Journal of Environmental and Tourism Education Vol. 8 No. 1 June 2025

The Role of Technology and Inclusivity in Enhancing Stakeholders' Perception of Environmental Safety in Cross River State, Nigeria

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Abstract
This study examines the relationship between the integration of technology and inclusivity in environmental education and their impact on stakeholders' perception of environmental safety in Southern Cross River State, Nigeria. A correlational research design was adopted, with a sample of 400 respondents selected using the Taro Yamane formula. Data were collected through a structured 20-item questionnaire, validated by experts, and tested for reliability using Cronbach's alpha (α = .69–.89). Pearson product-moment correlation analysis revealed a significant positive relationship between technology integration in environmental education and stakeholders' perception of environmental safety ($r(398) = .131$, $p = .009$), indicating that increased use of technology enhances environmental awareness. However, no significant relationship was found between inclusive and culturally relevant environmental education and stakeholders' perception of environmental safety ($r(398) = .022$, $p = .664$). These findings suggest that while technology plays a crucial role in shaping environmental perceptions, inclusivity alone may not be a strong predictor. The study recommends further integration of technological tools in environmental education programs and continued efforts to promote inclusivity in learning.

Keywords: Environmental education, technology integration, inclusivity, stakeholders' perception, environmental safety, Cross River State, Nigeria.

Introduction and Background

Environmental degradation, particularly in developing regions like Cross River State, Nigeria, remains a significant challenge. The state's rich biodiversity, including tropical rainforests and unique ecosystems, is under threat from rapid urbanization, industrialization, and unsustainable resource exploitation, leading to deforestation, pollution, and habitat loss (Mondal & Palit, 2022). These environmental issues threaten both ecosystems and the livelihoods of local populations.

Environmental safety is an urgent concern globally, intensified by pollution and climate change (Hussain & Reza, 2023). The degradation of natural habitats, pollution, and resource depletion disrupt ecosystems, harm biodiversity, and affect human health (Sharma, 2024). Air and water

pollution, for example, contribute to respiratory and cardiovascular diseases, while also exacerbating extreme weather events and food security issues. To address these challenges, proactive environmental protection measures and sustainable practices are crucial (Rawat & Agarwal, 2015).

Regulatory frameworks and technological advancements are key to improving environmental safety. Government agencies, like the U.S. Environmental Protection Agency, enforce environmental laws and set standards for pollution control (Gunningham, 2011). Innovations such as pollution monitoring systems, renewable energy technologies, and waste treatment processes can help reduce environmental risks (Kundariya et al., 2021). Sustainable practices like recycling and energy efficiency further mitigate the impact of human activities (Li et al., 2017).

Technology also plays a crucial role in environmental education. Tools like virtual and augmented reality can offer immersive learning experiences, enhancing student engagement and knowledge retention (Mahmoud et al., 2020). Furthermore, incorporating indigenous knowledge systems and promoting community-based learning can strengthen environmental education by fostering a sense of stewardship and responsibility (Didham & Ofei-Manu, 2015; Whyte, 2013). Teacher training and professional development programs are essential for equipping educators with the tools to effectively teach environmental concepts and practices (Semerikov et al., 2020).

Integration of Technology in Environmental Education and Stakeholders' Perception of Environmental Safety. Environmental education fosters awareness and action toward sustainability. With technological advancements, educators utilize tools like virtual field trips, Geographic Information Systems (GIS), and interactive simulations to enhance engagement (Anderson et al., 2015). These digital resources provide immersive experiences, enabling learners to explore environmental concepts and interact with real-world data.

Technological Tools in Environmental Education

Baxter and Hainey (2023) investigated how immersive technologies influence students' learning experiences, particularly in remote education during the COVID-19 pandemic. Their study, involving 83 participants, highlighted the benefits of virtual learning, including enhanced engagement. However, challenges such as high equipment costs and motion sickness hinder widespread adoption. While immersive technologies offer pedagogical benefits, further research is necessary to address barriers to their effective use.

Culturally Relevant Environmental Education and Stakeholder Perception

Sheya (2014) explored the integration of Indigenous knowledge (IK) into environmental education in Namibian schools, emphasizing the need for culturally relevant curricula. Despite support from educators and traditional leaders, IK remains marginalized, necessitating a shift toward a cross-cultural Science, Technology, and Society (STS) framework. Similarly, Anderson et al. (2022) advocated for a culturally responsive evaluation framework in environmental education, addressing systemic inequities and ensuring inclusive learning practices.

Statement of the Problem

Despite growing awareness of environmental challenges, a gap remains between knowledge and action. Traditional educational methods often fail to foster meaningful behavioral change, leaving communities and policymakers struggling with issues like pollution and habitat loss. Bridging this gap requires innovative educational approaches that enhance stakeholders' perception of environmental safety and drive tangible sustainability efforts.

Purpose of the study

The main purpose of this study is to investigate Innovative Environmental Education Strategies and Enhancing Stakeholders Perception of Environmental Safety among Residents of Cross River State, Nigeria. Specifically, the study seeks to:

1. Examine the relationship between integration of technology in environmental education and enhancement of stakeholders' perception of environmental safety.
2. Investigate the relationship between inclusive and culturally relevant environmental education and enhancement of stakeholders' perception of environmental safety.

Research hypotheses

The following research hypotheses were formulated to guide the study:

1. There is no significant relationship between integration of technology in environmental education and enhancement of stakeholders' perception of environmental safety.
2. There is no significant relationship between inclusive and culturally relevant environmental education with the enhancement of stakeholders' perception of environmental safety.

Methodology

Research design

The correlational research design was adopted for this study. The study is conducted in Cross River State of Nigeria. Cross River State. The target population of this study is the total number of residents in urban centres of Southern education zone of Cross River State. Seven LGAs

make up this zone with a total population of 1,496,300 persons. The Taro Yamane formula was used to determine the sample size from the population. The sample size for this study will be 400 respondents.

Data was obtained through structured questionnaire. A twenty-item questionnaire was used for data collection. The instrument was designed in three sections, "A," "B" and "C" section. "A" consists of the respondents' personal data while "B" consisted of ten items and section "C" asked ten questions on Enhancing Stakeholders Perception of Environmental Safety.

A draft copy of the instrument was submitted to the supervisor and two experts in Measurement and Evaluation in the Faculty of Education, University of Calabar, Calabar to vet the items for face and content validity. Some items were dropped while others were modified as applicable to the study. However, out of 35 items that were developed for the study, 20 were retained as modified by the experts while 15 were dropped on account of irrelevance and ambiguity.

To ascertain the reliability of the instruments, Cronbach alpha reliability method was used. The instrument was administered once on 35 inhabitants in 2 communities in Ikom which were not part of the sample communities of this study. After the instrument was administered and retrieved from the respondents, they were coded, and the data subjected to statistical analysis using Cronbach alpha reliability scale. The reliability coefficient estimates realized from the result were within the range of .69 to .89.

The questionnaire was administered in each of the sampled community. The respondents were informed of the exercise and the essence of giving objective responses to the items. They were also told to be honest and objective in their responses as information obtained will be treated with all amounts of confidentiality and used as data for the research work only. The questionnaire was administered by the help of three trained assistants.

A four-point Likert-type-scale questionnaire ranging from strongly agree to disagree was adopted for the responses of the questionnaire. All scoring will be carried out with the use of the following keys.: SD - Representing strongly disagreed = 1 point, D - Representing disagreed = 2 points, A - Representing agreed. = 3 points, SA - Representing strongly agreed. = 4 points. However, the coding will be reversed for negatively worded items.

Presentation of results

Ho_1

How does integration of technology in environmental education relate with the enhancement of stakeholders' perception of environmental safety. The two variables in this hypothesis were integration of technology in environmental education and enhancement of stakeholders' perception of environmental safety among residents of southern education zone, Cross River State, Nigeria. Both variables were measured continuously. To test this hypothesis, Pearson product moment correlation analysis was used.

A Pearson Product Moment Correlation was conducted to examine the relationship between the integration of technology in environmental education and the enhancement of stakeholders' perception of environmental safety (N=400). The analysis revealed a significant positive correlation between the effectiveness of integration of technology (M = 17.22, SD = 1.37) and the perception of environmental safety (M = 25.02, SD = 3.09), r (398) = .131, p = .009. This suggests that as the effectiveness of technology integration in environmental education increases, stakeholders' perception of environmental safety also tends to improve. The result of analysis as presented in Table 1.

Table 1: Pearson Product Moment Correlation analysis of the relationship between integration of technology in environmental education and the enhancement of stakeholders' perception of environmental safety (N=400)

Variables	$\bar{x}$	SD	r-cal	p-value
Integration of technology in environmental education	17.22	1.37		
			.131*	.009
Perception of Environmental Safety	25.02	3.09		

* Significant at .05 level, df=398.

Ho_2

To what extent does inclusive and culturally relevant environmental education relate with the enhancement of stakeholders' perception of environmental safety. The two variables in this hypothesis were inclusive and culturally relevant environmental education and enhancement of stakeholders' perception of environmental safety among residents of southern education zone, Cross River State, Nigeria. Both variables were measured continuously. To test this hypothesis, Pearson product moment correlation analysis was used.

A Pearson product-moment correlation was conducted to examine the relationship between inclusivity in environmental education and stakeholders' perception of environmental safety

among 400 participants. Descriptive statistics indicated that the mean score for inclusivity in environmental education was M=16.87M = 16.87M=16.87, SD=0.78SD = 0.78SD=0.78, and the mean score for perception of environmental safety was M=25.02M = 25.02M=25.02, SD=3.09SD = 3.09SD=3.09. The analysis revealed a weak, non-significant correlation between inclusivity in environmental education and perception of environmental safety, r (398) =.022 p=.664.

Given that the p-value is greater than the .05 significance level, the null hypothesis that there is no relationship between inclusivity in environmental education and perception of environmental safety cannot be rejected. This suggests that inclusivity in environmental education does not significantly correlate with stakeholders' perception of environmental safety in this sample. The result of analysis as presented in Table 2.

Table 2: Pearson Product Moment Correlation analysis of the relationship between inclusive and culturally relevant environmental education and the enhancement of stakeholders' perception of environmental safety (N=400)

Variables	$\bar{x}$	**SD**	**r-cal**	**p-value**
Inclusivity in Environmental Education	16.87	.784		
			.022	.664
Perception of Environmental Safety	25.02	3.09		

* Significant at .05 level, df=398.

Discussion of findings

Effect of Integration of technology in environmental education on enhancement of stakeholders' perception of environmental safety.

The findings from the first hypothesis suggest that integration of technology in environmental education relate with the enhancement of stakeholders' perception of environmental safety in Southern Cross River State, Nigeria. The analysis revealed a significant positive correlation between the effectiveness of technology and the perception of environmental safety, leading to the rejection of the null hypothesis. This result reveals a significant correlation between the variables, supporting the findings of Baxter and Hainey (2023). They explored undergraduate students' perceptions of immersive technologies in enhancing their learning experiences, gathering insights from students across various academic disciplines to assess if these technologies can boost learning and engagement in higher education. Utilizing a case study approach with a mixed methods methodology based on questionnaires, the study involved 83

participants. It aimed to gauge students' opinions on the effectiveness of immersive technologies in higher education, especially in the context of the shift to remote learning due to the COVID-19 pandemic. Their findings call for further research on the application of immersive technologies in higher education. Although the study highlights benefit such as increased engagement, it also points out concerns like the preference for traditional face-to-face instruction and issues like equipment costs and motion sickness related to virtual reality. Moreover, these findings align with those of Zhao et al. (2020), who discovered that students engaging in virtual field trips showed higher levels of engagement and knowledge retention compared to traditional classroom learning. Similarly, Chernikova et al. (2020) conducted a meta-analysis of several studies and concluded that interactive simulations significantly enhanced students' understanding of complex environmental concepts.

Effect of inclusive and culturally relevant environmental education on enhancement of stakeholders' perception of environmental safety.

The analysis of hypothesis two indicated a weak and non-significant correlation between inclusivity in environmental education and the perception of environmental safety. These results suggest that, in this sample, inclusivity in environmental education does not have a significant relationship with stakeholders' perceptions of environmental safety. This finding contrasts with previous research by Sheya (2014), who examined the integration of indigenous knowledge into Environmental Education in Namibian schools. Sheya emphasized the growing interest in the role of indigenous communities in sustainable development and argued that incorporating Indigenous Knowledge (IK) into formal curricula, particularly in environmental education, is vital for making education relevant to rural students and addressing environmental issues. Sheya concluded that effective integration of IK in EE might require a shift from content-heavy curricula to a cross-cultural Science, Technology, and Society (STS) framework, promoting equitable comparison and utilization of all knowledge systems in environmental understanding.

Additionally, this study's findings diverge from the results of an article by Djonko-Moore et al. (2018), which explored how experiential science education improved science knowledge and engagement among urban children. Their study focused on cultural relevance and eco-justice in a weeklong summer camp for third- to sixth-grade children from African American and Latinx communities in Colorado. The camp included environmental and climate change lessons, activities at local community sites, and visits to nature and science-themed locations. The researchers used pre- and post-tests, focus group interviews, and reviews of journals and student work samples to assess the impact. They found that experiential learning positively influenced the children's science content knowledge and engagement in science activities and

field trips. This study proposed a model for developing culturally relevant experiential learning opportunities to engage underrepresented children in science.

Conclusion and recommendation

In conclusion, the findings from this study underscore the multifaceted relationship between various educational approaches and stakeholders' perceptions of environmental safety in Southern Cross River State, Nigeria. The integration of technology emerges as a potent tool in enhancing these perceptions, whereas inclusivity in environmental education shows a weak and non-significant correlation.

Based on the findings of the study on environmental education and stakeholders' perception of environmental safety in Southern Cross River State, Nigeria, the following recommendations are drawn: stakeholders should ensure the following:

1. Enhance Technological Integration: Encourage the further integration of technology, especially visual and creative communication tools, into environmental education programs. This can effectively engage stakeholders and enhance their perception of environmental safety.
2. Address Inclusivity in Education: Although the study found a weak correlation, efforts should be made to ensure inclusivity in environmental education. This includes catering to diverse learning needs and ensuring that educational resources are accessible to all stakeholders, regardless of background or ability.

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