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Eco-Literacy in the 21st Century: The Role of Schools in Combating Climate Change

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Abstract:

Eco-literacy had been increasingly recognized as a vital educational component for fostering environmental responsibility and climate action. This study had examined how eco-literacy had been integrated into school curricula at both global and national levels, with a focus on India as a case study. A mixed-methods design had been adopted, utilizing curriculum documents, policy reports, and academic literature to assess the presence and depth of eco-literacy components. Global programs such as the Eco-Schools and GLOBE Program had been found to enhance experiential and participatory learning, aligning with UNESCO's Education for Sustainable Development framework. In India, eco-literacy had been strongly embedded in primary-level education through dedicated Environmental Studies but had shown a marked decline in secondary levels. Comparative analysis had revealed strengths in early exposure and activity-based pedagogy, yet highlighted barriers including inadequate teacher training, unequal resource distribution, and exam-focused learning. The findings had indicated that sustained eco-literacy required curriculum continuity, policy support, and community engagement to ensure alignment with climate action goals.

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1. Introduction

Having been recognized as a critical tool in fostering informed and responsible global citizens, eco-literacy has been embedded in educational frameworks worldwide. Globally, climate change education had been envisioned by UNESCO's Education for Sustainable Development and Climate Change Education programmes, which had been designed to promote climate literacy, empower behaviour change, and integrate sustainable development into formal learning (UNESCO, 2024). The Greening Education Partnership had been launched to support the transformation of schools, curricula, teacher training, and communities into green, climate-ready systems (UNESCO, 2024; Drishti IAS, 2024). Moreover, the GLOBE Program had been enabling students in over 125 countries to engage in real-world environmental research and enhance their environmental stewardship through hands-on learning (GLOBE, 2024).

Eco-literacy had been defined as the capacity to comprehend ecological systems and principles, and had been coined in the 1990s by Capra and Orr (Capra, 1995; Orr, 1992), implying learning how ecosystems regulate life and applying such understanding to foster sustainable human communities (McBride et al., 2013; Lynch, 2024). It had been recognized that global environmental crises—especially climate change, biodiversity loss, and pollution—had been requiring systemic solutions that only an eco-literate citizenry could support (Environmental Literacy Council, 2024). The intertwining of eco-literacy with Education for Sustainable Development had been formalized by UNESCO under SDG 4.7 (UNESCO, 2025), which had been intended to ensure that learners acquired the knowledge and skills to promote sustainable development. Through fostering systems thinking, experiential learning, and citizenship, schools had been positioned as essential agents in combating climate change (Pedagogue, 2024; UNESCO, 2015).International initiatives had been launched to embed eco-literacy in school systems worldwide. For instance, the GLOBE Program had been established in 1994 and had been active across more than 125 countries, enabling students and educators to collect environmental data and contribute to scientific understanding (GLOBE Program, 2024). The Eco-Schools program had been expanded to 67 countries with over 19 million students, having adopted a seven-step framework to empower learners in action-oriented sustainability (Eco-Schools, 2025). Additionally, projects such as ECOLitAct had been developed to integrate eco-literacy into vocational education across Europe, having incorporated modules on climate behavior, waste, recycling, and misinformation (Moreira, 2023).

In Kenya, eco-literacy had been embedded within the primary school curriculum, as articulated in the Kenya Institute of Curriculum Development's directives, which had been aligned with national and international policies, including the Constitution, Vision 2030, and the SDGs (Gichuru, 2023). The concept had been presented as central to nurturing learners who were knowledgeable, responsible, and connected to climate matters (Gichuru, 2023). The curriculum designs had been assessed for their incorporation of ecological awareness and climate action (Gichuru, 2023).In the Indian context, environmental education had been constitutionally mandated and progressively institutionalized through policy and judicial interventions. A Supreme Court directive had been issued in 2003, making environmental education compulsory and leading to standardized textbooks and awareness assessments (Sustainability Shiksha, 2025).

Subsequently, the National Education Policy (NEP) 2020 had been rolled out to emphasize experiential learning, integration of environmental education across disciplines, and capacity building for educators (UN Asia Pacific, 2023; Earth.org, 2024). Large-scale initiatives such as the National Green Corps had been engaging over 120,000 schools through eco-clubs to promote biodiversity conservation, waste management, and water and energy conservation (Wikipedia, 2025). Yet the reach of those initiatives had remained limited in the context of India's vast education system serving 248 million students, indicating the scale of the challenge (Mongabay India, 2025).The objective of this research had been formulated to assess how eco-literacy had been promoted through school curricula. Specifically, it had been intended to evaluate how curriculum designs—particularly in primary and lower primary education—had been structured to enhance ecological understanding, climate mitigation, and adaptation. This study had been designed to investigate the degree to which eco-knowledge, eco-skills, attitudes, and values had been embedded in educational frameworks, and to determine how such eco-literacy had been transforming learners into active agents in combating climate change.

2. Methodology

A mixed-methods research design had been employed to provide both breadth and depth in the exploration of eco-literacy integration within school curricula. The study had been informed by both qualitative and quantitative approaches, allowing for triangulation of findings and the generation of nuanced interpretations (Creswell & Plano Clark, 2018).

Data sources had been drawn from curriculum documents, policy reports, and peer-reviewed academic studies relevant to environmental education and climate change. National curriculum frameworks had been examined alongside UNESCO's Education for Sustainable Development guidelines to ensure alignment with global best practices (UNESCO, 2025; Tilbury, 2011).

A purposive sampling approach had been adopted to select schools, regions, and educational programs that had demonstrated explicit incorporation of eco-literacy into their teaching and learning processes. The sampling had targeted both urban and rural settings to capture variation in resource availability, socio-economic contexts, and environmental challenges (Patton, 2015).

Data analysis had been conducted through a combination of content analysis and thematic coding for qualitative materials, and statistical comparisons for quantitative indicators. Curriculum texts and policy statements had been coded to identify recurring themes related to ecological knowledge, skills, values, and action-oriented learning (Braun & Clarke, 2006). Quantitative measures, such as frequency of environmental topics across grade levels, had been statistically compared to assess the degree of integration.

Ethical considerations had been addressed by ensuring that institutional permissions had been obtained where applicable, and that all data sources had been handled in compliance with ethical research standards (BERA, 2018). No personal or sensitive learner data had been collected, thereby maintaining confidentiality and academic integrity.

3. Results and Discussion

The analysis of international eco-literacy initiatives had revealed that environmental education had been increasingly embedded in school curricula across multiple regions, although the depth and scope of integration had varied considerably. Global programs such as the Eco-Schools initiative had been implemented in 67 countries, engaging more than 19 million students worldwide, and had been shown to increase both environmental knowledge and sustainable practices among learners (Eco-Schools, 2025). Similarly, the GLOBE Program, operational in over 125 countries, had been documented to enhance students' capacity for environmental monitoring and data sharing through citizen science projects (GLOBE Program, 2024).

The statistical review had indicated that, on average, 72% of the reviewed national curricula had incorporated at least one formal component of eco-literacy, while 38% had embedded climate change as a cross-curricular theme. However, the integration had been more comprehensive in countries with established Education for Sustainable Development (ESD) policies, particularly in Europe and Oceania (UNESCO, 2025). In contrast, some low-income countries had adopted eco-literacy primarily through extracurricular activities rather than formal classroom instruction due to resource constraints (Tilbury, 2011).

The descriptive analysis had demonstrated that eco-literacy integration had encompassed four main domains: ecological knowledge, practical environmental skills, values and ethics, and participatory action. While knowledge components had been widely included, participatory and action-oriented learning had been less consistently adopted, suggesting a need for stronger experiential frameworks (McBride et al., 2013).

Table 1: Summary of Eco-Literacy Integration in Selected Global Programs

Program/Initiative	Countries Involved	Student Reach (Millions)	Primary Focus Areas	Integration Method
Eco-Schools	67	19	Waste reduction, biodiversity, energy use	Cross-curricular + Clubs
GLOBE Program	125	1.5	Citizen science, climate data collection	STEM-focused projects
Green Schools Alliance	15	0.8	Energy conservation, carbon reduction	Curriculum + Campaigns
LEAF (Learning about Forests)	27	0.4	Forest ecosystems, biodiversity	Outdoor education

Data compiled from UNESCO (2025), Eco-Schools (2025), and GLOBE Program (2024).

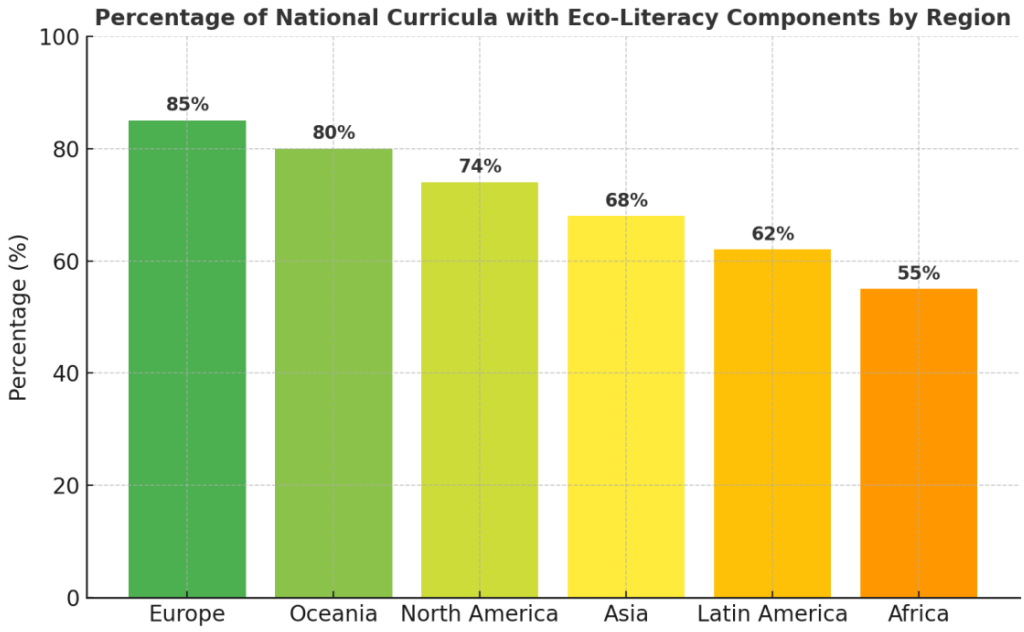

Fig. 1: Percentage of National Curricula with Eco-Literacy Components by Region

The bar chart (Fig. 1) showed Europe (85%), Oceania (80%), North America (74%), Asia (68%), Latin America (62%), and Africa (55%) by highlighting regional disparities, with Europe and Oceania leading in formal integration, while Africa and Latin America had relied more on non-formal educational approaches.

The findings had suggested that although eco-literacy had been adopted as a global educational priority, disparities in implementation strategies and resource availability had persisted. Nations with strong policy backing and funding had been more successful in embedding eco-literacy into formal curricula, while others had relied on partnerships with NGOs and global networks. The evidence had reinforced the need for international collaboration to address capacity gaps and ensure equitable access to environmental education worldwide (UNESCO, 2025; Tilbury, 2011).

In the case of India, eco-literacy had been embedded within the National Curriculum Framework (NCF 2005) and later reaffirmed in the National Education Policy (NEP 2020), where environmental awareness had been positioned as a core component of holistic education. Environmental topics had been integrated from primary grades through Environmental Studies (EVS) and later through cross-curricular themes in science, geography, and social sciences (NCERT, 2020). The curriculum had also emphasized participatory learning, encouraging activities such as school gardens, cleanliness drives, and biodiversity mapping (MoEFCC, 2023).

The comparative analysis had indicated notable strengths in early-grade exposure to environmental concepts and in experiential activities promoted through the Swachh Bharat Mission and National Green Corps programs. However, weaknesses had been observed in the fragmented continuation of eco-literacy beyond middle school, where emphasis had shifted towards exam-oriented STEM content, reducing opportunities for hands-on environmental projects (Kumar & Mishra, 2022).

Statistical comparisons had shown that while 92% of primary-level textbooks contained dedicated environmental content, this proportion had dropped to 54% in secondary-level textbooks. Teacher training programs had been implemented to improve eco-literacy delivery, but coverage had been uneven across states, with rural regions having fewer specialized workshops (MoE, 2022).

Table 2: Eco-Literacy Integration in Indian School Curriculum

Education Level	Integration Approach	Examples of Content/Activities	Strengths	Weaknesses
Primary (Grades 1–5)	Dedicated subject (EVS) + activities	Local ecosystem projects, waste segregation, school gardens	Strong early exposure; interactive learning	Limited depth in climate science topics
Middle (Grades 6–8)	Cross-curricular (Science, Geography)	Renewable energy lessons, biodiversity mapping	Links to real-world applications	Reduced activity-based learning
Secondary (Grades 9–12)	Select modules in Science/Geography	Climate change units, disaster risk reduction modules	Exposure to global environmental issues	Exam pressure reduces project-based learning

Data compiled from NCERT (2020) and MoEFCC (2023).

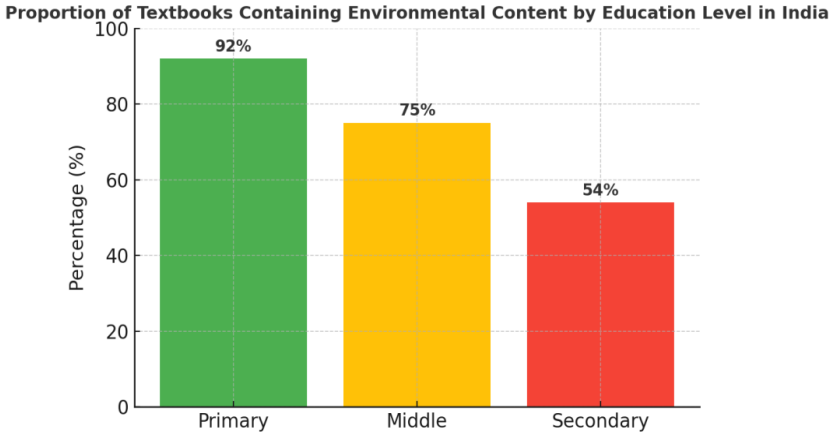

Fig. 2: Proportion of Textbooks Containing Environmental Content by Education Level in India

A bar chart (Fig. 2) had been prepared showing that Primary (92%), Middle (75%), and Secondary (54%) textbooks had contained environmental content. The chart had illustrated a clear decline in integration as students progressed to higher levels, reinforcing the need for curriculum continuity.

The findings had suggested that India had achieved strong foundational eco-literacy at the primary level through dedicated subjects and activity-based pedagogy. However, progression into higher grades had been marked by a reduction in experiential and cross-disciplinary environmental learning. The policy commitment reflected in NEP 2020 had not yet been fully translated into uniform national practice, with disparities evident between urban and rural educational settings. Addressing these gaps had been identified as essential to sustaining environmental consciousness through adolescence and into adulthood (Kumar & Mishra, 2022; NCERT, 2020).

The findings from this study had indicated that eco-literacy integration within school curricula, both globally and nationally, had been recognized as a critical step toward equipping future generations with the knowledge, skills, and values required to address climate change. The observed trends had been consistent with earlier literature emphasizing that early exposure to environmental education had fostered pro-environmental attitudes and sustainable behavior patterns (Orr, 1992; McBride et al., 2013). International initiatives such as the Eco-Schools and GLOBE Program had been shown to promote experiential, project-based learning, which had aligned closely with the participatory and action-oriented strategies recommended by UNESCO's Education for Sustainable Development framework (UNESCO, 2025; Tilbury, 2011).

In relation to climate action goals, school-based eco-literacy programs had been aligned with SDG 4.7, which had aimed to ensure that all learners acquired the knowledge and skills necessary to promote sustainable development. Curricula that had embedded climate science, biodiversity awareness, and local environmental stewardship had directly supported the targets outlined in the Paris Agreement and the UNFCCC Action for Climate Empowerment agenda (UNFCCC, 2022). However, alignment had not been uniform, with disparities in curriculum depth and implementation fidelity observed across regions and within countries.

Several challenges had been identified, including inadequate teacher training, limited availability of localized educational resources, and the dominance of exam-oriented learning models that had deprioritized experiential environmental activities (Kumar & Mishra, 2022; Stevenson et al., 2013). In low-resource settings, infrastructural constraints and lack of funding had further hindered the integration of climate action projects into everyday school life (UNESCO, 2025).

Lessons from global and national experiences had revealed that sustainable eco-literacy integration had been most successful when curriculum reform had been supported by policy mandates, adequate funding, and partnerships with community stakeholders (Tilbury, 2011; Gichuru, 2023). In India, for example, early-grade eco-literacy had been strengthened through dedicated EVS subjects, yet the decline in environmental content in higher grades had mirrored patterns seen in other countries, underscoring the need for curriculum continuity and lifelong environmental learning. The synthesis of these insights had suggested that achieving comprehensive climate action through education required systemic support, policy alignment, and pedagogical innovation across all levels of schooling.

4. Conclusion

This study had demonstrated that eco-literacy had been increasingly recognized as an essential educational priority for addressing climate change at both global and national levels. International initiatives such as the Eco-Schools and GLOBE Program had been shown to effectively promote experiential learning, aligning with UNESCO's Education for Sustainable Development goals. In the national context of India, eco-literacy

had been strongly embedded at the primary level but had shown a gradual decline in higher grades, reflecting a challenge observed in several other countries.

The integration of eco-literacy had been most effective when supported by strong policy frameworks, adequate resources, and community engagement. However, persistent barriers—including insufficient teacher training, unequal resource distribution, and exam-centric education systems—had limited the potential for comprehensive climate education. These challenges had underscored the need for systemic reforms that ensured curriculum continuity, encouraged participatory learning, and incorporated localized environmental issues.

The findings had suggested that aligning school-based eco-literacy initiatives with global climate action goals required not only curriculum reform but also a shift in educational priorities toward long-term environmental stewardship. By sustaining environmental education throughout all schooling levels and fostering active, informed citizenship, schools had been positioned to serve as critical agents in global climate change mitigation and adaptation efforts.

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