



ADVANCING ECO-LITERACY THROUGH DIGITAL ENVIRONMENTAL EDUCATION IN PUBLIC SECONDARY SCHOOLS IN RIVERS STATE



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Abstract

This paper advocates for the integration of digital technologies in environmental education as a strategic approach to enhance eco-literacy among students in both public and private secondary schools. In an era marked by rapid technological advancement and escalating environmental challenges, education systems must adapt by leveraging on digital tools such as virtual simulations, interactive apps, and multimedia resources to foster deeper understanding of environmental issues. While public schools often benefit from better access to technology, public schools frequently face barriers including limited infrastructure and connectivity, thereby widening the digital and environmental education gap. This paper argues that inclusive digital environmental education is essential not only for equitable learning but also for cultivating a generation equipped to address sustainability challenges. Drawing on global best practices and current educational trends, the paper emphasizes the need for policy support, targeted investment, and teacher training to ensure that students across geographic and socio-economic divides are empowered with the knowledge and skills to become active environmental stewards.

Keywords: *Eco-Literacy, Digital Environmental Education, Public Secondary School*

Introduction

In recent years, the world has witnessed a surge in environmental crises, ranging from rising global temperatures and extreme weather events to biodiversity loss and pollution. These challenges pose a threat not only to ecosystems but also to human health, food security, and socio-economic development. Climate change, in particular, continues to disrupt natural systems and amplify existing inequalities, especially in vulnerable communities (IPCC, 2021). As the planet grapples with these pressing environmental issues, the need for informed, proactive, and environmentally conscious citizens has become more urgent than ever.

Environmental education has emerged as a critical tool in fostering awareness, knowledge, and behavior change necessary to address these global concerns. It equips learners with the understanding and skills needed to make responsible decisions and take action for the environment. Studies have shown that when students are taught environmental concepts early, they are more likely to develop sustainable habits and attitudes throughout life (Anderson et al., 2022). However, the effectiveness of environmental education depends significantly on how it is delivered, particularly in an era dominated by technology.

Digital tools have transformed the landscape of modern education, offering innovative, interactive, and flexible learning experiences. In environmental education, technologies such as virtual simulations, online games, mobile applications, and multimedia content have proven effective in enhancing students' engagement and comprehension of complex ecological processes (Kuo & Chen, 2023). These tools can make abstract concepts tangible and provide learners with real-time data and global perspectives. Yet, access to these digital resources is uneven, especially between public and private schools, creating a digital divide that threatens to widen educational inequalities and limit the reach of environmental literacy efforts.



This position paper advocates for the equitable integration of digital tools in environmental education to promote eco-literacy among students in both public and private school settings. It examines the potential of digital environmental education to bridge learning gaps, explores the challenges faced by under-served schools, and proposes strategic interventions to ensure that all learners—regardless of location and ownership are empowered to understand and act on environmental issues. Digital environmental education, if equitably implemented, can enhance eco-literacy among students across both rural and urban settings.

Conceptual/Theoretical Clarification

An understanding of the key concepts underpinning this paper is essential for contextual clarity. Eco-literacy, also known as ecological literacy, refers to the ability to understand the natural systems that make life on earth possible and to apply this understanding in making informed decisions about environmental sustainability. It encompasses knowledge of ecological principles, systems thinking, and the development of attitudes and values that promote environmental stewardship (Capra & Luisi, 2020). Eco-literate individuals are not only knowledgeable about environmental issues but are also motivated to act responsibly in their interactions with the environment.

Digital environmental education involves the use of digital technologies—such as mobile applications, online platforms, simulations, multimedia content, and virtual laboratories—to deliver environmental learning experiences. These digital tools support the teaching and learning of environmental topics by enhancing access to interactive, up-to-date, and real-world environmental data and scenarios (Kuo & Chen, 2023). The goal is to improve learners' engagement, comprehension, and ability to connect theory to practice through digital means.

The digital divide refers to the gap between individuals or groups that have access to modern information and communication technologies and those that do not. In the context of education, it highlights disparities in access to computers, internet connectivity, digital content, and the skills necessary to utilize these tools effectively. This divide is particularly stark between rural and urban school environments, where infrastructural and socio-economic differences often determine the extent of digital inclusion.

Public and private school settings differ significantly in terms of infrastructure, teacher availability, access to educational resources, and community support. Private schools are typically located in densely populated, economically active areas and are often better equipped with digital infrastructure and qualified personnel. In contrast, public schools are situated in most populated and more remote regions where access to educational technology, qualified teachers, and funding is often limited (Adeyemi & Oladipo, 2022). These disparities impact the effectiveness and reach of digital environmental education programs.

This position paper is underpinned by two key theoretical frameworks. The Digital Learning Theory emphasizes how technology can enhance cognitive development and active learning. It posits that digital tools—when effectively integrated—can foster student-centered, interactive, and collaborative learning environments (Siemens, 2021). Complementing this is the Environmental Education Theory, which focuses on the role of education in shaping environmental awareness, attitudes, and behaviors. It advocates for experiential learning, systems thinking, and interdisciplinary approaches to build a deep understanding of ecological relationships and sustainability practices. Together, these theories provide a comprehensive framework for analyzing how digital technologies can transform environmental education and promote eco-literacy across diverse educational contexts.

Current State of Environmental Education

Environmental education has gradually gained recognition within educational systems globally as a necessary response to growing ecological challenges. Across various levels of education—from primary through tertiary—environmental themes are being integrated into curricula. In many countries, including Nigeria, environmental education is embedded within subjects such as Basic Science, Geography, Agricultural Science, and Social Studies at the primary and secondary levels. At the tertiary

level, dedicated courses on Environmental Science, Ecology, and Sustainable Development are offered, although often as electives rather than core requirements (Eze & Ezeudu, 2021). However, despite its inclusion, environmental education is still not uniformly prioritized, and in many contexts, it lacks the practical orientation needed to influence student behavior and action.

Traditionally, the teaching of environmental concepts has relied heavily on textbook-based instruction, lectures, and rote memorization. These conventional methods often fail to convey the complexity and urgency of environmental issues, and they limit students' ability to interact with real-world data or experiential learning opportunities. By contrast, digital approaches have introduced dynamic methods such as interactive simulations, educational games, virtual field trips, and augmented reality experiences that allow learners to visualize and explore environmental processes (Nwachukwu & Obasi, 2022). These tools not only make learning more engaging but also support better retention and application of knowledge. Yet, the adoption of these digital innovations remains uneven—particularly in resource-constrained rural schools.

In Nigeria, efforts to mainstream environmental education have been hindered by challenges such as outdated curriculum content, inadequate teacher training, and limited access to technology. Nevertheless, there are emerging initiatives that demonstrate the transformative potential of digital environmental education. For example, the “Green Schools Project” initiated by some NGOs in partnership with schools across Lagos and Abuja promotes environmental awareness through digital storytelling and mobile-based learning modules. In Kenya, the “eLearning for Climate Action” initiative integrates climate literacy into school curricula using tablets and mobile apps, enabling students in remote areas to access interactive content (UNEP, 2022). Globally, programs like NASA’s “Earth Science Education Collaborative” have empowered students with real-time environmental data, fostering eco-literacy through hands-on digital engagement.

Despite these promising cases, the divide in access to digital tools continues to reinforce educational inequalities between public and private learners. While private schools may benefit from high-speed internet and modern devices, their public counterparts often struggle with basic infrastructure, thereby limiting their exposure to digital environmental education. This disparity calls for deliberate policies and investments aimed at expanding digital access, teacher capacity, and curriculum innovation to ensure environmental education reaches and benefits all students, regardless of geographic location.

The Promise of Digital Tools in Environmental Education

In the evolving landscape of education, digital tools have emerged as powerful instruments for enhancing the delivery and impact of environmental education. These tools offer diverse functionalities, ranging from simulations and virtual laboratories to mobile applications, interactive media, and online collaborative platforms. Their integration into classroom instruction presents innovative pathways for engaging students, visualizing complex ecological systems, and fostering environmentally responsible behavior (Kuo & Chen, 2023).

Simulations and virtual labs enable learners to experiment with ecological models, observe environmental phenomena, and test hypotheses in risk-free, virtual environments. For instance, students can simulate the effects of deforestation on carbon cycles or explore virtual ecosystems to study biodiversity without leaving the classroom. These experiences bridge the gap between theoretical knowledge and practical understanding, making abstract concepts more tangible and relatable (Wang & Tsai, 2021).

Mobile apps are also playing a growing role in environmental literacy. Applications such as Earth Now, EcoChallenge, and iNaturalist provide real-time environmental data, interactive challenges, and opportunities for citizen science participation. These apps empower students to track local environmental conditions, document changes, and contribute to global data repositories, fostering a sense of agency and ecological responsibility (UNESCO, 2021). In addition, interactive media such as digital games, animations, podcasts, and virtual field trips present information in compelling formats that appeal to various learning styles and increase student motivation.

The benefits of these digital tools are significant. First, they enhance student engagement by transforming passive learning into active exploration. Interactivity, visual appeal, and personalized feedback sustain attention and stimulate curiosity—qualities essential for environmental consciousness and problem-solving. Second, they support real-time data collection and experiential learning, allowing learners to connect classroom content to their immediate environment and global issues. This approach encourages critical thinking and the application of knowledge to real-world contexts. Lastly, digital tools promote global interconnectedness, enabling students from diverse regions to collaborate on environmental projects, share insights, and understand their roles in a shared ecological future. Platforms such as GLOBE and Eco-Schools Global exemplify how students can engage in cross-border environmental action and learning.

As these tools continue to evolve, their role in shaping eco-literate, digitally fluent learners is becoming more critical. However, the potential of digital environmental education will only be fully realized when these technologies are equitably accessible and contextually adapted to the realities of both urban and rural learning environments.

Challenges in Public Schools

While digital tools hold significant promise for advancing environmental education, public schools face profound challenges that hinder their effective adoption and utilization. One of the most pressing obstacles is the limited ICT infrastructure and internet access. Many public schools in Nigeria and other developing regions lack basic technological resources such as computers, projectors, stable electricity, and broadband connectivity (Adebayo & Olayemi, 2022). This digital divide creates a stark disparity between urban and rural learners, restricting the latter's access to interactive environmental content, global data repositories, and real-time simulations that are essential for modern eco-literacy. In addition to infrastructural limitations, teacher training and digital competence remain inadequate in rural contexts. Teachers often lack the technical skills or professional development opportunities needed to effectively integrate digital tools into environmental instruction. Without proper guidance, even when devices are available, they may go underutilized or be misapplied, leading to minimal educational value (Ezeonu & Okorie, 2023). The absence of trained digital facilitators further reinforces traditional, lecture-based pedagogies, leaving environmental education static and disconnected from learners' lived realities.

Financial and logistical constraints also pose significant barriers. Many public communities contend with budgetary shortfalls, prioritizing immediate infrastructural needs over technological investments. Furthermore, irregular government support, maintenance challenges, and insecurity in some areas complicate efforts to deploy and sustain ICT infrastructure. Non-governmental organizations and donor agencies have attempted to bridge some of these gaps, but their efforts are often piecemeal and not scaled systemically (UNICEF, 2021).

The cumulative impact of these challenges on students' learning is profound. Students in under-resourced public schools are denied opportunities to engage deeply with environmental issues, limiting their awareness, critical thinking, and capacity for action. While their urban counterparts may participate in global digital environmental campaigns or simulate climate change scenarios in class, public students often receive outdated or overly theoretical instruction that fails to inspire or prepare them for environmental stewardship. This educational inequity not only undermines national environmental goals but also exacerbates broader socio-economic divides.

Addressing these challenges demands targeted policy interventions, investment in digital infrastructure, continuous teacher training, and inclusive curriculum reforms that ensure no learner is left behind—regardless of geographic location.

Bridging the Digital Divide

To ensure equitable access to quality environmental education across diverse regions, deliberate efforts must be made to bridge the digital divide that continues to marginalize rural learners. A central strategy is increased government and donor investment in rural ICT infrastructure. This includes

extending broadband connectivity to underserved areas, subsidizing the cost of digital devices for schools, and ensuring stable electricity through renewable energy sources like solar power. Such investments must be sustained and coordinated with education sector reforms to foster long-term impact (World Bank, 2022).

Public-private partnerships (PPPs) represent another viable approach. Collaborations between government agencies, technology firms, and educational institutions can accelerate the deployment of cost-effective digital tools. For example, initiatives like Airtel's "Adopt-a-School" or MTN's School Connectivity Projects have demonstrated how corporate involvement can expand digital access and improve learning conditions in remote areas (Adekunle & Uzochukwu, 2023). These partnerships also offer a platform for innovation by tailoring technology solutions to the unique needs of rural learners and teachers.

Given the limitations in connectivity, mobile-based learning and offline content delivery systems are essential. Many students in rural settings already use mobile phones, making them practical channels for delivering environmental content through apps, SMS modules, or preloaded educational media. Tools like Kolibri and ULesson provide offline learning options that reduce reliance on constant internet access while still offering rich, interactive content (UNESCO, 2023). These tools can be localized to reflect students' environments, promoting relevance and deeper understanding.

Simultaneously, capacity-building programs for teachers are crucial. Teachers must be equipped not only with digital skills but also with pedagogical techniques for integrating environmental content into digital formats. Government-led in-service training, peer mentoring, and certification programs can help teachers feel confident using technology in meaningful ways. Such training should be continuous, context-sensitive, and linked to broader educational quality improvement initiatives (Nwogu & Ekene, 2024).

Finally, the role of NGOs and community-based initiatives cannot be overstated. Organizations such as Connected Development (CODE) and Paradigm Initiative have been instrumental in providing digital literacy programs and environmental advocacy workshops in hard-to-reach areas. Community libraries, youth centers, and local radio programs can also serve as hubs for digital environmental education, especially when they foster partnerships with schools and involve local leaders to ensure sustainability and cultural alignment.

Addressing the digital divide in environmental education is not a one-size-fits-all endeavor. It requires a multi-stakeholder, context-driven strategy that balances technological innovation with inclusivity, capacity development, and grassroots participation.

Conclusion

In light of escalating global environmental challenges—from climate change to biodiversity loss—there is an urgent need to equip learners with the knowledge, skills, and attitudes required to understand and address these complex issues. Inclusive digital education emerges as a powerful tool for promoting eco-literacy, enabling students in both public and private settings to engage actively with environmental concepts. However, as this paper has shown, disparities in access to digital tools and infrastructure continue to marginalize rural learners, limiting their exposure to critical environmental education.

Therefore, a coordinated response from all stakeholders is essential. Governments must prioritize inclusive policy frameworks and sustained investment in digital infrastructure. Educators should embrace innovative teaching methods that integrate technology with environmental content. Technology companies must develop accessible and context-appropriate learning tools, while civil society organizations can play a pivotal role in grassroots mobilization, capacity building, and advocacy. The convergence of these efforts will ensure that no learner is left behind in the digital environmental revolution.

Ultimately, closing the digital divide is not merely an issue of technological advancement—it is a matter of educational justice and social equity. More importantly, it is a prerequisite for nurturing a



generation capable of making informed decisions and taking responsible action for the environment. Investing in inclusive digital environmental education today is investing in a sustainable tomorrow.

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