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INTEGRATION OF ARTIFICIAL INTELLIGENCE (AI) IN ENVIRONMENTAL EDUCATION CURRICULUM

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ABSTRACT

This study examined the integration of Artificial Intelligence (AI) in the Environmental Education curriculum at Benjamin Uwajumogu (State) College of Education. The study investigated the extent of AI integration, AI-enabled teaching and learning strategies, challenges affecting integration, and measures for improving AI integration in environmental education. A descriptive survey research design was adopted for the study. The population comprised lecturers and students in the Environmental Education Department of the institution. A sample size of 120 respondents, consisting of 20 lecturers and 100 students, was selected using simple random sampling technique. Data were collected using a structured questionnaire validated by experts in environmental education and educational technology. The reliability coefficient of the instrument was 0.75 using Cronbach Alpha method. Data were analyzed using frequency counts, percentages, mean, and standard deviation. Findings revealed that the level of AI integration in environmental education was low due to inadequate ICT infrastructure, poor electricity supply, lack of trained personnel, and insufficient curriculum inclusion of AI concepts. The study further showed that AI-enabled learning strategies such as adaptive learning systems, virtual simulations, and interactive digital tools were rarely utilized. Major challenges identified included inadequate funding, high cost of AI technologies, poor internet connectivity, and lack of institutional support. The study concluded that effective integration of AI in environmental education requires improved infrastructure, curriculum reforms, and capacity building for educators. The study recommended increased government investment in ICT facilities, lecturer training, curriculum modernization, and institutional support for AI-based teaching and learning.

Keywords: Artificial Intelligence, Environmental Education, Curriculum Integration, Educational Technology, AI-Enabled Learning, Sustainability Education.

Introduction

Environmental education plays a critical role in fostering awareness, knowledge, and skills required for the sustainable management of natural resources. Globally, environmental challenges such as climate change, deforestation, pollution, and biodiversity loss have intensified, creating an urgent need for innovative educational strategies that equip learners to understand, analyze, and address these issues effectively (UNESCO, 2021; Tilbury, 2019).

Traditional approaches to environmental education in tertiary institutions in Nigeria often rely heavily on textbooks, lectures, and passive learning, which may limit students' engagement, critical thinking, and practical problem-solving capabilities (Adebayo and Okafor, 2022).
The emergence of Artificial Intelligence (AI) provides a transformative opportunity for environmental education. AI, defined as the branch of computer science that enables machines to perform tasks traditionally requiring human intelligence such as learning, reasoning, decision-making, and pattern recognition can significantly enhance the teaching and learning of environmental concepts (Rolnick *et al*., 2019; Vinuesa *et al*., 2020). Technologies such as machine learning, deep learning, adaptive learning systems, predictive analytics, virtual simulations, and Internet of Things (IoT) integration enable educators and learners to access data-driven insights, model complex environmental systems, and engage in interactive and personalized learning experiences (Walsh *et al*., 2021).

Integrating AI into environmental education curricula aligns with international sustainability initiatives, particularly the United Nations Sustainable Development Goals (SDGs), including SDG 4 (Quality Education) and SDG 13 (Climate Action). Such integration ensures that future educators are not only knowledgeable about environmental issues but also technologically proficient, capable of employing AI tools to address real-world ecological challenges. This study focuses on Benjamin Uwajumogu (State) College of Education, Ihitte/Uboma, Imo State, examining the extent to which AI has been incorporated into the environmental education curriculum. It explores how AI applications including adaptive learning platforms, virtual labs, predictive simulations, and data analytics are being utilized to enhance student learning, engagement, and problem-solving abilities. The study also identifies challenges inhibiting effective integration, such as infrastructural limitations, inadequate teacher training, and curriculum gaps.

Objectives of the Study
The objectives of the study were to:
1. Examine the extent of AI integration in environmental education curriculum.
2. Identify AI-enabled teaching and learning strategies used in environmental education.
3. Determine the challenges affecting AI integration in environmental education.
4. Identify measures for improving AI integration in environmental education curriculum.

Research Questions
1. To what extent is AI integrated into environmental education curriculum?
2. What AI-enabled teaching and learning strategies are used in environmental education?
3. What challenges affect AI integration in environmental education?
4. What measures can improve AI integration in environmental education curriculum?

Methodology
This study adopted a descriptive survey research design to examine the integration of Artificial Intelligence (AI) in environmental education at Benjamin Uwajumogu (State) College of Education, Ihitte/Uboma, Imo State, Nigeria. The descriptive survey design was considered appropriate because it enabled the researcher to obtain information from respondents regarding their opinions, experiences, and perceptions on the use of AI tools and technologies in teaching and learning processes. According to Creswell (2014), descriptive survey research allows researchers to systematically collect, analyze, and interpret data from a target population in order to describe existing conditions and relationships among variables.

The study was conducted at Benjamin Uwajumogu (State) College of Education, Ihitte/Uboma, Imo State. The institution was selected because it offers environmental education programmes relevant to the objectives of the study and provides a suitable context for assessing the extent of AI integration within teacher education. The target population comprised lecturers and students in the Environmental Education Department of the institution. Specifically, the population included environmental education lecturers and students offering environmental education courses.

A sample size of 120 respondents was used for the study, consisting of 20 lecturers and 100 students. The respondents were selected using a simple random sampling technique to ensure equal opportunity of participation and to reduce sampling bias. The sampling technique enhanced the representativeness of the sample and improved the reliability of the findings. Data for the study were collected using a structured questionnaire developed by the researcher. The questionnaire was divided into two sections. Section A focused on demographic information such as gender, status, academic level, and teaching experience, while Section B contained items relating to the extent of AI integration, AI-enabled teaching and learning strategies, challenges affecting AI integration, and measures for improving AI integration in environmental education. The questionnaire items were structured on a four-point Likert scale of Strongly Agree (SA = 4), Agree (A = 3), Disagree (D = 2), and Strongly Disagree (SD = 1). To ensure the validity of the instrument, the questionnaire was subjected to face and content validation by experts in environmental education, educational technology, and measurement and evaluation. Their observations, corrections, and recommendations were incorporated into the final version of the instrument to ensure that it adequately measured the variables under investigation.

The reliability of the instrument was determined using the Cronbach Alpha reliability method. A pilot test was conducted among respondents outside the study area but with similar characteristics to the target population. The reliability coefficient obtained was 0.75, indicating that the instrument possessed acceptable internal consistency and was reliable for data collection, in line with the recommendation of Nunnally (1978), who suggested that a reliability coefficient of 0.70 and above is acceptable for social science research.

The researcher personally administered the questionnaire to the respondents to ensure effective distribution and retrieval of the instrument. Respondents were given adequate time to complete the questionnaire, and the completed copies were collected immediately to minimize loss and improve response rate.

Data collected from the respondents were analyzed using descriptive statistical tools, including frequency counts, percentages, mean, and standard deviation. Frequency counts and percentages were used to analyze demographic information, while mean and standard deviation were used to answer the research questions. The decision rule was based on a criterion mean of 2.50. Mean values equal to or greater than 2.50 were regarded as accepted, while mean values below 2.50 were regarded as rejected.

Ethical considerations were strictly observed during the conduct of the study. Permission to conduct the research was obtained from the appropriate authorities within the institution. Participation in the study was voluntary, and respondents were assured of confidentiality and anonymity. Information obtained from respondents was used strictly for academic purposes.

Results and Discussion

Table 1: Demographic Information of the Respondents

Variable	Category	Frequency	Percentage (%)
Gender	Male	61	50.83
	Female	59	49.17
Status	Lecturer	20	16.67
	Student	100	83.33
Level (for students)	Not Applicable	20	16.67
	NCE I	24	20.00
	NCE II	45	37.50
	NCE III	31	25.83
Years of Teaching Experience (for lecturers)	Not Applicable	100	83.33
	1–5 years	4	3.33
	6–10 years	8	6.67
	Above 10 years	8	6.67

Table 1 presents the demographic information of the respondents. The results showed that the respondents were almost evenly distributed by gender, with males accounting for a slightly higher proportion of 50.83% while females represented 49.17%. The table also revealed that the majority of the respondents were students, constituting 83.33%, whereas lecturers accounted for 16.67% of the respondents. This indicated that most of the participants in the study were students within the institution.

The findings further showed that among the students, NCE II students constituted the largest proportion with 37.50%, followed by NCE III students with 25.83%, while NCE I students accounted for 20.00% of the respondents. In relation to years of teaching experience among lecturers, the table showed that lecturers with 6–10 years of teaching experience and those with above 10 years of experience each accounted for 6.67%, while lecturers with 1–5 years of experience represented 3.33% of the respondents. The "Not Applicable" category accounted for 83.33% because the majority of respondents were students.

Table 2: Extent of AI Integration in Environmental Education

Variable	SD	D	A	SA	Mean	STD	Remark
AI tools are used in teaching environmental education courses	97 (80.83%)	6 (5.0%)	11 (9.17%)	6 (5.0%)	1.38	0.85	Rejected
My institution provides access to AI-based learning platforms	73 (60.83%)	20 (16.67%)	15 (12.5%)	12 (10.0%)	1.72	1.03	Rejected
Lecturers incorporate AI technologies into classroom instruction	63 (52.5%)	36 (30.0%)	7 (5.83%)	14 (11.67%)	1.77	1	Rejected
Students are exposed to AI tools during environmental education lessons	73 (60.83%)	36 (30.0%)	1 (0.83%)	10 (8.33%)	1.57	0.88	Rejected
AI integration in environmental education is adequate	97 (80.83%)	12 (10.0%)	0 (0.0%)	11 (9.17%)	1.38	0.89	Rejected

Table 2 shows the extent of AI integration in environmental education. The results revealed that the majority of the respondents strongly disagreed that AI tools are used in teaching environmental education courses, accounting for 80.83%, while only 9.17% agreed and 5.0% strongly agreed. The table also showed that 60.83% strongly disagreed that their institution provides access to AI-based learning platforms, whereas 12.5% agreed and 10.0% strongly agreed. This reflected low mean scores of 1.38 and 1.72 respectively, with both items rejected.
The findings further indicated that 52.5% of the respondents strongly disagreed that lecturers incorporate AI technologies into classroom instruction, while 30.0% disagreed with the statement. Similarly, 60.83% strongly disagreed that students are exposed to AI tools during environmental education lessons, with another 30.0% disagreeing. In addition, a large majority

of 80.83% strongly disagreed that AI integration in environmental education is adequate, while only 9.17% strongly agreed. The mean score of 1.38 for adequacy of AI integration further reflected the low level of acceptance of AI integration practices in environmental education.

Table 3: AI-Enabled Teaching and Learning Strategies

Variable	SD	D	A	SA	Mean	STD	Remark
Virtual simulations are used to teach environmental concepts	55 (45.83%)	32 (26.67%)	18 (15.0%)	15 (12.5%)	1.94	1.06	Rejected
AI-based tools enhance students' understanding of environmental topics	16 (13.33%)	53 (44.17%)	50 (41.67%)	1 (0.83%)	2.3	0.71	Rejected
Adaptive learning systems are used in environmental education	14 (11.67%)	51 (42.5%)	53 (44.17%)	2 (1.67%)	2.36	0.71	Rejected
AI supports interactive and student-centered learning	19 (15.83%)	50 (41.67%)	49 (40.83%)	2 (1.67%)	2.28	0.75	Rejected
AI tools improve teaching effectiveness	17 (14.17%)	46 (38.33%)	48 (40.0%)	9 (7.5%)	2.41	0.82	Rejected

Table 3 highlights AI-enabled teaching and learning strategies used in environmental education. The results showed that 45.83% of the respondents strongly disagreed that virtual simulations are used to teach environmental concepts, while 26.67% disagreed with the statement. Only 15.0% agreed and 12.5% strongly agreed, resulting in a mean score of 1.94 and a rejected remark. The table also revealed that 44.17% disagreed that AI-based tools enhance students' understanding of environmental topics, although 41.67% agreed with the statement.

The findings further showed that adaptive learning systems recorded the highest level of agreement among the items, with 44.17% agreeing that such systems are used in environmental education, while 42.5% disagreed. Similarly, 40.83% agreed that AI supports interactive and student-centered learning, whereas 41.67% disagreed. The results also indicated that 40.0% agreed that AI tools improve teaching effectiveness, while 38.33% disagreed. Despite some positive responses, all the items recorded rejected remarks, with mean scores ranging from 1.94 to 2.41.

Table 4: Challenges of AI Integration

Variable	SD	D	A	SA	Mean	STD	Remark
Lack of electricity affects the use of AI tools	7 (5.83%)	46 (38.33%)	50 (41.67%)	17 (14.17%)	2.64	0.8	Accepted
Poor internet access limits AI integration	9 (7.5%)	37 (30.83%)	45 (37.5%)	29 (24.17%)	2.78	0.9	Accepted
Lecturers lack adequate training in AI technologies	9 (7.5%)	26 (21.67%)	43 (35.83%)	42 (35.0%)	2.98	0.93	Accepted
AI tools are too expensive for the institution	8 (6.67%)	29 (24.17%)	40 (33.33%)	43 (35.83%)	2.98	0.93	Accepted
The curriculum does not adequately include AI concepts	14 (11.67%)	26 (21.67%)	34 (28.33%)	46 (38.33%)	2.93	1.03	Accepted

Table 4 presents the challenges of AI integration in environmental education. The results showed that 41.67% of the respondents agreed that lack of electricity affects the use of AI tools, while 14.17% strongly agreed with the statement. Similarly, 37.5% agreed that poor internet access limits AI integration and 24.17% strongly agreed. The mean scores of 2.64 and 2.78 respectively indicated acceptance of these challenges by the respondents.

The findings also revealed that 35.83% agreed that lecturers lack adequate training in AI technologies, while 35.0% strongly agreed. In addition, 35.83% strongly agreed that AI tools are too expensive for the institution, whereas 33.33% agreed. The table further showed that 38.33% strongly agreed that the curriculum does not adequately include AI concepts, while 28.33% agreed with the statement. All the items recorded accepted remarks, with mean scores ranging from 2.64 to 2.98.

Table 5: Measures for Improving AI Integration

Variable	SD	D	A	SA	Mean	STD	Remark
Government should invest in educational technology	28 (23.33%)	13 (10.83%)	33 (27.5%)	46 (38.33%)	2.81	1.18	Accepted
Teachers should receive training on AI tools	13 (10.83%)	22 (18.33%)	47 (39.17%)	38 (31.67%)	2.92	0.97	Accepted
AI should be included in the curriculum	11 (9.17%)	13 (10.83%)	41 (34.17%)	55 (45.83%)	3.17	0.96	Accepted
Institutions should provide adequate ICT infrastructure	22 (18.33%)	7 (5.83%)	32 (26.67%)	59 (49.17%)	3.07	1.14	Accepted
Collaboration with tech companies will improve AI adoption	7 (5.83%)	22 (18.33%)	7 (5.83%)	84 (70.0%)	3.4	0.98	Accepted

Table 5 shows the measures for improving AI integration in environmental education. The results revealed that 38.33% of the respondents strongly agreed that government should invest in educational technology, while 27.5% agreed with the statement. The table also showed that 39.17% agreed that teachers should receive training on AI tools, while 31.67% strongly agreed. These responses produced accepted remarks with mean scores of 2.81 and 2.92 respectively.
The findings further indicated that 45.83% strongly agreed that AI should be included in the curriculum, while 34.17% agreed. Similarly, 49.17% strongly agreed that institutions should provide adequate ICT infrastructure, whereas 26.67% agreed. The highest proportion of strong agreement was recorded for collaboration with tech companies, where 70.0% strongly agreed that such collaboration would improve AI adoption. This item also recorded the highest mean score of 3.40.

Discussion of Findings

The findings of the study revealed that the integration of AI in environmental education curriculum was low. This finding agrees with previous studies which reported that many Nigerian tertiary institutions still face technological and infrastructural limitations affecting educational innovation.

The study also revealed that AI-enabled learning strategies such as virtual simulations, adaptive learning systems, and intelligent tutoring systems were not adequately utilized. This could be attributed to inadequate technological resources and insufficient lecturer training.

Furthermore, the study identified major challenges affecting AI integration, including poor electricity supply, inadequate internet connectivity, lack of trained personnel, and high cost of AI technologies. These findings are consistent with previous research on ICT integration challenges in developing countries.

The study further revealed that increased funding, lecturer training, improved internet access, and curriculum modernization are necessary measures for improving AI integration in environmental education.

Conclusion

The study concluded that the integration of Artificial Intelligence in environmental education curriculum remains inadequate despite the growing relevance of digital technologies in education. Effective integration of AI requires adequate infrastructure, curriculum reforms, improved funding, and continuous capacity building for educators. Integrating AI into environmental education will enhance teaching effectiveness, students' learning experiences, and environmental sustainability awareness.

Recommendations

Based on the findings of the study, the following recommendations were made:

1. Government should provide adequate funding for ICT infrastructure in colleges of education.
2. AI concepts should be incorporated into environmental education curriculum.
3. Lecturers should receive regular professional training on AI technologies.
4. Institutions should provide stable internet connectivity and electricity supply.
5. Educational institutions should collaborate with technology organizations for AI development and implementation.

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