Research Article

TEACHING FOR TOMORROW: LEVERAGING ECOLOGICAL SYSTEMS THEORY TO PROMOTE ENVIRONMENTAL AWARENESS IN NIGERIA

ENSEÑANZA PARA EL MAÑANA: APROVECHANDO LA TEORÍA DE LOS SISTEMAS ECOLÓGICOS PARA PROMOVER LA CONCIENCIA AMBIENTAL EN NIGERIA

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ABSTRACT

Environmental degradation in Nigeria, driven by deforestation, oil pollution, and climate-induced flooding, is compounded by persistently low levels of environmental literacy among the population. This study explored the pedagogical application of Bronfenbrenner's Ecological Systems Theory (EST) as a framework for strengthening environmental awareness. A mixed-methods design was adopted, combining a structured Likert-scale survey administered to 100 purposively selected respondents in Ondo State, Nigeria, comprising secondary school students, adult community members, and teachers, with a systematic review of empirical literature published between 2021 and 2025 and a theoretical analysis of EST applied to environmental education. Descriptive statistics revealed an overall grand mean of 2.73 (Neutral), with media exposure recording the highest item mean (M = 3.75) and trust in government enforcement of environmental regulations recording the lowest (M = 1.94, Strongly Disagree). Mesosystem and macrosystem subscales fell within the Disagree range, indicating critically weak school-community linkages and governance credibility. Based on these findings, a five-level EST-aligned conceptual framework and seven multi-level recommendations for curriculum developers, educators, and policymakers were developed to address Nigeria's environmental awareness deficit within post-colonial and socio-economic constraints.

KEYWORDS: Environmental education; ecological systems theory; sustainability pedagogy; Nigeria; environmental literacy

RESUMEN

La degradación ambiental en Nigeria, impulsada por la deforestación, la contaminación petrolera y las inundaciones inducidas por el cambio climático, se agrava por los persistentemente bajos niveles de alfabetización ambiental en la población. El presente estudio exploró la aplicación pedagógica de la Teoría de los Sistemas Ecológicos (TSE) de Bronfenbrenner como marco para fortalecer la conciencia ambiental. Se adoptó un diseño de métodos mixtos que combinó una encuesta estructurada de escala Likert administrada a 100 encuestados seleccionados de manera intencional en el estado de Ondo, Nigeria (estudiantes de secundaria, miembros adultos de la comunidad y docentes) con una revisión sistemática de la literatura empírica publicada entre

2021 y 2025, y un análisis teórico de la TSE aplicada a la educación ambiental. Los estadísticos descriptivos revelaron una media global de 2,73 (Neutral), con la exposición mediática registrando la media más alta por ítem (M = 3,75) y la confianza en la aplicación gubernamental de las regulaciones ambientales registrando la más baja (M = 1,94, Totalmente en desacuerdo). Las subescalas del mesosistema y del macrosistema cayeron en el rango de Desacuerdo, lo que indica vínculos escuela-comunidad y credibilidad de gobernanza críticamente débiles. A partir de estos hallazgos, se desarrollaron un marco conceptual alineado con la TSE en cinco niveles y siete recomendaciones multinivel para desarrolladores curriculares, educadores y formuladores de políticas.
PALABRAS CLAVE: *Educación ambiental; teoría de los sistemas ecológicos; pedagogía para la sostenibilidad; Nigeria; alfabetización ambiental*

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INTRODUCTION

Environmental sustainability has emerged as a defining challenge of the twenty-first century, and Nigeria illustrates the acute character of this crisis across much of the Global South. The country's significant ecological resources, encompassing tropical rainforests, coastal wetlands, and one of the largest river systems in the world, are under severe and accelerating threat. Deforestation, desertification, oil spills, urban flooding, and inadequate waste management are undermining both biodiversity and human health, while simultaneously impeding progress towards the United Nations Sustainable Development Goals, particularly SDG 13 (Climate Action) and SDG 15 (Life on Land) (Ibaba, 2025; Babalola and Olawuyi, 2021). Rapid urbanisation and population growth have further strained natural resources and infrastructure (Onuoha et al., 2022; (Ibimilua, & Ayiti, 2024). A critical dimension of this crisis is the persistently low level of environmental awareness among Nigerian citizens. Research indicates that most Nigerians demonstrate only superficial familiarity with environmental concepts, lacking substantive knowledge of causes, long-term impacts, and available courses of action (Morakinyo et al., 2025; Ogunbode,& Arnold, 2012). Environmental education, the globally accepted instrument for developing ecological literacy and pro-environmental behaviour, has not been adequately integrated into Nigeria's formal education system (Ibaba, 2025). Media-based sensitisation efforts have similarly failed to produce lasting behavioural change, largely because they are decontextualised, intermittent, and disconnected from community realities (Onyike, 2025).

This situation points to the need for a theoretically grounded and contextually sensitive framework for understanding how environmental attitudes develop and how they may be modified. Bronfenbrenner's Ecological Systems Theory (EST) offers such a framework. By mapping human development onto a series of nested environmental systems, from immediate family and school settings to broader cultural, policy, and historical structures, EST enables the design of multi-level educational interventions that engage families, schools, communities, media, and government actors simultaneously (Bronfenbrenner, 1979; Guy-Evans, 2025).

The four systemic factors that perpetuate Nigeria's environmental awareness deficit were identified as follows. First, the absence of formal environmental education from most school curricula means that learners complete their formal education without meaningful engagement with ecological issues (Agbor et al., 2025). Second, environmental legislation exists but is poorly enforced, and public participation in policy formulation remains minimal (Babalola and Olawuyi, 2021). Third, cultural and socio-economic pressures, including economic survival imperatives and traditional land-use practices, frequently override environmental concerns (Onuoha et al., 2022). Fourth, media campaigns remain predominantly urban and do not reach rural populations, who are often most proximate to ecological degradation (Onyike, 2025). The hypothesis advanced in this study

is that EST, rigorously applied and contextually adapted, can provide the systemic framework needed to address these interrelated deficits.

The overarching aim of this study was to examine the potential of Bronfenbrenner's EST as an empirically grounded and theoretically coherent framework for strengthening environmental awareness in Nigeria. Specifically, the study assessed the current level of environmental awareness among Nigerian respondents across each of the five EST system levels; mapped the systemic determinants of environmental attitudes onto EST's nested systems; evaluated the strengths and limitations of EST when applied to environmental education in post-colonial, low-income contexts; proposed an EST-aligned conceptual framework for environmental pedagogy; and developed multi-level recommendations for curriculum development, teacher training, media strategy, and environmental policy.

METHODOLOGY

This research article originated from a mixed-methods study that combined quantitative and qualitative techniques for data collection and analysis. The quantitative component adopted a cross-sectional survey design using a structured Likert-scale questionnaire to generate descriptive statistics of environmental awareness across the five EST system levels. Following the classification advanced by Creswell and Creswell (2018), the study was situated within the post-positivist paradigm, and the research design was exploratory and descriptive, suitable for baseline-mapping studies that seek to record the distribution and central tendency of attitudes within a defined sample. Analytic triangulation was applied, drawing on three streams of evidence, namely the EST theoretical framework, the systematic literature review, and the primary survey data, to illuminate and confirm interpretations (Musa et al., 2023; Madugu and Ibrahim, 2024).

The research was conducted in the following sequence. First, the EST framework was reviewed and its five system levels operationalised as subscales for the survey instrument. Second, the Environmental Awareness Likert Scale (EALS) was developed, validated by subject-matter experts, and piloted. Third, the survey was administered to 100 respondents over four weeks. Fourth, descriptive statistical analysis was conducted on the collected data. Fifth, the survey findings were triangulated with the systematic literature review to develop the conceptual framework and recommendations.

The target population comprised secondary school students, adult community members, and teachers in Ondo State, southwestern Nigeria. Ondo State was selected because it is representative of both urban and peri-urban communities within the southwestern ecological zone of the country. A purposive sampling strategy was employed to ensure representation across the three respondent categories, which correspond to distinct EST system levels: secondary school students (microsystem and mesosystem), adult community members (exosystem and macrosystem), and teachers (microsystem professional stakeholders). The total accessible population across the sampled schools and communities in Ondo State was estimated at approximately 800 individuals. A sample of 100 respondents was drawn, yielding a sampling fraction of 12.5 per cent, consistent with the recommendation of Creswell and Creswell (2018) that samples of 30 to 500 are appropriate for descriptive survey research. The demographic profile of participants is presented in Table 1.

Table 1: Demographic Profile of Survey Respondents (n = 100)

Characteristic	Category	n	%
Gender	Female	54	54.0
	Male	46	46.0
Age Group	15-20 years	38	38.0
	21-30 years	32	32.0
	31-45 years	22	22.0
	46 years and above	8	8.0
Respondent Type	Secondary school student	48	48.0
	Adult community member	32	32.0
	Teacher / educator	20	20.0
Residence	Urban	61	61.0
	Peri-urban / semi-rural	39	39.0

Note. SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree; M = Mean; SD = Standard Deviation.

The EALS was a researcher-designed instrument comprising 20 items distributed across five subscales, each corresponding to one EST system level (four items per subscale). Items were rated on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) and were worded in the first person to maximise personal relevance. Content validity was established through expert review by two specialists in environmental education and one specialist in educational measurement. Face validity was confirmed through a pilot test with 15 respondents outside the final sample, following which minor wording adjustments were made. Internal consistency reliability, estimated using Cronbach's alpha, yielded coefficients of .74, .78, .71, .76, and .73 for the microsystem, mesosystem, exosystem, macrosystem, and chronosystem subscales respectively, all exceeding the conventional threshold of .70 for exploratory research (Nunnally, 1978). The complete EALS instrument is presented in Table 2.

Table 2: Environmental Awareness Likert Scale (EALS) Survey Instrument

Code	Item	Subscale (EST Level)
MS1	Family regularly discusses environmental issues at home.	Microsystem
MS2	School includes environmental topics in classroom lessons.	Microsystem
MS3	Teachers encourage environmentally responsible behaviour.	Microsystem
MS4	Peers and classmates are concerned about environmental problems.	Microsystem
ME1	School organises community-based environmental activities.	Mesosystem
ME2	A strong connection exists between environmental learning at school and community practice.	Mesosystem
ME3	Parents in the community are involved in school environmental programmes.	Mesosystem
ME4	Environmental messages from school are reinforced at home.	Mesosystem
EX1	Regular exposure to environmental information through radio, TV, or social media occurs.	Exosystem
EX2	Local government provides adequate support for environmental education in the area.	Exosystem
EX3	NGOs and civil society organisations are active in promoting environmental awareness.	Exosystem
EX4	Parents' work situation allows sufficient time to engage with environmental matters.	Exosystem
MA1	Awareness of Nigeria's national environmental laws and policies exists.	Macrosystem
MA2	Cultural and traditional values in the community support environmental conservation.	Macrosystem
MA3	The government can be trusted to enforce environmental regulations effectively.	Macrosystem
MA4	Nigeria's environmental policies are adequate to address the country's ecological challenges.	Macrosystem
CH1	Awareness of how Nigeria's environment has changed over past decades is present.	Chronosystem
CH2	Historical resource extraction patterns (e.g., oil) are connected to today's environmental problems.	Chronosystem
CH3	Environmental conditions in Nigeria have worsened during respondents' lifetimes.	Chronosystem
CH4	Long-term thinking about sustainability is valued in the community.	Chronosystem

Note. Rating scale: 1 = Strongly Disagree; 2 = Disagree; 3 = Neutral; 4 = Agree; 5 = Strongly Agree

Questionnaires were administered in person by the research team over four weeks. All participants provided informed consent prior to participation. For student respondents, parental or guardian consent was obtained in addition to the student's own assent. Participation was voluntary and anonymous, with no personally identifiable information collected. All completed questionnaires were screened for missing responses; none required rejection.

Frequency counts, percentages, means (M), and standard deviations (SD) were computed for each item and subscale using descriptive statistics. Item means were interpreted against the following scale: 1.00-1.79 = Strongly Disagree; 1.80-2.59 = Disagree; 2.60-3.39 = Neutral; 3.40-4.19 = Agree; 4.20-5.00 = Strongly Agree. These cut-points followed the convention established by Bolarinwa, (2015). for environmental attitude scales in the Nigerian context. Subscale means were derived by aggregating item-level statistics and mapped onto the corresponding EST levels to enable integrative interpretation.

The research was conducted in accordance with accepted ethical standards for research involving human subjects, including informed consent, confidentiality, voluntary participation, and the right to withdraw without consequence. All data were stored securely and anonymised prior to analysis. Ethics approval was obtained from the responsible institutional ethics committee.

RESULTS AND DISCUSSION

This section presents descriptive statistics for the 20-item EALS across the five EST subscales, followed by an integrated discussion of the findings in relation to EST theory and the extant empirical literature on environmental education in Nigeria.

MICROSYSTEM (FAMILY AND SCHOOL)

Subscale Mean = 2.91; Neutral. As can be seen in Table 3, all four microsystem items fell within the Neutral range (M = 2.76-3.01). Teacher encouragement of environmentally responsible behaviour recorded the highest item mean (MS3: M = 3.01, SD = 1.16), suggesting that individual educators are perceived as partial environmental role models. School integration of environmental topics recorded the lowest mean (MS2: M = 2.76, SD = 1.01), with 36 per cent of respondents disagreeing or strongly disagreeing. Family discussions of environmental concerns (MS1: M = 2.90) and peer concern for the environment (MS4: M = 2.98) were similarly moderate.

Table 3: Descriptive Statistics: Microsystem (Family and School) (n = 100)

Code	Item	SD 1 (%)	D 2 (%)	N 3 (%)	A 4 (%)	SA 5 (%)	M	SD	Interp.
MS1	Family regularly discusses environmental issues at home.	8%	25%	39%	25%	3%	2.90	0.97	Neutral
MS2	School includes environmental topics in classroom lessons.	12%	24%	45%	14%	5%	2.76	1.01	Neutral
MS3	Teachers encourage environmentally responsible behaviour.	10%	23%	36%	18%	13%	3.01	1.16	Neutral
MS4	Peers and classmates are concerned about environmental problems.	8%	27%	33%	23%	9%	2.98	1.09	Neutral

Note. SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree; M = Mean; SD = Standard Deviation.

These findings indicate that microsystem actors are engaged in environmental education in an inconsistent and unsystematic manner, insufficient to produce durable behavioural change in the absence of reinforcement across other system levels. This aligns with the broader literature, which finds that individual teacher enthusiasm without curricular embedding fails to achieve ecological literacy (Agbor et al., 2025).

MESOSYSTEM (SCHOOL-COMMUNITY LINKAGES)

Subscale Mean = 2.40; Disagree. Table 4 presents the mesosystem results, which registered the lowest subscale mean of all five EST levels. Parental involvement in school environmental programmes (ME3: M = 2.11, SD = 0.84) was the lowest-rated item in the entire survey, with 69 per cent of respondents disagreeing or strongly disagreeing. Only 15 per cent agreed that their school organises community-based environmental activities (ME1: M = 2.37), and only 19 per cent perceived a strong school-community link for environmental learning (ME2: M = 2.54).

Table 4: Descriptive Statistics: Mesosystem (School-Community Linkages) (n = 100)

Code	Item	SD 1 (%)	D 2 (%)	N 3 (%)	A 4 (%)	SA 5 (%)	M	SD	Interp.
ME1	School organises community-based environmental activities.	22%	36%	27%	13%	2%	2.37	1.03	Disagree
ME2	A strong connection exists between environmental learning at school and community practice.	18%	32%	31%	16%	3%	2.54	1.06	Disagree
ME3	Parents in the community are involved in school environmental programmes.	25%	44%	26%	5%	0%	2.11	0.84	Disagree
ME4	Environmental messages from school are reinforced at home.	19%	35%	26%	11%	9%	2.56	1.18	Disagree

Note. SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree; M = Mean; SD = Standard Deviation.

These results demonstrate a fundamental deficiency in mesosystem connections. Environmental knowledge acquired at school is not reinforced at home or within the wider community, preventing its consolidation into habitual behaviour. This finding aligns with Bronfenbrenner (1979), who identified weak mesosystem linkages as a primary mechanism through which school-level environmental education fails to generate community-level change in Nigeria.

EXOSYSTEM (MEDIA AND GOVERNMENT SERVICES)

Subscale Mean = 2.76; Neutral. As Table 5 shows, the exosystem subscale was characterised by a pronounced divergence between media exposure and institutional support. Media exposure (EX1: M = 3.75, SD = 1.01) was the highest-rated item in the entire survey, with 61 per cent of respondents agreeing or strongly agreeing that they are regularly exposed to environmental information through radio, television, or social media. In sharp contrast, local government support for environmental education (EX2: M = 2.21) was rated poorly, with 63 per cent of respondents disagreeing or strongly disagreeing.

Parental time for environmental engagement was also rated low (EX4: M = 2.36), reflecting financial pressures that constrain family-level environmental action. NGO activity was rated at a moderate level (EX3: M = 2.71), indicating an underutilised resource. High media reach combined with weak institutional support confirms the pattern identified by Onyike (2025), who found that generic, decontextualised media campaigns fail to translate into applied environmental knowledge or behavioural change.

Table 5: Descriptive Statistics: Exosystem (Media and Government Services) (n = 100)

Code	Item	SD 1 (%)	D 2 (%)	N 3 (%)	A 4 (%)	SA 5 (%)	M	SD	Interp.
EX1	Regular exposure to environmental information through radio, TV, or social media occurs.	1%	11%	27%	34%	27%	3.75	1.01	Agree
EX2	Local government provides adequate support for environmental education in the area.	28%	35%	25%	12%	0%	2.21	0.99	Disagree
EX3	NGOs and civil society organisations are active in promoting environmental awareness.	13%	26%	42%	15%	4%	2.71	1.01	Neutral
EX4	Parents' work situation allows sufficient time to engage with environmental matters.	19%	38%	31%	12%	0%	2.36	0.93	Disagree

Note. SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree; M = Mean; SD = Standard Deviation.

MACROSYSTEM (POLICY AND CULTURAL NORMS)

Subscale Mean = 2.44; Disagree. Table 6 presents the most alarming set of findings in the survey. Trust in government enforcement of environmental regulations (MA3: M = 1.94, SD = 0.80) fell within the Strongly Disagree range, with 75 per cent of respondents indicating disagreement or strong disagreement. Policy awareness (MA1: M = 2.34) and policy adequacy (MA4: M = 2.21) were equally low, indicating that environmental governance is perceived as both invisible and ineffective.

Table 6: Descriptive Statistics: Macrosystem (Policy and Cultural Norms) (n = 100)

Code	Item	SD 1 (%)	D 2 (%)	N 3 (%)	A 4 (%)	SA 5 (%)	M	SD	Interp.
MA1	Awareness of Nigeria's national environmental laws and policies exists.	21%	32%	39%	8%	0%	2.34	0.90	Disagree
MA2	Cultural and traditional values in the community support environmental conservation.	2%	25%	28%	36%	9%	3.25	1.00	Neutral
MA3	The government can be trusted to enforce environmental regulations effectively.	33%	42%	23%	2%	0%	1.94	0.80	Str. Disagree
MA4	Nigeria's environmental policies are adequate to address the country's ecological challenges.	30%	29%	31%	10%	0%	2.21	0.99	Disagree

Note. SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree; M = Mean; SD = Standard Deviation.

According to EST, the macrosystem provides the institutional and normative context within which all lower-level systems operate. Where citizens fundamentally distrust the government's willingness or capacity to enforce environmental protection, the macrosystem actively undermines rather than supports individual and community-level environmental action. The only positive indicator at this level was the perception that cultural and traditional values support environmental conservation (MA2: M = 3.25, SD = 1.00), with 45 per cent of respondents agreeing or strongly agreeing. This represents a potentially significant but underutilised cultural resource for environmental education programming.

CHRONOSYSTEM (LONG-TERM AND HISTORICAL AWARENESS)

Subscale Mean = 3.14; Neutral. As indicated in Table 7, the chronosystem subscale recorded the highest mean of all five EST levels. The perception that environmental conditions in Nigeria have worsened during respondents' lifetimes (CH3: M = 3.57, SD = 0.99) was the highest-rated item across the macrosystem and chronosystem subscales, with 54 per cent agreeing or strongly agreeing. The connection between historical resource extraction and present environmental problems (CH2: M = 3.34) was also rated at moderate-to-positive strength.

Table 7: Descriptive Statistics: Chronosystem (Long-term and Historical Awareness) (n = 100)

Code	Item	SD 1 (%)	D 2 (%)	N 3 (%)	A 4 (%)	SA 5 (%)	M	SD	Interp.
CH 1	Awareness of how Nigeria's environment has changed over past decades is present.	9%	27%	36%	22%	6%	2.89	1.04	Neutral
CH 2	Historical resource extraction patterns (e.g., oil) are connected to today's environmental problems.	2%	20%	39%	20%	19%	3.34	1.07	Neutral
CH 3	Environmental conditions in Nigeria have worsened during respondents' lifetimes.	3%	9%	34%	36%	18%	3.57	0.99	Agree
CH 4	Long-term thinking about sustainability is valued in the community.	15%	22%	40%	18%	5%	2.76	1.07	Neutral

Note. SD = Strongly Disagree; D = Disagree; N = Neutral; A = Agree; SA = Strongly Agree; M = Mean; SD = Standard Deviation.

These findings indicate that respondents possess a strong sense of lived environmental degradation, an experiential chronosystem awareness, even where formal historical or policy knowledge is limited. Community valuation of long-term sustainability thinking remained, however, in the Neutral range (CH4: M = 2.76), suggesting that experiential environmental awareness has not yet translated into a community culture of long-term environmental custodianship.

CROSS-SUBSCALE SUMMARY AND INTEGRATED DISCUSSION

The comparative subscale means across the five EST levels are presented in Table 8, enabling an integrated reading of the survey findings.

Table 8: Cross-Subscale Summary of EALS Scores by EST Level (n = 100)

EST Subscale	Subscale Mean (M)	Interpretation	Key Finding
Microsystem	2.91	Neutral	Moderate family and school engagement; inconsistent and unsystematic
Mesosystem	2.40	Disagree	Weakest subscale: school-community linkages critically absent
Exosystem	2.76	Neutral	High media exposure (M = 3.75) but poor government support (M = 2.21)
Macrosystem	2.44	Disagree	Negligible trust in government (M = 1.94); cultural values moderately positive
Chronosystem	3.14	Neutral	Highest subscale; strong awareness of environmental deterioration (M = 3.57)
Overall Grand Mean	**2.73**	**Neutral**	**Environmental awareness is moderate overall but structurally fragile**

Note. Interpretation scale: 1.00-1.79 = Strongly Disagree; 1.80-2.59 = Disagree; 2.60-3.39 = Neutral; 3.40-4.19 = Agree; 4.20-5.00 = Strongly Agree.

Three analytically significant patterns emerged from the cross-subscale data. First, the overall grand mean of 2.73 falls within the Neutral range, indicating that environmental awareness is present among the sample but remains tenuous and structurally dependent on media exposure rather than institutionally supported environmental education. Second, the mesosystem (M = 2.40) and macrosystem (M = 2.44) subscales both fell within the Disagree range, confirming that school-community linkages and governance credibility, the two critical connectors within the EST framework, are its weakest components in the Nigerian context. Third, the high chronosystem mean (M = 3.14) reflects respondents' experiential knowledge of environmental deterioration, an underutilised pedagogical resource that EST-aligned education must mobilise.

The survey results, when triangulated with EST theory and the empirical literature, reveal a pattern of structurally fragile environmental awareness sustained primarily by media exposure. Research consistently demonstrates that media-driven awareness, without reinforcement from microsystem and mesosystem actors, is insufficient to drive behavioural change (Onyike, 2025; Agbor et al., 2025). The near-total absence of trust in government enforcement (MA3: M = 1.94) is particularly significant: according to EST, the macrosystem constitutes the institutional framework within which all lower-level interactions occur, and where citizens perceive environmental governance as ineffective, even well-designed microsystem interventions face a structural ceiling.

The mesosystem deficit is equally consequential. EST theory holds that behavioural norms are consolidated when multiple microsystems, such as school, family, and community, consistently reinforce the same values. The findings that 69 per cent of respondents disagreed that parents are involved in school environmental programmes (ME3), and that only 19 per cent perceived a strong school-community relationship for environmental learning (ME2), indicate that these reinforcing connections are almost entirely absent. Environmental knowledge acquired at school therefore has little opportunity to become habituated behaviour.

By contrast, the chronosystem findings offer cautious grounds for optimism. Respondents' recognition that environmental conditions have worsened over their lifetimes (CH3: M = 3.57) and that historical resource extraction contributes to current environmental problems (CH2: M = 3.34) represents a reservoir of experiential environmental knowledge that formal education has not yet mobilised. EST theory suggests that this experiential awareness, grounded in lived experience of environmental change, can serve as a powerful affective and motivational foundation for more transformative environmental education, a point that is central to the conceptual framework presented below.

These results are consistent with the findings of Agbor et al. (2025), Babalola and Olawuyi (2021), and Morakinyo et al. (2025), and confirm that a qualitative shift is required: from the mere dissemination of information to an approach that builds mesosystem connections between school and community, restores macrosystem credibility through governance accountability, and mobilises chronosystem experiential awareness as a springboard for transformative learning.

BRONFENBRENNER'S ECOLOGICAL SYSTEMS THEORY AND ENVIRONMENTAL PEDAGOGY

Urie Bronfenbrenner (1917-2005) argued that human development cannot be understood in isolation from the nested environmental systems within which individuals are embedded (Bronfenbrenner, 1979). The microsystem encompasses the immediate settings of family, classroom, peer group, and neighbourhood. The mesosystem comprises the interconnections between microsystems, such as the school-home relationship. The exosystem includes settings in which the individual does not participate directly but whose decisions nonetheless affect their development, including parental workplaces and national media policies. The macrosystem encompasses the broad cultural, ideological, and institutional patterns of a society. The chronosystem captures the temporal dimension of development, including both life-course changes and historical processes such as colonial resource extraction.

Applied to environmental education, EST's multi-level architecture means that environmental attitudes and behaviours are jointly shaped by immediate relational settings, institutional arrangements, structural socio-economic forces, cultural values, and historical processes. A student who receives strong environmental education at school but returns to a household and community where environmental concern is economically inaccessible or socially marginalised is unlikely to convert that education into durable pro-environmental behaviour. Conversely, a student whose school, family, community organisations, and local government consistently model and reinforce environmental responsibility is substantially more likely to internalise pro-environmental dispositions (Lasekan et al., 2024).

Several limitations of EST must be acknowledged when applying it to the Nigerian context. The theory was developed within mid-twentieth-century North American child development studies, and its assumptions regarding family structure, institutional stability, and individual developmental agency do not translate uniformly across cultural settings. In post-colonial societies such as Nigeria, the macrosystem is partially constituted by legacies of colonial administrative frameworks and externally imposed educational systems, complicating the theory's original formulation of cultural-behavioural relationships (Onuoha et al., 2022).

EST is also primarily descriptive: it identifies systemic influences on behaviour but does not, of itself, prescribe how those systems should change. Furthermore, it risks underestimating structural power asymmetries. In contexts of extreme inequality, such as Niger Delta communities subject to decades of corporate environmental negligence and state complicity, even well-designed microsystem and mesosystem interventions may be insufficient without structural political-economic change. The chronosystem dimension also remains underdeveloped in applied environmental education research, with longitudinal qualitative approaches seldom deployed in

the Nigerian literature. These limitations are incorporated into the framework and recommendations that follow.

Based on the survey findings and the reviewed literature, four principles for EST-aligned environmental education in Nigeria were identified. First, environmental education must foster systems thinking by developing students' capacity to perceive the connections between environmental events, social structures, and individual behaviours. Second, it must be grounded in contextual relevance, addressing the specific environmental and socio-cultural conditions of Nigerian learning contexts. Third, effective environmental behavioural change requires multilevel engagement across the full range of EST system levels simultaneously. Fourth, environmental education must cultivate historical and temporal consciousness by connecting present-day ecological conditions to their historical antecedents.

Table 9 maps concrete pedagogical strategies onto each level of EST, illustrating how the framework may be operationalised in Nigerian educational settings.

Table 9: EST Levels and Corresponding Pedagogical Strategies for Environmental Awareness in Nigeria

EST Level	Key Actors	Pedagogical Strategy	Example Application
Microsystem	Students, teachers, families, peers	Integrate environmental content into core subjects; cultivate pro-environmental classroom culture	Embedding waste-sorting and energy-conservation practices as routinised classroom activities
Mesosystem	School-family-community partnerships	Create formal linkages between environmental learning in school and practices at home and in the community	School-parent environmental compact; joint school-community tree-planting or clean-up projects
Exosystem	Local government, NGOs, employers	Advocate for resource allocation to EE; reduce economic barriers to pro-environmental behaviour	Local government subsidies for school environmental projects; NGO-supported community monitoring
Macrosystem	National government, media, cultural leaders	Align EE with cultural values; strengthen policy mandates; engage traditional and religious leaders	Framing conservation in culturally resonant terms; mandatory EE in national curriculum standards
Chronosystem	All stakeholders over time	Build longitudinal EE programmes that develop competencies progressively; connect lived experience to historical analysis	Spiral curriculum deepening from primary through secondary school; intergenerational environmental storytelling

Source: Based on Bronfenbrenner (1979) and survey findings (2026).

Based on the data provided by the EALS survey and within the conceptual framework of the EST, the following seven multilevel recommendations were developed for curriculum developers, educators, and policymakers:

1. Integrate Environmental Education into the National Curriculum (Microsystem and Macrosystem).

As survey item MS2 (M = 2.76) confirmed, school integration of environmental content was inadequate across the sample. Environmental education must be embedded as a compulsory component of the national curriculum from primary to senior secondary level, with content calibrated to Nigeria's diverse ecological zones and delivered through inquiry-based, project-oriented methodologies rather than rote instruction. Teacher pre-service and in-service training must incorporate environmental education as a core competency. The success indicator for this recommendation is a measurable increase in school environmental literacy scores within three to five years of implementation.

2. Establish School-Community Environmental Partnerships (Mesosystem).

The mesosystem subscale (M = 2.40) identified the most urgent area of need. School environmental action committees comprising teachers, parents, community leaders, and local

government representatives should be constituted to design and implement at least one community-based environmental programme per academic year. Success indicators include the percentage of schools with active school-community partnerships and the proportion of students reporting regular home discussions of environmental issues.

3. Develop Contextually Grounded, Sustained Media Campaigns (Exosystem).

The high media exposure score (EX1: M = 3.75) combined with persistently low environmental knowledge confirms a quality deficit rather than a reach deficit. Media campaigns must shift from generic national awareness messaging to sustained, localised, behaviour-specific campaigns delivered in local dialects and featuring local environmental actors. Pre- and post-exposure surveys measuring behavioural intentions and reported practice changes should serve as success indicators.

4. Strengthen Policy Enforcement and Rebuild Institutional Trust (Macrosystem).

The near-complete absence of trust in government enforcement (MA3: M = 1.94) constitutes the most critical structural barrier identified. Environmental regulatory agencies must be adequately funded and legally insulated from political interference. Pilot community-based environmental monitoring programmes, in which citizens directly participate in enforcement and reporting, should be established to rebuild public confidence in governance. A measurable increase in public trust scores regarding government enforcement of environmental regulations is the recommended success indicator.

5. Mobilise Cross-Sector Partnerships to Finance Environmental Education (Exosystem and Macrosystem).

Sustainable environmental education requires dedicated funding. A National Environmental Education Fund, established through collaboration among federal and state governments, international development agencies, corporate social responsibility initiatives, and civil society organisations, should prioritise teacher training, curriculum development, and community-based projects in underserved communities. Fund disbursement rates and geographical distribution of funded projects constitute appropriate success indicators.

6. Leverage Digital and Mobile Technologies for Environmental Education (Exosystem and Chronosystem).

Nigeria's expanding mobile network coverage provides an underexploited channel for environmental education. Free-to-access digital learning materials and mobile applications designed for low-bandwidth environments should be developed by education authorities and made available to underserved communities. Platforms should incorporate citizen reporting functions for environmental violations. Success indicators include the number of users accessing educational materials and the volume of environmental violation reports submitted.

7. Promote Intergenerational and Family-Based Environmental Learning (Microsystem and Chronosystem).

The chronosystem findings (CH3: M = 3.57; CH2: M = 3.34) confirmed that respondents possess strong experiential and historical awareness of environmental deterioration, a latent pedagogical resource. Schools should engage families through structured home-learning activities, parent education workshops, and intergenerational environmental storytelling programmes that connect this lived environmental memory to contemporary sustainability science. Traditional and religious leaders should be engaged as champions of environmental stewardship. The proportion of households reporting regular environmental discussions and at least one home-based practice change per year is the recommended success indicator.

CONCLUSIONS

This study generated an empirically grounded understanding of environmental awareness in Nigeria across the five levels of Bronfenbrenner's Ecological Systems Theory. A structured Likert-scale survey administered to 100 respondents in Ondo State, triangulated with a systematic literature review and EST theoretical analysis, produced the following substantive findings.

Environmental awareness among the sampled population was present but structurally fragile, with an overall grand mean of 2.73 (Neutral). Media exposure was the dominant source of environmental awareness (EX1: M = 3.75), while school-community mesosystem linkages (M = 2.40) and macrosystem governance credibility (M = 2.44) registered within the Disagree range, confirming their status as the critical weak points of the environmental awareness system in this context.

The most significant finding was the near-complete absence of trust in government enforcement of environmental regulations (MA3: M = 1.94, Strongly Disagree). This result demonstrates that EST cannot function as a straightforward multi-level intervention framework in post-colonial, governance-constrained contexts without first addressing macrosystem credibility. Where citizens have no confidence in the government's will or capacity to enforce environmental law, even the most carefully designed microsystem and mesosystem educational interventions encounter a structural ceiling that pedagogy alone cannot overcome. Restoring macrosystem credibility through governance accountability is therefore not one recommendation among seven; it is a prerequisite for the success of all others.

The chronosystem findings provided an important counterpoint. Respondents' lived awareness of environmental deterioration across their lifetimes (CH3: M = 3.57) and their recognition of the connection between historical resource extraction and current ecological problems (CH2: M = 3.34) represent a substantial reservoir of experiential knowledge that formal environmental education has not yet mobilised. EST-aligned pedagogy that draws on this experiential foundation can potentially bridge the gap between awareness and action that has characterised previous interventions.

The seven recommendations developed from this study are mutually reinforcing and grounded directly in the EALS survey evidence. They address each level of the EST framework simultaneously, consistent with the theory's central proposition that durable environmental behaviour requires multi-level systemic reinforcement. Future research should build on this baseline through longitudinal and multi-site studies that examine the effects of EST-aligned interventions on environmental knowledge, attitudes, and behaviours over time, so as to develop the evidence base needed to translate the conceptual framework presented here into effective and sustainable environmental education policy in Nigeria and across the Global South.

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STATEMENT OF DATA AVAILABILITY: The author(s) declare that the data used in the study/research performed are available without access restrictions for analysis by interested parties in the repository: [https://zenodo.org/me/uploads?q=&f=shared_with_me%3Afalse&l=list&p=1&s=10&sort=newest
[https://zenodo.org/me/uploads?q=&f=shared_with_me%3Afalse&l=list&p=1&s=10&sort=newest.

BIBLIOGRAPHIC REFERENCES

Agbor, C. N., Etan, M. O., Akuji, R. T., & Ogbor, C. O. (2025). Methods of teaching environmental education for sustainability. International *Journal of Economics, Environmental Development and Society, 6(2),* 209–233. https://www.ijeeds.com.ng/assets/vol.,-6(2)-agbor,-c.-n.,-etan,-m.-o.,-akuji,-r.-t.,-ogbor,-c.-o.pdf

Babalola, A., & Olawuyi, D. S. (2021). Advancing environmental education for sustainable development in higher education in Nigeria: *Current challenges and future directions. Sustainability, 13(19),* Article 10808. https://doi.org/10.3390/su131910808

Bolarinwa, O. A. (2015). Principles and methods of validity and reliability testing of questionnaires used in social and health science researches. *Nigerian Postgraduate Medical Journal, 22(4), 195–201.* https://doi.org/10.4103/1117-1936.173959

Bronfenbrenner, U. (1979). The ecology of human development: Experiments by nature and design. Harvard University Press.

Creswell, J. W., & Creswell, J. D. (2018). Research design: Qualitative, quantitative, and mixed methods approaches (5th ed.). SAGE Publications.

Guy-Evans, O. (2025). Bronfenbrenner's ecological systems theory. Simply Psychology. https://www.simplypsychology.org/bronfenbrenner.html

Ibaba, G. B. (2025). Environmental education and sustainable development in Nigeria. *International Journal of Scientific Research in Education, 18(2),* 239–244. https://www.ijsre.com.ng/assets/vol.,-18(2)-ibaba.pdf

Ibimilua, F. O., & Ayiti, O. M. (2024). Environmental problems and sustainable development in Nigeria. Research and Reviews: *Journal of Environmental Sciences, 6(2*), 41–50. https://doi.org/10.5281/zenodo.10985739

Kodiya, M. A., Modu, M. A., Ishaq, K., Yusuf, Z., Wakili, A. Z., Dayyabu, N., Jibrin, M. A., & Babangida, M. U. (2025). Environmental pollution in Nigeria: Unlocking integrated strategies for environmental sustainability. *African Journal of Environmental Sciences and Renewable Energy, 18(1),* 30–50. https://doi.org/10.62154/ajesre.2025.018.010588

Madugu, U., & Ibrahim, F. A. (2024). The imperative of triangulation in research. J*ournal of Political Discourse, 2(4),* 195–201. https://jopd.com.ng/index.php/jopdz/article/view/233

Morakinyo, O. E., Taiwo, R. O., Morenikeji, T., Abdulquadri, K., Oyeniyi, S. A., Oyeniran, D. O., Yusuff, I. O., & Odoh, A. E. (2025). An assessment of environmental education awareness, attitudes and engagements for environmental sustainability in Nigeria: A case study of LAUTECH students. *ABUAD Journal of Engineering and Applied Sciences, 3(1),* 1–15. https://doi.org/10.53982/ajeas.2025.0301.03-j

Musa, U. F., Yerima, H., & Abdulrasheed, I. K. (2023). Exploring the imperatives of triangulation designs in research methods: A literature perspective. *Journal of Peace Studies and Practice, 12, 1–15.*

Nunnally, J. C. (1978). Psychometric theory (2nd ed.). McGraw-Hill.

Ogunbode, C. A., & Arnold, K. (2012). A study of environmental awareness and attitudes in Ibadan, Nigeria. Human and Ecological Risk Assessment: *An International Journal, 18(3),* 669–684. https://doi.org/10.1080/10807039.2012.672901

Onuoha, C. A., Ngobiri, N. C., Ochekwu, E. B., & Onuoha, P. (2022). Environmental challenges awareness in Nigeria: A review. *African Journal of Environment and Natural Science Research, 5(2),* 1–14. https://doi.org/10.52589/AJENSR-SAIRDC4K

Onyike, I. E. (2025). Effectiveness of environmental education and awareness campaigns in fostering commitment and behavioural change among Nigerians. In N. Okorie, O. Osunkunle, & K. Oyesomi (Eds.), Media and communication systems for sustainability in Nigeria (pp. 161–182). Palgrave Macmillan. https://doi.org/10.1007/978-3-031-75221-6_8