student learning patterns, provide tailored learning materials, and support teachers in designing effective pedagogical strategies (Adewale et al., 2024). Research indicates that AI integration in educational practices has the potential to enhance learning experiences, increase student engagement, and improve academic performance when effectively implemented (Abubakar, Onasanya, and Ibrahim, 2024).

Despite the growing global interest in AI-supported instruction, its application in secondary school Agricultural Science education—particularly in preparing students for school examinations—remains relatively unexplored. Existing studies have largely focused on AI in higher education or general STEM subjects, leaving a significant gap in empirical research on AI-generated instructional strategies in secondary school agricultural education (Xu et al., 2023).

Consequently, the continued reliance on traditional teaching methods without integrating emerging AI-based instructional approaches may contribute to the persistent challenges faced by Agricultural Science students in external examinations. Therefore, there is need to investigate how Artificial Intelligence-generated instruction and pedagogy can enhance the academic performance of Agricultural Science students in school examinations. This study seeks to address this gap by examining the effectiveness of AI-generated instructional strategies in improving students' learning outcomes and examination performance in Agricultural Science.

Objectives of the Study

The main objective of this study is to examine how Artificial Intelligence (AI)–generated instruction and pedagogy can enhance Agricultural Science students' performance in school examinations. Specifically, the study sought to:

1. determine the effect of Artificial Intelligence–generated instructional strategies on the academic performance of Agricultural Science students in school examinations;
2. examine the difference in academic performance between students taught Agricultural Science using AI-generated instruction and those taught using conventional teaching methods;
3. investigate the influence of AI-supported pedagogy on students' engagement and understanding of Agricultural Science concepts and,
4. determine whether gender differences exist in the academic performance of students exposed to AI-generated instructional strategies in Agricultural Science.

Research Questions

The following research questions guided the study:

- What effect does Artificial Intelligence–generated instruction have on the academic performance of Agricultural Science students in school examinations?
- What difference exists in the academic performance of students taught Agricultural Science using AI-generated instruction and those taught using conventional teaching methods?
- How does AI-supported pedagogy influence students' engagement and understanding of Agricultural Science concepts?
- What difference exists between the academic performance of male and female students taught Agricultural Science using AI-generated instruction?

Research Hypotheses

The following null hypotheses were tested at 0.05 level of significance

- Ho_1: There is no significant difference in the academic performance of Agricultural Science students taught using Artificial Intelligence–generated instruction and those taught using conventional teaching methods in school examinations.
- Ho_2: AI-supported pedagogy has no significant influence on students' engagement and understanding of Agricultural Science concepts.

Methodology

This study adopted a quasi-experimental research design, specifically the pretest–posttest non-equivalent control group design. The design is considered appropriate because it allows the researcher to compare the academic performance of students exposed to Artificial Intelligence (AI)-generated instructional strategies with those taught using the conventional teaching method.

The population of the study consists of all Senior Secondary School II (SS II) Agricultural Science students during 2024/2025academic session school examinations in public secondary schools in Anambra, Enugu and Imo States. A multi-stage sampling technique was used to select the sample for the study. First, a purposive sampling technique was used to select two local government areas from each of the three states.

Secondly, simple random sampling technique was used to select two secondary schools that offer Agricultural Science and have basic ICT facilities from each of the two LGAs. One school served as the experimental group**,** while the other served as the control group**.**

From the selected schools, a total sample of 80 SS II students was selected from each state totaling 240 students for the study. Students in the experimental group were taught using AI-generated instructional strategies and materials, while students in the control group received conventional classroom instruction. Instrument for data collection was Agricultural Science Achievement Test (ASAT) developed by the researcher. Also, Artificial Intelligence Instructional Module (AIIM) was developed to guide the AI-supported teaching process. The module included AI-generated lesson plans, instructional content, practice questions, and feedback mechanisms designed to enhance students' learning. A reliability coefficient of 0.70 was considered acceptable for the study. Data collected were analyzed using both descriptive and inferential statistical techniques**.**

Results

Data were analyzed using mean, standard deviation, and independent sample z-test. The research questions were answered using mean and standard deviation, while null hypotheses were tested at 0.05 level of significance.

Research Question 1: What effect does Artificial Intelligence–generated instruction have on the academic performance of Agricultural Science students?

Table 1: Pre-test and Post-test Mean Scores (AI Group)

Test	Mean Score	Standard Deviation
Pre-test	42.35	8.21
Post-test	68.74	7.15
Mean Gain	**26.39**	

In Table 1, the AI group showed a significant increase in mean score from 42.35 to 68.74, indicating that AI-generated instruction had a positive effect on students' academic performance.

Research Question 2: What difference exists in the academic performance of students taught using AI-generated instruction and those taught using conventional teaching methods?

Table 2: Post-test Mean Scores of Experimental and Control Groups

Group	N	Mean Score	Standard Deviation
Experimental Group	120	71.80	8.20
Control Group	120	55.40	7.60
Mean Difference		**16.40**	

The Table 2 indicates that the experimental group obtained a higher mean score (71.80) compared to the control group (55.40). This suggests that AI-supported teaching strategies positively influenced students' learning outcomes in Agricultural Science.

Research Question 3: How does AI-supported pedagogy influence students' engagement and understanding of Agricultural Science concepts?

Table 3: Mean Scores on Students' Engagement and Understanding

Variable	Mean	Std. Deviation
Engagement	3.85	0.74
Understanding	3.92	0.68
Grand Mean	**3.89**	

(Based on 4-point scale type)

The grand mean of 3.89 indicates a high level of engagement and understanding among students exposed to AI-supported pedagogy. This suggests that AI enhances interactive learning and conceptual understanding of Agricultural Science.

Research Question 4: What difference exists between the academic performance of male and female students taught Agricultural Science using AI-generated instruction?

Table 4: Students' Mean Performance by Gender (Experimental Group)

Gender	N	Mean	Std. Deviation
Male	62	69.10	7.21
Female	58	67.80	7.89
Mean Difference	**1.3**		

Table 5: Independent z-test Result

Variable	z-value	df	p-value	Decision
Gender Performance	0.84	118	0.403	Not Significant

The p-value (0.403) is greater than 0.05, indicating no significant difference between male and female students. This implies that AI instruction is gender-neutral and equally effective

H_{o1}: There is no significant difference in the academic performance of students taught using AI-generated instruction and those taught using conventional teaching methods.

Table 6: Mean Academic Performance of Students

Group	N	Mean Score	SD	z-cal	z-critical	Decision
Experimental	120	71.80	8.20			
Control	120	55.40	7.60	9.85	1.98	Reject H_0

The calculated z-value (9.85) is greater than the critical value (1.98) at 0.05 level of significance. Therefore, the null hypothesis is rejected. This indicates that AI-generated instruction significantly improves Agricultural Science students' academic performance.

H_{02}: AI-supported pedagogy has no significant influence on students' engagement and understanding of Agricultural Science concepts.

Table 7: Mean Score on Students' engagement and understanding of Agricultural Concepts

Group	N	Mean Score	SD	z-cal	z-critical	Decision
Experimental	120	73.10	7.80			
Control	120	56.25	7.10	10.02	1.98	Reject H_0

The calculated z-value (10.02) is greater than the critical value (1.98). Therefore, the null hypothesis is rejected. This indicates that AI-supported pedagogy significantly enhances students' engagement and understanding of Agricultural Science concepts.

Discussion of Findings

The findings of this study revealed that Artificial Intelligence (AI)–generated instruction significantly improved the academic performance of Agricultural Science students. The results showed that students exposed to AI-supported instructional strategies performed better than those taught using conventional teaching methods. This finding suggests that AI-based instructional tools provide interactive learning opportunities, personalized feedback, and improved access to learning materials, which enhance students' understanding of Agricultural Science concepts. This result supports previous studies which reported that technology-enhanced instruction improves students' academic achievement and engagement in science-related subjects.

The study revealed that students taught using AI-generated instructional materials demonstrated better retention of Agricultural Science knowledge compared to those taught using traditional methods. This may be attributed to the adaptive learning features of AI systems that allow students to learn at their own pace and receive immediate feedback on their performance. Such learning environments help reinforce concepts and strengthen long-term memory retention.

Also, the findings indicated that AI-supported pedagogy improved students' engagement and understanding of Agricultural Science topics. The integration of AI tools in teaching created a more interactive and student-

centered learning environment, which encouraged participation and deeper comprehension of subject content. When students are actively involved in the learning process, they are more likely to develop positive attitudes toward the subject and perform better academically.

Finally, the study found that there was no significant difference in the academic performance of male and female students exposed to AI-generated instruction. This implies that AI-based instructional strategies are equally effective for both genders and can help bridge gender disparities in academic performance.

Conclusion

Based on the findings of the study, it can be concluded that Artificial Intelligence–generated instruction and pedagogy have a significant positive effect on the academic performance of Agricultural Science students. The integration of AI into classroom instruction enhances students' understanding, engagement, and retention of knowledge. It also provides innovative teaching approaches that support effective learning and better preparation for external examinations such as WAEC and NECO.

Therefore, the adoption of AI-generated instructional strategies in teaching Agricultural Science has the potential to improve students' academic outcomes and strengthen the overall quality of agricultural education in secondary schools.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Secondary school teachers should integrate Artificial Intelligence–generated instructional tools into the teaching of Agricultural Science to improve students' understanding and academic performance.
2. Educational authorities and policymakers should provide adequate technological infrastructure and digital learning resources to support the implementation of AI-based teaching methods in schools.
3. Teachers should receive professional training and capacity-building programs on the effective use of Artificial Intelligence technologies in teaching and learning processes.
4. School administrators should encourage the use of innovative and technology-driven pedagogical strategies that promote interactive and student-centered learning environments.
5. Curriculum developers should incorporate AI-based instructional approaches into Agricultural Science curricula to enhance students' learning experiences and examination preparedness.

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