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Digital Tools Integration for Geography and Environmental Education Programme in Federal Colleges of Education, North Central Nigeria

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Highlights:

Descriptive survey adopted to assess digital tools integration in Geography and Environmental Education programmes

Findings show moderate utilization of digital tools like mobile phones and Google Classroom

Challenges are include poor ICT infrastructure, unstable power, internet, funding, training, and resistance to change.

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Abstract: The integration of digital technologies into Geography and Environmental Education is essential for improving teaching effectiveness and supporting sustainable curriculum development in teacher education institutions. This study assessed digital tools integration in Geography and Environmental Education programmes in Federal Colleges of Education in North-Central Nigeria. Three objectives and three research questions guided the study: to identify commonly used digital tools, determine their extent of utilization, and examine challenges affecting their integration. A descriptive survey research design was adopted. The population comprised 150 lecturers and NCE III students from Federal Colleges of Education in North-Central Nigeria. Census sampling was used because the population was manageable. Data were collected using the researcher-developed Digital Tools Integration in Geography and Environmental Education Questionnaire (DTIGEEQ), validated by experts in relevant fields, with a Cronbach's alpha reliability coefficient of 0.82. Mean and standard deviation were used for data analysis, with 2.50 as the criterion mean. Findings revealed that mobile phones, PowerPoint presentations, internet resources, multimedia videos, and Google Classroom were the most commonly used digital tools, while the overall level of utilization was moderate. Major constraints included inadequate ICT infrastructure, unstable electricity supply, poor internet connectivity, insufficient funding, inadequate lecturer training, limited technical support, and resistance to technological change. The study concludes that strengthening digital infrastructure and lecturers' digital competencies is crucial for effective digital integration. It recommends increased investment in ICT facilities, continuous professional development for lecturers, and stronger institutional support.

Keywords*:* Digital tools integration, Geography Education, Environmental Education, Colleges of Education, North-Central Nigeria.

Introduction

Environmental sustainability has become a central global development priority owing to the increasing threats posed by climate change, biodiversity loss, environmental degradation, deforestation, flooding, desertification, and unsustainable exploitation of natural resources. These environmental challenges have profound implications for ecological integrity, socio-economic development, and human well-being, thereby necessitating innovative educational approaches capable of promoting sustainable development (UNESCO, 2023; United Nations, 2023). Education for Sustainable Development (ESD) recognizes environmental education as a critical mechanism for equipping learners with the knowledge, skills, values, and competencies required to make informed decisions and undertake responsible actions towards environmental sustainability (UNESCO, 2020). Consequently, environmental education has become an indispensable component of teacher education programmes worldwide. The rapid advancement of

digital technologies has fundamentally transformed teaching, learning, assessment, communication, and curriculum delivery across educational systems. Technologies such as learning management systems, mobile applications, virtual laboratories, Geographic Information Systems (GIS), cloud computing, multimedia resources, artificial intelligence, and online collaborative platforms have expanded opportunities for interactive, learner-centred, and inquiry-based learning (OECD, 2024; World Bank, 2024). Within environmental education, digital technologies facilitate virtual field experiences, environmental simulations, remote sensing, geospatial analysis, and access to real-time environmental data, thereby enriching learners' understanding of complex environmental issues while promoting critical thinking, collaboration, and problem-solving competencies (Olatunde-Aiyedun et al., 2024).

Colleges of Education occupy a strategic position within Nigeria's educational system because they prepare teachers responsible for implementing environmental education at the basic education level. The quality of teacher preparation therefore determines the effectiveness of environmental literacy programmes and the achievement of national sustainable development goals. Integrating digital technologies into environmental education is essential for producing teachers who possess the technological, pedagogical, and environmental competencies required for twenty-first-century classrooms (Koehler et al., 2022). Despite growing investments in educational technology globally, evidence suggests that digital integration in many Nigerian Colleges of Education remains inadequate because of infrastructural deficits, unstable electricity supply, inadequate funding, poor internet connectivity, limited access to modern instructional technologies, and insufficient digital competence among lecturers (OECD, 2024; Usman et al., 2025). Consequently, environmental education in many institutions continues to rely predominantly on conventional teaching approaches, limiting opportunities for experiential learning, innovation, collaborative learning, and sustainability-oriented curriculum implementation.

Although previous studies have examined technology integration within higher education, most have concentrated on general ICT adoption, e-learning, or digital competence without specifically investigating the integration of digital tools in environmental education and its implications for sustainable curriculum development in Colleges of Education within North Central Nigeria. This represents an important empirical gap because teacher education institutions play a critical role in preparing future educators capable of promoting environmental sustainability through technology-enhanced instruction. The increasing complexity of environmental challenges requires teacher education institutions to prepare graduates who possess both environmental literacy and digital competencies necessary for sustainable development. However, observations indicate that digital integration in environmental education within many Colleges of Education in North Central Nigeria remains below expectation. Teaching continues to depend largely on conventional instructional methods, while advanced digital technologies such as virtual laboratories, environmental simulation software, Geographic Information Systems, and smart learning platforms are inadequately utilized. In addition, inadequate ICT infrastructure, unstable electricity supply, poor internet connectivity, insufficient funding, limited technical support, and inadequate professional capacity among lecturers continue to impede effective technology integration.

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Although several empirical studies have investigated ICT adoption in higher education, there remains limited evidence on the extent to which digital tools are integrated into environmental education programmes and how such integration contributes to sustainable curriculum development in Colleges of Education in North Central Nigeria. The absence of such evidence limits informed policy decisions, curriculum innovation, and strategic investment in digital transformation within teacher education institutions. It is against this background that this study identify the digital tools commonly used in geography and environmental education programmes in Colleges of Education in North-Central Nigeria; Determine the extent of utilization of digital tools in geography and environmental education programmes in Colleges of Education in North-Central Nigeria and Examine the challenges affecting the integration of digital tools in geography and environmental education programmes in Colleges of Education in North-Central Nigeria.

Research Questions

1. What digital tools are commonly used in geography and environmental education programmes in Colleges of Education in North-Central Nigeria?

2. What is the extent of utilization of digital tools in geography and environmental education programmes in Colleges of Education in North-Central Nigeria?

3. What challenges affect the integration of digital tools in geography and environmental education programmes in Colleges of Education in North Central Nigeria?

Concept of Geography

Geography is the scientific study of the Earth's physical features, human populations, places, environments, and the interactions between people and their surroundings. It seeks to explain the spatial distribution of natural and human phenomena and how these phenomena influence one another across different locations and scales. Geography integrates knowledge from both the natural and social sciences, making it a multidisciplinary field that addresses environmental, economic, political, cultural, and technological issues (De Blij et al., 2022; Knox & Marston, 2021).

According to Knox and Marston (2021), geography is concerned with understanding the characteristics of places, the relationships between people and their environments, and the spatial patterns that shape human activities. The discipline examines why phenomena are located where they are, how places differ, and how interactions between humans and the environment influence sustainable development. Within the educational context, geography plays a vital role in developing learners' spatial thinking, environmental awareness, problem-solving abilities, and decision-making skills. Geography education equips students with knowledge and competencies needed to understand global environmental challenges such as climate change, biodiversity loss, urbanization, resource depletion, and sustainable development. Consequently, geography contributes significantly to achieving the Sustainable Development Goals (SDGs) through environmental literacy and responsible citizenship (UNESCO, 2020).

Concept of Environmental Education

Environmental education is a lifelong learning process through which individuals acquire the knowledge, skills, values, attitudes, and competencies needed to understand environmental issues and participate in solving them (UNESCO, 2020). It promotes environmental literacy, responsible citizenship, and sustainable lifestyles by encouraging learners to appreciate the relationship between

humans and their environment (Tilbury, 2021). According to Babalola and Olawuyi (2021), environmental education equips learners with critical thinking, problem-solving, and decision-making skills necessary for addressing contemporary environmental challenges. Wals (2020) further argues that environmental education fosters sustainability-oriented learning by encouraging behavioural change and active participation in environmental conservation. In Colleges of Education, environmental education prepares prospective teachers with the competencies required to integrate sustainability principles into classroom instruction and community development (United Nations, 2023).

Concept of Digital Integration

Digital integration refers to the purposeful incorporation of digital technologies into teaching, learning, assessment, and curriculum implementation to improve educational quality and learning outcomes (Koehler etal 2022). Effective digital integration involves combining technological knowledge, pedagogical knowledge, and content knowledge to create meaningful learning experiences (Koehler et al., 2022). OECD (2024) notes that digital integration enhances learner engagement, collaboration, personalized learning, and access to educational resources. Similarly, Ertmer and Ottenbreit-Leftwich (2021) maintain that successful digital integration depends on teachers' digital competence, institutional support, and positive attitudes toward technology. In environmental education, digital tools such as computers, mobile devices, multimedia, internet resources, virtual laboratories, Geographic Information Systems (GIS), and learning management systems enhance interactive learning and environmental awareness (Usman et al., 2025). Therefore, effective digital integration strengthens teaching effectiveness and promotes innovative learning practices.

Concept of Sustainable Curriculum Development

Sustainable curriculum development is the continuous process of designing, implementing, reviewing, and improving educational programmes to incorporate sustainability principles and respond to emerging societal needs (UNESCO, 2023). It seeks to equip learners with the knowledge, skills, values, and attitudes needed to promote environmental sustainability, social responsibility, and economic development (United Nations, 2023). According to Babalola and Olawuyi (2021), sustainable curricula emphasize learner-centred instruction, interdisciplinary learning, innovation, and lifelong learning. Ekung et al. (2019) argue that sustainable curriculum development requires continuous adaptation to environmental, technological, and societal changes to maintain curriculum relevance. Furthermore, OECD (2024) and World Bank (2024) emphasize that integrating digital technologies into curriculum implementation enhances curriculum flexibility, improves learning outcomes, supports innovation, and prepares graduates with the digital competencies required for sustainable development. Consequently, sustainable curriculum development is essential for producing competent teachers capable of addressing twenty-first-century environmental challenges.

Methodology

This study adopted a descriptive survey research. The population of the study was one hundred and fifty (150) comprised all lecturers and NCE three students of Geography and Environmental Education from the four federal colleges of education in North Central Nigeria, which includes Federal College of Education Okene, Kogi State, Federal College of

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Education, Odugbo, Benue State, Federal College of Education Kontagora, Niger State and Federal College of Education Pankshin, Plateau State. The population was gotten through phone calls to friends in those schools to collect the number of lecturers and students in Geography department and environmental education. The students and lecturers number should have been specified but they answer the same question, that was why they were not categorized. Federal College of Education, Pankshin, Plateau State and Federal College of Education, Kontagora, Niger State are still in the portal of NCCE as Federal Colleges of Education until they finish up with their current NCE students. Therefore, the sample size was one hundred and fifty (150) drawn from the entire population of the study as the population is considered manageable and therefore census sampling was used to adopt the entire population for the study. Data were collected using a researcher-developed questionnaire titled Digital Tools Integration in Geography and Environmental Education Questionnaire (DTIGEEQ), which consisted of 23 items for the three research questions. The instrument was subjected to face and content validation by experts in Geography and Environmental Education, Educational Technology, and Measurement and Evaluation. Its reliability was established using the Cronbach Alpha method, which yielded a reliability coefficient of 0.82, indicating that the instrument was reliable for the study. Data collected were analyzed using mean and standard deviation, while a criterion mean of 2.50 served as the basis for decision-making, with mean scores of 2.50 and above regarded as accepted and those below 2.50 regarded as rejected.

Research Question 1

What digital tools are commonly used in Geography and Environmental Education programmes in Colleges of Education in North-Central Nigeria?

Table 1

Mean Ratings of Digital Tools Commonly Used in Environmental Education Programmes (N = 150)

Digital Tool	M	SD	Decision
Mobile phones	3.61	0.60	Accepted
PowerPoint presentations	3.54	0.68	Accepted
Internet resources	3.48	0.72	Accepted
Multimedia videos	3.32	0.81	Accepted
Google Classroom	3.10	0.87	Accepted
Social media platforms	3.08	0.85	Accepted
Zoom/Virtual learning platforms	2.94	0.91	Accepted
Environmental databases	2.73	0.95	Accepted
Grand Mean	3.23	—	Accepted

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The results presented in Table 1 indicate that respondents agreed that mobile phones (M = 3.61, SD = 0.60), PowerPoint presentations (M = 3.54, SD = 0.68), internet resources (M = 3.48, SD = 0.72), multimedia videos (M = 3.32, SD = 0.81), Google Classroom (M = 3.10, SD = 0.87), social media platforms (M = 3.08, SD = 0.85), Zoom/virtual learning platforms (M = 2.94, SD = 0.91), and environmental databases (M = 2.73, SD = 0.95) are commonly used in Environmental Education programmes. The grand mean of 3.23 shows that digital tools are generally used in the institutions.

Research Question 2

What is the extent of utilization of digital tools in Geography and Environmental Education programmes in Colleges of Education in North-Central Nigeria?

Table 2

Mean Ratings on the Extent of Utilization of Digital Tools (N = 150)

Item	M	SD	Decision
Use of PowerPoint presentations during instruction	3.42	0.75	Accepted
Use of internet resources in teaching	3.38	0.81	Accepted
Use of Google Classroom/Learning Management System	3.15	0.88	Accepted
Use of multimedia instructional videos	3.27	0.79	Accepted
Use of mobile learning applications	3.11	0.92	Accepted
Use of environmental simulation software	2.21	0.95	Rejected
Use of virtual laboratories	2.18	0.98	Rejected
Use of smart classroom technologies	2.30	1.01	Rejected
Grand Mean	2.88	—	Accepted

Table 2 shows that respondents agreed that PowerPoint presentations, internet resources, Google Classroom, multimedia instructional videos, and mobile learning applications are utilized in Environmental Education programmes. However, environmental simulation software, virtual laboratories, and smart classroom technologies were not adequately utilized, with mean ratings below the criterion mean of 2.50. The overall grand mean of 2.88 indicates a moderate extent of digital tool utilization.

The findings in Table 3 reveal that respondents agreed that inadequate ICT infrastructure (M = 3.68), poor internet connectivity (M = 3.61), unstable electricity supply (M = 3.74), insufficient funding (M = 3.59), inadequate lecturer training (M = 3.42), limited technical support (M = 3.37), and resistance to technological change (M = 3.11) constitute the major challenges affecting the integration of digital tools in Environmental Education programmes. The grand mean of 3.50 confirms that these challenges significantly hinder effective digital integration.

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Research Question 3

What challenges affect the integration of digital tools in Geography and Environmental Education programmes in Colleges of Education in North-Central Nigeria?

Table 3

Mean Ratings on the Challenges Affecting Digital Tool Integration (N = 150)

Challenge	M	SD	Decision
Inadequate ICT infrastructure	3.68	0.56	Accepted
Poor internet connectivity	3.61	0.62	Accepted
Unstable electricity supply	3.74	0.51	Accepted
Insufficient funding	3.59	0.65	Accepted
Inadequate lecturer training	3.42	0.73	Accepted
Limited technical support	3.37	0.70	Accepted
Resistance to technological change	3.11	0.82	Accepted
Grand Mean	3.50	—	Accepted

Discussion Findings

The findings in research question one (1) revealed that mobile phones, PowerPoint presentations, internet resources, multimedia videos, and Google Classroom are the most commonly used digital tools in environmental education programmes in Federal Colleges of Education in North-Central Nigeria. This indicates that lecturers and students predominantly rely on readily available and affordable digital technologies to facilitate teaching and learning. The widespread use of these tools suggests a growing awareness of the importance of digital technologies in improving instructional delivery and learner engagement in environmental education. This finding is consistent with Olatunde-Aiyedun et al. (2024), who reported that digital technologies enhance environmental education by improving access to instructional resources, promoting learner participation, and supporting collaborative learning. Similarly, Usman et al. (2025) found that mobile technologies and internet-based platforms are among the most frequently utilized digital tools in Nigerian Colleges of Education because of their accessibility and ease of use. The study also found that the extent of digital tool utilization in research question two (2) environmental education programmes is moderate. While basic technologies such as PowerPoint presentations, internet resources, multimedia instructional videos, Google Classroom, and mobile learning applications are regularly utilized, advanced technologies including virtual laboratories, environmental simulation software, and smart classroom technologies are used to a much lesser extent. This finding suggests that although digital technology has gained acceptance within the institutions, its integration remains largely confined to conventional digital resources rather than more sophisticated technologies capable of supporting experiential and inquiry-based environmental learning. The finding agrees with Karofi (2025), who observed that technology integration in Nigerian Colleges of Education remains moderate because of inadequate digital infrastructure and limited access to advanced instructional technologies. It also supports the OECD (2024) position that effective digital integration depends on adequate infrastructure, institutional support, and

continuous professional development for educators. Furthermore, the findings identified unstable electricity supply in research question three (3), inadequate ICT infrastructure, poor internet connectivity, insufficient funding, lack of lecturer training, limited technical support, and resistance to technological change as the major challenges affecting the integration of digital tools in environmental education programmes. These constraints indicate that the successful integration of digital technologies requires not only the availability of digital tools but also enabling institutional conditions that support their effective utilization. This finding corroborates UNESCO (2023), which identified inadequate infrastructure, digital inequality, and limited institutional support as major barriers to technology integration in education. The finding also agrees with Ekung et al. (2019), who reported that inadequate funding and infrastructural deficiencies significantly hinder the implementation of technology-driven and sustainability-focused educational initiatives in higher education institutions.

Conclusion

The study concludes that digital tools are commonly used in environmental education programmes in Colleges of Education in North-Central Nigeria, with mobile phones, PowerPoint presentations, internet resources, and multimedia technologies being the most frequently utilized. However, the overall extent of digital tools utilization is moderate because advanced technologies are not widely adopted. The study also concludes that inadequate ICT infrastructure, unstable electricity supply, poor internet connectivity, insufficient funding, and limited digital competence among lecturers are the major challenges affecting the effective integration of digital tools. Therefore, addressing these challenges is essential for improving the integration and utilization of digital technologies in environmental education programmes.

Recommendations

. Management of Colleges of Education should provide adequate digital facilities such as multimedia equipment, reliable internet access, and modern ICT resources to promote the effective use of digital tools in environmental education.

. Regular training and capacity-building programmes should be organized for lecturers to enhance their competence in the utilization of both basic and advanced digital technologies for teaching environmental education.

. Government and educational stakeholders should address the major barriers to digital integration by improving electricity supply, increasing funding for ICT infrastructure, strengthening technical support services, and providing stable internet connectivity in Colleges of Education.

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