Review of Education – [Special Edition] Volume 37, Issue 4 [2025]: 95-102
https://reviewofeducation.unn.edu.ng/ | ISSN: 978-2585-10-6 [PRINT]

INTEGRATING DIGITAL TECHNOLOGIES INTO ENVIRONMENTAL EDUCATION CURRICULUM: ADDRESSING PEDAGOGICAL ISSUES IN THE 21ST CENTURY

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Abstract - The 21st century has witnessed a transformative shift in education, largely driven by rapid advancements in digital technologies. In environmental education, this shift presents unprecedented opportunities that enhance teaching and learning that address the evolving needs of learners. However, effective implementation of environmental education curriculum in Nigeria has been hindered by several factors. These factors comprise pedagogical issues such as traditional teaching methods, lack of qualified teachers and inadequate training, limited access to technology and internet connectivity among others that, mar the effective implementation of environmental education curriculum thereby requiring urgent intervention. This paper proposes the integration of digital technologies with planning, innovative instructional delivery and assessment tools as effective solution to the situation. Digital technologies are innovations that can revolutionize environmental education pedagogical landscape in many ways. These technologies encompass innovations such as virtual and augmented realities, online simulations, digital collaboration platforms like online discussion boards and cloud-based platforms, modern assessment tools such as interactive quizzes, and digital portfolios for students to showcase their work, reflect on their learning, and set environmental goals. Additionally, automated assessment software can streamline grading and provides instant feedback, freeing up instructors to focus on teaching and mentoring. The paper concluded that the integration of digital technologies can transform the current state of environmental education curriculum to enhance environmental awareness, literacy, stewardship and acquisition of problem-solving skills among students.

Keywords: Digital technologies, environmental education, curriculum, pedagogical Issues

Introduction

Digital technology's quick development has had a big impact on many industries worldwide. Haleem et al. (2022) define digital technologies as digital tools, systems, and resources that use a variety of digital tools, including computers, smartphones, tablets, and software applications, to create, process, store, manage, and communicate information. In the same vein, Dias, and Victor (2022) posited that digital technologies are digital tools and media that are used to support and enhance teaching and learning using the combination of digital hardware, software, and network that enable the creation, communication, and exchange of digital information. Digital technologies are playing critical role across various fields including education. It is acknowledged that education plays a significant role in raising living standards all over the world and it has contributed significantly to societies and development globally. Education in Nigeria is an instrument per excellence for effecting national

development. The National Policy on Education of the Federal Republic of Nigeria (FRN, 2014) acknowledged that no nation can achieve economic, social, technological progress and self-sufficiency without a good system of education to sustain the achievement. For the National Policy on Education to be implemented, it stipulates that the country's educational objectives must be clearly defined in terms of their relevance to the needs of individuals and society, in accordance with the realities of our environment and the modern world, and for the benefit of all citizens. This can be achieved through proper environmental education.

Concept of Environmental Education

Environmental education is a process of infusing into the educational system, environmental contents in order to enhance the awareness of people on environmental issues at all levels of education. According to Badamasi (2015) environmental education (EE) is seen as learning activities that increases learners' awareness, knowledge, skills, attitudes and commitment to the environment. In a similar vein, Yadav et al. (2022) Define environmental education as a process of learning that incorporates environmental knowledge and interactions in an effort to address the worsening relationship between humans and the environment. Environmental education is essential for advancing sustainability, conservation, and environmental consciousness, according to Yadav et al. (2022). Lack of formal training in the subject has an impact on the accuracy and depth of education when it comes to conveying environmental knowledge. Poppe et al. (2018) opined that environmental education is a process that aims to raise awareness, knowledge, and skills necessary for individuals to make informed decisions and take responsible actions towards the environment. Similarly, Uralovich et al. (2023) posited that environmental education as a lifelong learning process that helps individuals develop a deeper understanding and appreciation of the natural world, as well as the skills and knowledge necessary to make informed decisions and take responsible actions towards the environment. While Llopiz-Guerra et al. (2024) maintained that environmental education is a learning process that increases awareness, understanding, and concern for the environment, as well as develops skills and values necessary for individuals to participate in decision-making and problem-solving. Operationally, environmental education is the process of recognizing values and clarifying concepts in order to develop skills and attitudes necessary to understand and appreciate the interrelatedness among humans, cultures, and biophysical surroundings. Environmental education also entails practice in decision-making and self-formation of behaviours about issues concerning environmental quality. Therefore, environmental education is the process that enables individuals to acquire experiences about the associated problems in the environment as well as develop skills and attitudes towards sustainable development and conservation of natural resources for the present generation without compromising the needs of the future generation.

Objectives of Environmental Education

Consequently, it could be inferred that the major objective of environmental education is to create awareness about the environment and possible ways of conserving the environment. More specifically, the objectives of environmental education according to Gbendu, (2019) are classified as follows: (i) Awareness, to help social groups and individuals acquire an awareness and sensitivity of the total environment and its allied problems (ii) Knowledge, to help social groups and individuals to gain a variety of experiences and acquire

basic skills of the environment and its associated problems (iii) Attitudes, to help social groups and individuals to acquire a set of values and feeling of concern and protection.(iv) Skills, to help social groups and individuals to acquire skills for identifying and solving environmental problems. (v) Participation, to provide social groups and individuals with an opportunity to be actively involved at all levels working towards the resolution of environmental problems. Introduction to environmental education, environmental awareness and literacy, environmental issues and challenges, environmental values and attitudes, environmental action and citizenship, assessment and evaluation are all included in the environmental education curriculum. This can be achieved through the infusion of digital technologies across all levels of education in the existing curriculum.

Integrating digital technologies into environmental education curriculum presents a unique opportunity to enhance students' understanding of environmental issues, promote sustainable practices, teaching, learning, and assessment. According to Johnston et al. (2022) digital technology as tools, systems and devices that can generate, create, store or process data. The data processing and logic capabilities of digital technologies are enabled through micro- processes that are programmed to perform various functions. In a similar vein, Edwards, (2019) posited that digital technologies refer to devices such as personal computers and tablets, tools such as cameras, calculators and digital toys, systems such as software and apps, augmented and virtual reality, and less tangible forms of technology such as the internet. In another development, as part of explication of strategizing in a digital world, Volberda et al. (2021) have promoted work on the adoption of digital technologies, stating that it has positive impacts in different fields, whilst Kohtamäki et al. (2022) emphasized that the role of technology in planning is a key component in the educational sector as it used to harness various aspects of research and practices. However, pedagogical issues can hinder the effective implementation of environmental education. This paper discusses the objectives of environmental education curriculum in Nigeria, pedagogical issues, and how technological integration can address these issues and offers recommendations for successful implementation of environmental education curriculum.

Environmental education curriculum implies a structured program of study that aims to equip students with the knowledge, skills, and values necessary to understand and address environmental issues. According to Omoseebi. (2021) environmental education curriculum goal is to equip learners with the necessary competencies to contribute effectively to environmental sustainability through awareness and sensitivity to the environment and its associated problems, fostering knowledge and understanding of the environment and environmental challenges. Omoseebi. (2021) also noted that it helps in building attitudes of concern for the environment and motivation for actively participating in environmental improvement and protection, enhancing skills to identify and solve environmental problems, and encouraging participation in activities that lead to the resolution of environmental issues concerning critical components in the curriculum. Environmental education curriculum is based on environmental knowledge, environmental skills, environmental values and attitudes, and environmental citizenship. Environmental knowledge means the understanding of environmental concepts, principles, and issues, such as ecology, conservation, climate change, and sustainability, which will raise students' awareness of environmental issues and their impact on human health and well-being. Environmental skills imply the development of

skills necessary for environmental problem-solving, critical thinking, and decision-making, such as data collection, analysis, and interpretation. Environmental values and attitudes, refer to the promotion of values and attitudes that support environmental stewardship, such as respect for nature, empathy for other living beings, and responsibility for environmental actions. Finally, environmental citizenship which implies encouragement of active citizenship and community involvement in environmental decision-making and problem-solving in relation to pedagogical challenges.

Furthermore, integrating environmental education curriculum faces several pedagogical challenges such as traditional teaching methods, lack of qualified teachers and inadequate training, limited access to technology and internet connectivity among others have hinder curriculum implementation. Traditional teaching methods, which are predominantly teacher-centered, may not effectively engage students in environmental education. According to Fitrianto, and Saif. (2024) traditional teaching methods in environmental education often focus on lectures, textbooks, and hands-on activities, while these methods can be effective, they may not be sufficient to engage students and promote deep learning. In another development, Raja, (2018) argue that traditional teaching methods has limited engagement, as lectures and textbooks can be dry and unengaging leading to students disinterest and lack motivation. Raja, (2018) also, pointed out that lack of interactivity as it often focusses on one-way communication, limiting opportunities for students' interaction and collaboration. In the same vein, Tularam, (2019) maintained that traditional teaching methods may not provide students with opportunities to apply environmental concepts to real-world problems. Meanwhile the integration of digital technologies in environmental education curriculum can provide students with more engaging, interactive, and effective learning experiences. According to Hajj-Hassan et al. (2024), digital technologies enhance the teaching of environmental education by providing interactive, immersive, engaging learning experiences, increase students' motivation and engagement. In a similar vein, Mollah (2024) posited that digital technologies provide students with the opportunities to explore complex environmental concepts in a more interactive and immersive way and to apply environmental concepts to real-world problems and case studies.

In relation to the lack of qualified teachers and inadequate training which is one of the most pressing challenges of environmental education in Nigeria. Olatunde-Aiyedun and Ogunode (2021) state that there is a dearth of certified educators with specific expertise in environmental education. Many of the teachers assigned to teach environmental content are not formally trained in the field, which has an impact on the breadth and precision of instruction. The implication is that students often receive superficial knowledge, leading to poor understanding of complex environmental issues such as climate change, biodiversity loss, and pollution. As it concerns limited access to technology and internet connectivity this pose a serious challenge to both teachers and students as it affects content delivery, limiting their access to materials and resources (Maphosa, 2021). Regarding assessment tools, the standardized testing methods may not accurately measure students' understanding and application of environmental concepts, because it is often based on rote memorization rather than application of knowledge (Adom et al., 2020). There is an urgent need for an alternative assessment tool that evaluate practical skills and attitudes toward environmental stewardship through digital technologies.

Therefore, the integration of digital technologies offers potential solutions to these pedagogical challenges as it enhances engagement, interactivity, and collaboration among others**.** Digital tools such as planning, innovative instructional delivery and assessment tools. Planning, is often a lack of adequately trained teachers proficient in environmental education content and pedagogy. Additionally, insufficient funding leads to inadequate teaching materials and resources, hindering effective curriculum planning (Olatunde-Aiyedun et al., 2024). As it relates to innovative instructional delivery such as virtual reality (VR) and augmented reality (AR) are immersive experiences that simulate real-world ecosystems enhancing students' engagement and understanding of environmental concepts and online simulations, this are interactive tools that model environmental systems, allowing students to explore complex relationships and consequences of human actions (Dele-Ajayi et al., 2019). According to Joo and Brongersma (2022) virtual reality (VR) is a computer generated-generated simulation of a three-dimensional environment that can be experienced and interacted with in a seemingly real or physical way. Also pointed out that (VR) create a completely artificial environment that shuts out the physical world, immersing user in a virtual world. While Dargan et al. (2023) posited that augmented reality (AR) is a technology that overlays digital information and images onto the real world, using a device's camera and display. It enhances the real world by adding the virtual objects, sounds and other sensory inputs that can be seen, heard and even felt. Dargan et al. (2023) also note that augmented reality (AR) aims to modify the perception of real-world images by overlaying digital data on them, accept the outdoors and come up with a novel and efficient model in all application areas.

Examples are eco-explorer is an online platform that uses VR and AR to teach environmental education and conservation, Climate change simulation are interactive tool that models the effects of climate change on global ecosystems. Srivastava, (2025) posited that environmental citizen science is a mobile app that enables citizens to contribute to environmental research and monitoring. In relation to assessment, there are modern forms of assessment such as interactive quizzes and games this are engaging ways to evaluate students' understanding of environmental concepts and promote critical thinking (Zainuddin et al., 2020). Digital portfolios are another online platform for students to showcase their work, reflect on their learning, and set environmental goals, while automated assessment tools are a software that streamlines grading and provides instant feedback, freeing up instructors to focus on teaching and mentoring (Zainuddin et al., 2020)

However, addressing pedagogical issues through technological integration using digital tools such as planning, innovative instructional delivery and assessment tools offers potential solutions to these pedagogical issues. Digital tools like augmented and virtual reality, mobile applications, online discussion boards and cloud-based platforms among others can provide interactive and immersive learning experiences, making environmental education more engaging for students', as it concerns access to resources, online platforms can offer a wealth of resources, including virtual labs and simulations, which can supplement limited physical teaching materials and provide practical learning opportunities. In relation to collaborative learning, technology facilitates collaboration among students through online forums and group projects, promoting the exchange of ideas and collective problem-solving. In addition, it led to global connections and partnerships that foster environmental citizenship

and community involvement. While flexible assessment, can offer immediate feedback and can be designed to evaluate a range of competencies, including critical thinking and practical application of knowledge. Hence, digital technologies can address pedagogical issues in environmental education through the provision of access to digital resources and educational materials, enhancing teachers' professional development and training, facilitating collaborative learning and engagement, supporting formative and summative assessment among others. Despite the benefits, several challenges impede the integration of digital technologies in environmental education in Nigeria. Such as infrastructure deficiencies, limited teacher training and capacity building, financial constraints, and resistance to change among others. Infrastructure deficiencies, many schools lack the necessary infrastructure, such as reliable electricity and internet connectivity, essential for implementing digital technologies. In term of limited teacher training, there is a shortage of teachers trained in both environmental education and the effective use of digital technologies, resulting in underutilization of available tools. As it concerned financial constraints, insufficient funding for education limits the acquisition of digital devices and the development of digital content tailored to the Nigerian context. While in term of resistance to change, some educators and stakeholders may demonstrate resistant in adopting new technologies due to the lack of familiarity or skepticism about their effectiveness.

Conclusion

Integrating digital technologies into Nigeria's environmental education curriculum holds significant promise in enhancing teaching and learning outcomes, leading to environmental awareness, literacy, and stewardship among students. However, addressing the pedagogical issues requires a comprehensive approach that includes improving infrastructure, providing adequate teacher training and capacity building, securing necessary funding and ensuring access to technology and internet connectivity. This will enable students to engage and address environmental issues effectively.

Recommendations

To facilitate the successful integration of digital technologies in environmental education, the following recommendations are proposed.

1. Infrastructure development. The government should prioritize the development of reliable electricity and internet connectivity in schools to support digital learning by allocating sufficient funds for the procurement of digital devices, development of localized digital content, and maintenance of technological infrastructure.
2. Teacher training and capacity building programs. Implement comprehensive pre-service and in-service training programs focusing on environmental education and the effective use of digital technologies in teaching and learning.
3. Curriculum review. The environmental education curriculum should be review to incorporate digital literacy and the use of digital tools in exploring environmental concepts.

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