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Climate Change Education in India: Current Status and Future Directions

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Abstract
Climate change education (CCE) is increasingly recognised as essential for strengthening climate literacy, resilience, and sustainable development. This paper presents a narrative policy review of the status of climate change education in India, examining how global frameworks and national education policies shape curricular integration and implementation practices. The review draws on peer-reviewed literature and institutional policy documents published between 2008 and 2024, including reports from UNESCO, UNICEF, UNFCCC, and the World Bank, alongside key Indian policy frameworks such as the National Education Policy (NEP) 2020 and the National Curriculum Framework for School Education (NCFSE) 2023. Findings indicate that while policy acknowledgement of climate education has increased, classroom implementation remains uneven due to gaps in teacher preparedness, limited infrastructural and digital resources, and fragmented curricular treatment of climate change. The paper concludes by recommending stronger integration of CCE across disciplines, systematic teacher capacity-building, and expansion of contextually grounded, experiential, and technology-supported pedagogies to strengthen climate education outcomes in India.

Keywords: Climate Change Education, Environmental education, Education policy, India.

Introduction:

Education systems can empower, prepare, and develop skilled youth to adapt to and mitigate climate change. Education can propel faster and better climate action (Sabarwal, S., Venegas Marin, S., Spivack, M. H., & Ambasz, D.,2024). Low-income nations are most severely affected by the heat and extreme weather events caused by climate change, which is additionally severely impacting education. Governments must take immediate action to prepare educational systems for climate change (World Bank Group, 2024). Climate change education helps people understand and address the impacts of the climate crisis, empowering them with the knowledge, skills, values, and attitudes needed to act as agents of change. UNESCO promotes climate change education as a key component of its work in education for sustainable development (UNESCO).

International climate governance increasingly recognizes education as a strategic mechanism for enabling informed participation in climate mitigation and adaptation. Within UNFCCC processes, climate change education is strongly linked to the agenda of *Action for Climate Empowerment*, which emphasises education, training, and public awareness as key enablers of climate action. UNESCO has further advanced this agenda through initiatives such as the Greening Education Partnership, calling for education systems to embed sustainability and climate action across curriculum, pedagogy, governance, and community engagement. In this framing, climate change education extends beyond knowledge transmission by fostering critical engagement, learner agency, and capacities for responsible decision-making and action.

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The CCESD Program of UNESCO prioritizes: (UNESCO, 2013)

1. Strengthening countries' capacity to provide quality climate change education for sustainable development;
2. Encouraging and enhancing innovative teaching approaches to integrate quality climate change education for sustainable development into school programs and curricula; and
3. Raising awareness about climate change and enhancing non-formal education programs through media, networking, and partnerships.

Global Status of Climate Change Education:

At the global level, the integration of climate change education (CCE) into formal education systems varies considerably across developed and developing countries, reflecting differences in policy alignment, institutional capacity, and resource availability. In developed countries such as the United States, Canada, the United Kingdom, and Germany, CCE is increasingly institutionalized through national or sub-national curriculum frameworks and aligned with broader agendas of education for sustainable development and global citizenship (OECD, 2021; UNESCO, 2023). Germany, for instance, integrates climate change across science, geography, and civic education, supported by structured teacher professional development and strong policy coordination between federal and state governments (UNESCO, 2021). Similarly, Canada and the United Kingdom emphasize interdisciplinary climate literacy, inquiry-based learning, and whole-school sustainability approaches (OECD, 2021). In contrast, in many developing countries such as Brazil and Kenya, climate change education is less systematically embedded within national curricula and is often addressed through general environmental education or externally supported initiatives led by non-governmental organizations and international agencies (UNESCO, 2021). While Brazil has incorporated climate and sustainability themes within national education guidelines, implementation remains uneven across regions, constrained by institutional and socio-economic disparities. In Kenya, CCE efforts are frequently project-based and community-oriented, reflecting gaps in teacher training, curriculum coherence, and instructional resources (World Bank Group, 2024). These global disparities underscore the importance of sustained policy commitment, teacher capacity-building, and curriculum integration in advancing equitable and effective climate change education worldwide.

Climate Change Education:

Indian Context: Climate change education (CCE) is increasingly recognized as a vital component of educational curricula worldwide, particularly in developing nations like India, where the impacts of climate change are becoming more apparent. India is one of the country most vulnerable to climate change, posing challenges such as rising temperatures, erratic monsoon patterns, and increased frequency of extreme weather events (IPCC, 2021). As a result, the need for effective climate change education has gained prominence, aiming to inform future generations about environmental issues and empower them to take action. India unveiled its long-anticipated National Action Plan on Climate Change (NAPCC) on June 30, 2008, nearly a year after its initial announcement, with the aim of addressing climate change through mitigation and adaptation strategies. The National Action Plan on Climate Change (NAPCC) was designed to guide climate action up to 2017 and instructed concerned ministries to submit comprehensive implementation plans to the Prime Minister's Council on Climate Change by December 2008. It is structured around eight key missions:

1. National Solar Mission
2. National Mission for Enhanced Energy Efficiency
3. National Mission on Sustainable Habitat
4. National Water Mission

5. National Mission for Sustaining the Himalayan Ecosystem
6. Green India Mission
7. National Mission for Sustainable Agriculture
8. National Mission on Strategic Knowledge for Climate Change

India launched the National Action Plan on Climate Change (NAPCC) in 2008 to strengthen national mitigation and adaptation responses through eight missions. While the NAPCC initially outlined mission frameworks up to 2017, its missions and associated policy mechanisms continue to guide India's climate governance through subsequent implementation, monitoring, and revision processes. Recent review mechanisms such as the Executive Committee on Climate Change (ECCC) and the Apex Committee for Implementation of the Paris Agreement (AIPA) have strengthened monitoring of state-level plans and national commitments under the Nationally Determined Contributions (NDCs) (Ministry of Environment, Forest and Climate Change, 2022). Several states, including Tamil Nadu, Odisha, Tripura, Gujarat, Madhya Pradesh, and Himachal Pradesh, have submitted revised SAPCCs accordingly. India's initial NDCs outline targets extending to 2030, and progress toward these commitments is periodically assessed through high-level review mechanisms, with the most recent evaluation conducted in February 2022 (Ministry of Environment, Forest and Climate Change, 2022).

The Indian government, alongside various non-governmental organizations (NGOs), has initiated several programs to integrate climate change education into school curricula. These initiatives are crucial for fostering awareness and understanding among students, who will be the future decision-makers and leaders. The National Council of Educational Research and Training (NCERT) has developed guidelines for incorporating climate change topics into science and social studies curricula, emphasizing the importance of interdisciplinary approaches (NCERT, 2017). However, the implementation of these guidelines and the effectiveness of such educational programs remain under-researched. Conservation of the natural environment is one of the most significant issues of the twenty-first century, according to NCFSE (2023). Environmental deterioration becomes a justice and equality issue even when seen solely from a human perspective (NCFSE, 2023). The National Curriculum Framework for School Education (NCFSE, 2023) highlights the importance of environmental literacy that all pupils should strive for sustainable activities, respect, and admiration for the environment, as well as other similar skills. To increase awareness and the capacity to behave responsibly in ecologically sustainable ways, it places the necessary emphasis on developing knowledge, skills, values, and dispositions. Learners will be able to make wise and well-informed choices on their individual and group efforts to address current issues and prevent the emergence of future ones. Focusing on the problems of climate change and environmental degradation is another priority of the National Education Policy, 2020, which seeks to proactively address these issues and offer particular suggestions for teaching at all levels (NCFSE, 2023).

Despite increasing policy attention to climate change education in India, there remains limited synthesis of how national directives translate into state-level practices and classroom realities. These include a lack of trained educators, insufficient resources, and varying levels of awareness among students and communities. Moreover, the effectiveness of climate change education is often hindered by cultural perceptions and socio-economic factors that influence how climate change is understood and addressed at the local level (Sinha, 2020). As such, it is imperative to critically examine the existing literature on climate change education in India to identify best practices, gaps in knowledge, and potential areas for future research.

State-level initiatives:

Several states have undertaken specific initiatives to incorporate climate change education. The Punjab government incorporated an activity book on climate change for grades 6-12. Programs like 'Safe Saturday' in Bihar have utilized digital platforms to teach disaster preparedness to over 8.4 million children. Maharashtra

introduced the "Majhi Vasundhara" (My Earth) curriculum, comprising over 100 lessons aimed at instilling green habits among students in grades 1-8. Kerala has integrated climate change and disaster management into its curriculum, utilizing digital content to reach remote areas.

Non-Governmental Efforts:

Non-governmental organizations have supported climate and environmental education in India through awareness programmes, teacher training initiatives, development of learning materials, and school–community partnerships. Organizations like the Society for Environment and Education, have been instrumental in promoting environmental awareness across various states, including West Bengal, Maharashtra, and Tamil Nadu. UNICEF India assists the government in strengthening teacher capacity to use digital tools for interactive instruction, with an emphasis on affordable, low-technology approaches that promote inclusive education. 'Mission Education', a flagship programme by Smile Foundation works with underserved children to provide education, nutrition and wellness support. They also promote climate action by teaching children environmental stewardship and sustainable habits, enabling them to play an active role in protecting and improving the planet. However, systematic evaluation of learning outcomes and long-term behavioural impacts remains limited across many NGO-led interventions, indicating the need for stronger monitoring frameworks and evidence-based scaling strategies.

Methodology:

Review Design:

This study adopts a narrative policy review approach to examine the global framing and national implementation of climate change education (CCE), with a specific focus on the Indian school education context. A narrative review design was selected because climate change education is interdisciplinary and policy-driven, requiring synthesis across curriculum frameworks, institutional reports, and peer-reviewed academic research.

Data Sources and Search Strategy:

Relevant literature and policy documents were identified from (i) academic databases and (ii) institutional repositories and government portals. Academic sources were searched using Google Scholar, ERIC, and selected journal platforms for environmental and sustainability education. Institutional and policy documents were retrieved from official websites and repositories including UNESCO, UNICEF, UNFCCC, World Bank, NCERT, the Ministry of Education (Government of India), and related national/state education portals. Key terms used included combinations of: "climate change education", "environmental education", "education for sustainable development", "climate literacy", "school education", "curriculum", and "India".

Inclusion and Exclusion Criteria:

Documents were included if:

1. They addressed climate change education or sustainability-related education,
2. They focused on policy, curriculum, pedagogy, or implementation,
3. They were published between 2008 and 2024, and
4. They were published in English.

Documents were excluded if:

1. They did not contain an explicit education component,

2. They were opinion-only pieces without conceptual or analytical value, or
3. They were duplicates or repetitive summaries of existing policy documents.

Data Analysis and Synthesis:

The selected documents were analysed using thematic synthesis. Themes were generated inductively and refined through iterative reading. Key themes included: (a) policy integration of climate education, (b) curriculum and interdisciplinary treatment of climate change, (c) teacher preparation and professional development, (d) state level and NGO interventions, (e) technology and infrastructure gaps, and (f) barriers to classroom implementation. The synthesis prioritised critical interpretation of patterns and gaps rather than mere descriptive listing.

Challenges in Climate Change Education

In a UNESCO report titled "Getting every school climate-ready," teaching children about the severity of climate change and its repercussions was deemed vital by nearly 95% of instructors. Less than 40% of educators thought they were competent to do so, and only roughly one-third thought they could sufficiently describe how climate change is affecting their area. A survey in Tamil Nadu revealed that 73.4% of students lacked a scientific understanding of climate change, and 58.5% could not distinguish between climate and weather (The Hindu, 2024). Furthermore, many curricula focus on general environmental topics without addressing immediate concerns related to climate change.

Lack of Technology and Digital Tools

The persistent lack of access to appropriate technology and digital learning tools. Despite the increasing recognition of digital platforms as powerful enablers of interactive, data-driven, and experiential climate learning, many schools, especially in rural and marginalized regions continue to operate with limited or no digital infrastructure. Inadequate availability of computers, unreliable internet connectivity, and insufficient access to climate-related digital resources such as simulations, geospatial tools, virtual laboratories, and real-time climate data significantly restrict students' opportunities to engage with complex climate concepts in meaningful ways.

Infrastructure and Environmental Challenges

Climate change impacts, such as extreme heat, have directly affected the learning environment. In response to intense heat waves, schools in several northern Indian states have advanced summer vacations and adopted temporary online classes, highlighting the urgent need to climate-proof education. This highlights the need for climate-resilient infrastructure in schools to ensure uninterrupted education.

Access and Resources

Wealthier nations generally have more resources to develop comprehensive CCE programs, including teacher training, digital tools, and interactive learning materials; meanwhile, in developing or underdeveloped countries, limited resources can hinder the implementation of CCE, though international organizations like UNESCO and UNICEF often step in to support these efforts.

Integration of CCE in the Existing Curriculum

Developed countries actively promote CCE through national policies and international commitments, such as the Paris Agreement's Action for Climate Empowerment (ACE) agenda. In contrast, others may lack the political will or infrastructure to prioritize CCE, leading to inconsistent or minimal efforts. The integration of climate change education into existing curricula poses logistical challenges. Many schools face overcrowded classrooms, limited

resources, and a rigid curriculum that prioritizes standardized testing over critical thinking and problem-solving skills (Bennett et al., 2017). These constraints can hinder the implementation of innovative teaching methods and limit opportunities for experiential learning.

Methods to overcome the challenges of CCE

Aikens et al. (2016) and Monroe et al. (2019) emphasized that most ESE policy research remains non-empirical and often under-theorized. Digital tools such as virtual reality, digital maps, and podcasts have emerged as effective means to enhance sustainability awareness (Hajj-Hassan et al., 2024). Bofferding and Kloser (2015) demonstrated that although students' understanding of climate change mitigation improved with instruction, misconceptions about adaptation strategies persisted. The methods of instruction in climate change education are diverse, ranging from traditional classroom teaching to more innovative approaches such as project-based learning, field trips, and community engagement. These methods aim to enhance students' understanding of climate science, its socio-economic implications, and the importance of sustainability practices. Research indicates that experiential learning, where students engage with real-world problems, is particularly effective in promoting environmental stewardship (Kolb, 1984). Furthermore, digital tools and resources have emerged as valuable assets in climate change education, providing access to a wealth of information and enabling collaborative learning experiences (UNESCO, 2019). UNESCO's Getting Climate Ready initiative emphasized integrating climate action across the schools, known as a whole-institution approach, which includes governance, curriculum, operations, and community partnerships (Hargis et al., 2024)

Experiential Learning

Experiential learning is a learning method whereby learning is focused on experience and reflection. According to the experiential learning theory that Kolb (1984) developed, he believed that knowledge is built or created in a cyclic process that goes through experiences, reflection, thinking, and action. In the context of climate change education, experiential learning can take many forms, including field trips, community projects, and hands-on activities. For example, studies have shown that students who participate in environmental field studies demonstrate improved understanding of ecological concepts and greater environmental awareness (Kahn & Kellert, 2002). Such experiences not only enhance knowledge retention but also foster a sense of responsibility toward the environment.

Effectiveness of Educational Interventions

Studies have shown that targeted educational interventions can significantly enhance students' knowledge about climate change. For instance, an interventional study in rural Bangalore demonstrated a notable increase in students' knowledge scores post-intervention. Similarly, activity-based teaching approaches in Tamil Nadu effectively improved students' understanding and attitudes towards climate change.

Project-Based Learning

Project-based learning (PBL) is another effective method for teaching climate change concepts. PBL engages students in solving real-world problems through collaborative projects, which can enhance critical thinking and problem-solving skills (Thomas, 2000). In India, PBL has been successfully implemented in various educational settings, allowing students to explore local climate issues and develop actionable solutions. For instance, a study by Choudhary et al. (2018) highlighted how students in a rural Indian school engaged in a project to reduce plastic waste in their community, demonstrating the potential of PBL to instill a sense of agency and empowerment among students.

Digital Learning Tools

The integration of digital tools in climate change education has transformed the way information is disseminated and accessed. Online platforms, simulations, and interactive resources can enhance students' understanding of complex climate systems and their implications (UNESCO, 2019). For example, the use of Geographic Information Systems (GIS) in education allows students to visualize climate data and analyze spatial patterns, fostering critical thinking and data literacy (Baker et al., 2016). Moreover, digital tools can support collaborative learning by linking students with peers and experts globally, helping them develop wider perspectives on climate-related issues.

Community Engagement and Service Learning

Community engagement is an essential part of climate change education because it links students to local environmental issues and encourages civic responsibility. Service learning, which combines community service with academic coursework, has been proven to improve students' understanding of social and environmental challenges (Jacoby, 1996). In India, programs that involve students in community-based climate action can build a sense of belonging and dedication to sustainability. For example, the Green Schools program in India motivates students to take part in tree planting, waste management, and water conservation efforts, reinforcing the idea that individual actions can contribute to broader environmental goals (Kumar et al., 2023). Eco clubs and community programs have played a key role in raising environmental awareness. In Bihar, UNICEF's partnership with the Bihar Education Project Council on eco clubs reached over 75,000 schools. These initiatives motivate students to participate in activities like tree planting and waste management, fostering a culture of sustainability.

Conclusion

Climate change education in India has developed progressively in recent years, shaped by national policy directives, state-level initiatives, and sustained engagement by non-governmental organizations. Education policies have increasingly recognized the importance of climate learning, leading to the gradual inclusion of climate-related themes within school curricula. At the state level, several interventions have attempted to contextualize climate change by linking it to locally experienced concerns such as water stress, declining agricultural productivity, and extreme weather events. In parallel, non-governmental organizations have strengthened implementation by supporting teacher professional development, producing locally relevant learning materials, and facilitating school–community partnerships. Collectively, these efforts reflect growing institutional and societal recognition of education as a key pathway for strengthening climate awareness and resilience among learners.

However, the translation of policy intentions into meaningful classroom practice remains uneven. Climate change is often treated in a fragmented manner within existing curricula, frequently appearing as a peripheral topic rather than an integrated interdisciplinary concern. This limits learners' opportunities to develop a coherent understanding of climate change across scientific, social, economic, and ethical dimensions. These gaps are further compounded by pronounced infrastructural and technological disparities, particularly in rural and socio-economically marginalized contexts, where limited digital access and inadequate learning facilities restrict the use of experiential and interactive pedagogies.

Research consistently underscores teachers as central mediators of effective climate education, yet many educators report inadequate training and institutional support. Strengthening pre-service and in-service teacher education, alongside the development of culturally responsive and contextually grounded curricula, is therefore essential. Overall, addressing these interconnected challenges through sustained institutional support, monitoring

mechanisms, and community engagement is crucial if climate change education in India is to move beyond awareness-building and cultivate informed, reflective, and action-oriented citizens capable of responding to growing climate risks.

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