Examining the Applications of Artificial Intelligence (AI) in Agricultural Pedagogical Process and Farming in Nigeria

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Abstract

This study examines the application of artificial intelligence in agricultural pedagogical process and farming in Nigeria. The study was guided by one objective. Reviews were undertaken in line with the objective of the study. The study was a descriptive survey. The target population was agricultural education teachers and students from across the state. A random sampling technique was used to select 202 respondents made up of students and teachers. The instrument for data collection was a questionnaire. The data generated were analyzed using Mean and Standard Deviation. The study concludes that the application of AI in teaching and learning agriculture will not only equip learners with modern skills for farming but also create motivation for farming among upcoming generation. The study recommended that training and re-training among teachers and students of agricultural science be conducted on use of Artificial Intelligence (AI) for teaching and learning in schools.

Keywords:

Artificial Intelligence, Technology, Teaching and Learning, Farming.

Introduction

Artificial Intelligence (AI) is already making its mark on agriculture, offering new tools to help improve efficiency, increase yields, and make more data-driven decisions. In the light of these, its application in the teaching and learning process has the ability to motivate learner towards the subject and pave way for the ability to understand ways to improve and enhance agricultural productions. It is important to note that the agricultural sector is undergoing a seismic shift, driven by the integration of cutting-edge technologies like Artificial Intelligence (AI). While AI has already made significant inroads into farming practices, its potential in agricultural education is equally transformative (Rehman et al. 2016; MacFadden et al. 2023). From personalized learning experiences to predictive analytics for curriculum design, AI is reshaping how agricultural knowledge is imparted and absorbed. Emphasis here is on the multifaceted role of AI in agricultural education, viz-a-viz teaching and learning and offering actionable insights

for instructors in the school system on how to pass across knowledge to the student for ease of comprehension.

AI in agricultural education refers to the application of artificial intelligence technologies to enhance the teaching, learning, and research processes in agriculture. This includes leveraging machine learning, natural language processing, and data analytics to create more efficient, personalized, and impactful educational experiences. For instance, AI can analyze vast datasets to identify trends in crop production, which can then be integrated into educational modules. It also enables adaptive learning platforms that cater to individual student needs, ensuring a more tailored and effective learning journey (Rehman et al. 2016; Devlet, 2021). Also, AI is used in education to enhance different aspects of teaching and learning that automates academic processes and free up teachers' time, and make accessible of interactive tools that makes learning more engaging.

Furthermore, Artificial Intelligence is playing a transformative role in the pedagogical process of agriculture by explaining how to optimize, strategies and automate agricultural production. AI applications in the classroom are making the learning of agriculture more efficient and more sustainable. Agricultural operation in modern time is exceedingly different compared to those performed few decades ago, basically because of alarming scientific and technological advancement in the modern society. Consequently, modern agriculture engages in the usage of various sophisticated technologies, where artificial intelligence comes in. It is in this view that DeLay et al (2021) noted that the advancement of technology has taken agricultural activities to the next level where sophistication has taken over manual labour, which has in turn enhance output. Hence, the acquiring the requisite knowledge to undertake sophistication in agriculture requires in depth knowledge which is what the usage of artificial intelligence entails in the pedagogical process. The use of AI helps to motivate learners to want to acquire agricultural skills and knowledge that will enhance production and also make the course more attractive to youth, since it use modern devices which are endearing to them and enticing to operate. Furthermore, the use of AI in the teaching and learning of modern agriculture have substituted conventional processes of chalk and talk to sophistication where AI is deployed for enhance yield.

The application of AI in agriculture entails the appliance of modern farm machineries, new farming methods and agrochemicals to agriculture. The application of AI has enabled agricultural sector to be able to meet the rising demands of food accompanied population increase. Nnodim and Raji (2020) and Alvarado et al (2024) opined that AI in farming is the integration of advanced engineering principles, farming techniques and scientific development to manipulate the growth, maturity and well-being of crops and livestock. This therefore tends to produce faster and larger farm products for consumption of the masses. Traditional farming is limited in its capacity to produce a miniature quantity of food for the masses. It is based on this impediment that the use of AI is essential for the teaching and learning of agricultural science in secondary schools. Teaching and Learning agriculture science as a subject in secondary school has flourished over the years in many developing countries. This is because the rationale for teaching the subject and the basis for its popularity is to permit students a wider set of future career options particularly farming and farming-related careers than is offered by the usual academic or general subjects (Tesha, 2018; Devlet, 2021). This shows that effective teaching and learning of Agricultural science subject in secondary schools is recognized by the level at which

students are encouraged to venture into agriculture as a future career. However, this motivation cannot be created in students having recognized the extent of drudgery and ardent tasks involved in traditional farming. Devlet (2021) noted that the application of AI in effective teaching and learning of agricultural science subject, creates the desire for farming profession among students.

The teaching and learning agriculture requires the utilization of modern agricultural methods, machineries and farm inputs for updated transfer of knowledge, hence, artificial intelligence (AI). The use of AI technologies in teaching and learning do not only create motivation for learning among learners but also boost their interest and enhance their decision to choose agriculture for future career. Equipping students with modern agricultural techniques and methods will facilitate farm productivity. AI in agriculture are aspect of technology concerned with new ways of carrying out agricultural practices easily and more efficiently. The rhetoric of teaching students the modern methods of farming lies in the slow adoption features of farmers. In other words, students will tend to develop more capacity to adopt new methods of farming when they are already enlightened to it in their various schools. Majorly, different government introduced agricultural science as a subject in schools to smoothen and enhance transition of students who may not have ability to proceed for further education to farm employment (Alvarado et al. 2024).

So, the utilization of AI in teaching and learning will benefits students who are to be future farmers in such that, they will be adequately equipped with better methods of farming. Students who possess modern agricultural skills with substantial positive results may become tools to induce change into farmers. Nnodim and Raji (2020) posited that the use of AI has the potential to increase agricultural production and sustainability. United Nation Educational Scientific Cultural Organization as cited by Chrispin et al (2020) asserted that the use of AI enhances effective teaching and learning of the agriculture and has the ability to provide supportive learning environment, motivated teachers with mastery of pedagogy and their subject matter, adequate access to teaching and learning resources as well as students who are ready to learn. Utilization of modern agricultural inputs such as fertilizers, agrochemicals and improved seeds in delivering agricultural science curriculum content helps to create awareness to agricultural science students on modern inputs available to them for efficient farm productivity (Laugo, 2009). This demand will also in turn enables Agricultural science teachers participate in agricultural extension activities from the schools.

Exploring AI Application in Farming in Nigeria

The integration of Artificial Intelligence (AI) into agriculture is transforming how food is grown, harvested, and distributed. With the world population expected to reach 9.7 billion by 2050, the demand for sustainable food production is more urgent than ever. AI is stepping up to meet these challenges by offering smarter, data-driven solutions that increase efficiency while reducing environmental impact. In the view of Nnodim and Raji (2020), AI applications such as precision farming, crop monitoring, and predictive analytics are helping farmers make better decisions, improve productivity, and manage natural resources more sustainably. Here's a closer look at how AI is shaping the future of agriculture. According to Andreasen et al (2022), harnessing the power of AI could potentially offer farms options to become more sustainable while improving productivity. The following are the domains of AI that are already having an

impact: Machine Learning (ML), Natural Language Processing (NLP), Computer Vision, Robotics, Expert Systems, and Reinforcement Learning.

Machine Learning: is a form of AI that allows computers to learn from data without being explicitly programmed. In agriculture, ML is used for tasks like yield prediction, where historical data on weather patterns, soil health, and crop performance can be analyzed to forecast future production. The predictive model may help farmers make informed decisions about planting, pest control, fertilizer application, or other resource allocations, ensuring minimal waste and more avenues to maximize yields. By leveraging ML, farmers may not only estimate future yields but also adapt more quickly to changing environmental conditions, improving overall efficiency and return on the investment of time and money.

Natural Language Processing: is another subset of AI that focuses on enabling computers to understand and interact with human language. This means using virtual assistants or chatbots to provide real-time advice on crops, pest control, weather forecasts, and more. These tools are especially useful in remote areas, where access to expert advice might be limited. Virtual assistants also allow you to ask questions in different languages. As a caution, a human expert should always review the output from these systems as the outputs differ wildly in their complexity, accuracy, and familiarity with agriculture. Since most of these systems are not specifically designed for agriculture, they must be appropriately trained to provide accurate advice.

Computer Vision: is another AI technology transforming agriculture by allowing machines to interpret visual data. Computer vision might be used to monitor crops and detect issues like plant diseases and weed growth. For instance, cameras equipped with AI can scan fields in real time, identifying diseases or pests of potential concern and enabling farmers to review the targeted information and possibly act before the problem spreads. A targeted approach saves time and reduces the need for widespread pesticide use, benefiting both the farmer's budget and the environment. Currently, cameras with computer vision combined with machine learning are being used to help guide equipment with the targeted broadcast of herbicides.

Robotics: is perhaps one of the most visible applications of AI in agriculture. Autonomous vehicles or robots can carry out labor-intensive tasks, such as harvesting crops, planting seeds, and even monitoring fields. These robots can work tirelessly and precisely, performing tasks that would require significant manual labor. For example, research is underway at Penn State to use robots equipped with AI to navigate orchards, carefully thinning fruit or pruning fruit trees. The autonomous robot offers the potential to reduce the need for human labor and can significantly increase farm efficiency during peak seasonal work. Furthermore, robots can now handle some delicate tasks with select crops, such as picking without damaging crops, ensuring higher-quality products reach the market. When combined with computer vision, these systems offer the opportunity to make real-time marketing decisions right in the field.

Expert Systems: are another form of AI designed to provide decision-making support. These systems mimic the expertise of human specialists by using rule-based algorithms to offer

recommendations in specific domains. First introduced to agriculture in the 1980s, current expert systems are far more robust thanks to advances in computer processing, quality data availability, and substantially improved algorithms. Today, expert systems can help farmers with crop selection, considering factors like soil composition, weather conditions, and potential market demand. Additionally, expert systems can offer guidance on irrigation practices, pest control strategies, and nutrient management, ensuring that the best possible advice is tailored to local conditions.

Reinforcement Learning: is a more advanced subset of AI that focuses on teaching machines to make decisions by interacting with their environment and learning from the results. The approach can be beneficial for optimizing processes. AI systems equipped with reinforcement learning might know when and how much product or water to apply based on environmental feedback such as soil moisture levels, weather forecasts, and plant needs. Over time, these systems improve their decision-making by receiving rewards (successful outcomes, such as optimal crop growth) or penalties (over- or under-watering). The ability to fine-tune irrigation and application schedules conserves resources and can contribute to maximizing yields by ensuring crops get what they need at the right time.

By integrating AI technologies into agricultural operations, farmers may have the opportunity to access new levels of precision and efficiency. Cost, access, and connectivity remain significant barriers to the widespread adoption of AI technologies. However, as AI technology improves in automating labor-intensive tasks, providing expert decision-making support, and optimizing critical processes, it may help farms become more efficient, competitive, and sustainable.

Research Question

What are the effect of Artificial Intelligence on the teaching and learning of agricultural science in secondary school in Delta State?

Methodology

The study was a descriptive survey. The target population was agricultural education teachers and students from across the state. A random sampling technique was used to select 202 respondents made up of students and teachers. The instrument for data collection was a self-structured questionnaire that was designed to elicit information from respondents based on the research question raised. The data generated were analyzed using Mean and Standard Deviation.

Data Presentation

Table 1: Mean response on the application of AI in the teaching and learning process

S/n	Items	Teachers			Students		
		Mean	**SD**	**Rmk**	**Mean**	**SD**	**Rmk**
1	Application of AI in the teaching learning process helps to provide indepth knowledge	3.75	1.01	Accepted	3.33	1.12	Accepted
2	The application of AI in teaching helps to update learners knowledge of agriculture	3.76	0.98	Accepted	3.45	1.13	Accepted
3	The use of AI provide a platform for smooth learning amongst students	3.54	1.03	Accepted	3.55	1.13	Accepted
4	The use of AI helps to abreast students and learners of the trending crop variety, species advancements in technology	3.65	1.05	Accepted	3.73	1.12	Accepted
5	AI application create a seamless platform for learning quick ways to operate farm with enhanced varieties	3.97	0.87	Accepted	4.10	1.02	Accepted
6	AI helps to acquaint learners with modern farming techniques	3.98	0.89	Accepted	4.10	0.79	Accepted
	Total	**3.86**	**1.01**		**3.79**	**1.10**	

Table 1 shows the effect of Artificial Intelligence (AI) on the teaching and learning of agriculture in senior secondary school in Delta State. The items with mean value greater that or equals to the criterion mean (3.00) were accepted. Hence analyzed data showed that the use of AI application in teaching and learning agricultural science provides in-depth knowledge to students, updates their knowledge, provides a platform for smooth learning, abreast students knowledge on latest varieties of crops, assist them in operating latest farm equipment and acquaint them with modern farming techniques. This finding aligns with the work of Laugo (2009) who noted that utilization of modern agricultural inputs such as fertilizers, agrochemicals and improved seeds in delivering agricultural science curriculum content helps to create awareness to agricultural science students on modern inputs available to them for efficient farm productivity.

Conclusion

Artificial Intelligence is revolutionizing agriculture by enhancing precision, enabling proactive crop monitoring, and improving decision-making through predictive analytics. These innovations not only boost productivity but also reduce environmental impact and promote sustainable food systems. In this light, the study concludes that the application of AI in teaching and learning agriculture will not only equip learners with modern skills for farming but also create motivation for farming among upcoming generation.

Recommendations

Based on the findings of this study, the following recommendations were made:
1. There should be training and re-training among teachers and students of agricultural science on use of Artificial Intelligence (AI) for teaching and learning in secondary schools.
2. Government should provide necessary inputs and farm machineries for teaching and learning agricultural science.

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