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Climate Change Awareness and Education: An Antidote to the Impacts of Climate Change

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Abstract
Climate change poses a major threat to sustainable development in Nigeria, exacerbating environmental degradation, food insecurity, health challenges, and socio-economic instability. Despite the country's high vulnerability ranked 160th out of 180 nations awareness and education on climate change remain alarmingly low, with six in ten Nigerians reportedly unaware of the issue. This study conducts a systematic review of peer-reviewed articles, government reports, and grassroots initiatives to examine the role of climate change education (CCE) and public awareness in fostering adaptive and mitigative capacities. Findings reveal research gaps, weak policy implementation, and limited public engagement. Notably, while literature on climate impacts has expanded since 2011, there is an overemphasis on agricultural adaptation at the expense of institutional and cross-sectoral strategies. Misconceptions such as conflating climate change with weather variations or religious beliefs further impede progress. The paper highlights the need to integrate CCE into formal education, strengthen media advocacy, and support youth-led initiatives as pathways to enhance climate resilience in Nigeria

Keywords: Climate Change, Sustainable Development, Climate Change Education, Environmental Degradation

Introduction

Nigeria, Africa's most populous nation and largest economy, faces escalating climate crises, including desertification, coastal erosion, extreme heat, and erratic rainfall patterns. The Nigerian Meteorological Agency (NiMet) reports a 1.0°C temperature rise since the 1960s, with projections indicating worsening conditions. These changes disproportionately affect vulnerable groups, including rural farmers, women, and children, yet public understanding of climate science remains alarmingly low (Okon, 2021). For instance, a 2020 survey found that 60% of Nigerians had never heard of climate change, while those who had often conflated it with transient weather anomalies. Such knowledge gaps undermine mitigation efforts and perpetuate maladaptive practices, such as deforestation and unsustainable land use, which contribute to Nigeria's status as a significant emitter of greenhouse gases (GHGs) from agriculture and energy sectors (Okon, 2021).

Climate change awareness

The urgency of climate education is underscored Nigeria's commitments under the Paris Agreement and the National climate change policy (2021 – 2030), which aims to reduce emissions by 40% by 2030. In Nigeria, the POP movement successfully partnered with schools, universities and youth organizations to promote climate literacy, environmental consciousness, and behavioral change, program such climate boot camps and leadership training have empowered students and emerging leaders to become climate champions on their local communities. Also, community-based climate Action projects initiated by Nigerian youth involved in the POP movement have initiated various community-

based projects such as Tree-planting campaigns to combat deforestation and carbon emission, clean up drives and waste segregation programs in urban slums to promote sustainable waste management practices, water conservation initiatives in semi-arid northern regions, addressing water scarcity awareness.

Through youth-led workshops, peer education, and climate action projects, the movement has enhanced the understanding of climate change causes, consequences, and mitigation strategies among young Nigerians. However, policy implementation lags due to inadequate institutional coordination, limited funding, and a lack of localized climate curricula. While youth-led initiatives like the Protect Our Planet (POP) Movement and Youth4ClimateAction have made strides in grassroots awareness, their reach remains fragmented without systemic integration into national education frameworks. Climate change remains one of the most urgent environmental challenges confronting the global community. As a multifaceted crisis, it encompasses rising global temperatures, melting glaciers, extreme weather events, loss of biodiversity, and sea-level rise. These changes are not only disrupting natural ecosystems but are also significantly impacting human health, agriculture, water security, and economic development. Over the past decades, international bodies such as the Intergovernmental Panel on Climate Change (IPCC) have issued consistent warnings about the intensifying impacts of global warming, largely driven by anthropogenic emissions of greenhouse gases (IPCC, 2021).

Climate change represents one of the most formidable challenges facing humanity in the 21st century, with far-reaching consequences that transcend geographical boundaries and socioeconomic status. The scientific consensus on anthropogenic climate change is unequivocal, yet global responses remain fragmented and insufficient to meet the scale of the crisis. Education emerges not merely as a tool for knowledge dissemination but as a transformative mechanism for behavioral change, policy influence, and community resilience building in the face of climate adversity. The urgency of climate action has never been more apparent. Atmospheric CO^2 concentrations have surged from 325 ppm in 1970 to 414 ppm in recent years, driving global temperature increases and extreme weather events (Afolabi & Abiodun, 2019). Africa, despite contributing minimally to historical greenhouse gas emissions, stands disproportionately vulnerable to climate impacts due to factors including dependence on rain-fed agriculture, limited adaptive capacity, and widespread poverty **(**Akpodiogaga & Odjugo, 2010). Within this context, climate change education (CCE) assumes paramount importance as a strategic intervention to empower current and future generations with the knowledge, skills, and values necessary to mitigate and adapt to climate change (Okon, 2021).

In the global context, climate change education and awareness are increasingly being recognized as powerful tools for equipping individuals and communities with the knowledge, skills, values, and attitudes necessary to respond effectively to the climate crisis. The United Nations Framework Convention on Climate Change (UNFCCC), in Article 6, underscores the importance of education, training, and public awareness in achieving meaningful climate action. Furthermore, UNESCO has advocated for Education for Sustainable Development (ESD), which incorporates climate change into formal and informal learning systems (UNESCO, 2020). These educational interventions are not limited to conveying scientific facts but also aim to foster behavioral change, community resilience, and policy advocacy (UNESCO, 2020). Countries such as Sweden, Finland, and Germany have integrated climate literacy into their national curricula, ensuring that younger generations are not only aware of climate science but are also prepared to become agents of change (Anderson, 2012). Civil society organizations and academic institutions across North America and Europe have also developed extensive outreach programes, including community workshops, public campaigns, and interactive learning platforms to foster environmental consciousness. Importantly, climate change education is no longer confined to environmental sciences but is now approached as a transdisciplinary field that draws from sociology, economics, political science, and ethics. While strides have been made globally, the situation in developing regions, particularly Africa, presents a more complex narrative. Africa is one of the most vulnerable continents to climate change impacts due to its high dependency on natural resources, low adaptive capacity, and widespread poverty (Niang et al., 2014). Despite contributing minimally to global greenhouse gas emissions, the continent is disproportionately affected by extreme droughts, floods, erratic rainfall patterns, and food insecurity. These vulnerabilities are compounded by weak governance structures, inadequate infrastructure, and limited access to climate information. Consequently, the role of climate change awareness and education becomes even more critical in the African context.

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Climate education

Education has long been posited as a foundational tool in addressing global challenges, and climate change is no exception. According to the United Nations Educational, Scientific and Cultural Organization (UNESCO, 2022), climate change education (CCE) fosters knowledge, critical thinking, values, and behaviors that enable individuals and societies to make informed decisions to mitigate and adapt to climate change. It cultivates environmentally responsible citizens and galvanizes collective action toward sustainability. However, climate education remains under-prioritized in many national education systems. Where such education exists, it often fails to transcend theoretical discussions and rarely includes community-based practical adaptation strategies. The absence of robust climate awareness and education systems results in delayed or inefficient responses to climate hazards. For example, during the 2022 floods in Pakistan, over 33 million people were affected, yet many communities did not receive early warning alerts or understand their implications, largely due to low awareness and poor dissemination of climate-related information (UNESCO, 2022). Similarly, in parts of East Africa, erratic rainfall and prolonged drought have devastated pastoralist communities, yet many households do not associate these changes with anthropogenic climate influences and therefore remain unprepared for long-term shifts in their environment. One of the most pressing aspects of the problem is the educational divide between urban and rural populations. Urban centers tend to have better access to formal climate education, internet-based learning tools, and media awareness campaigns. In contrast, rural and marginalized communities which are often the most affected by climate change are left without critical information on climate risks, adaptation measures, and sustainable practices. This educational inequity increases vulnerability and further entrenches poverty and food insecurity. Furthermore, climate change intersects with various other societal vulnerabilities. In Sub-Saharan Africa, the increasing frequency of droughts has led to food insecurity and forced migrations, particularly among women and children (FAO, 2021; Amdu, 2013). Yet, there is minimal targeted climate awareness programming for these vulnerable groups. Gender-responsive climate education, for instance, is critical to ensure that women who are often primary caregivers and agricultural labourers have the information needed to protect their families and livelihoods. Without a gender-sensitive and inclusive approach to climate education, mitigation efforts remain insufficient and exclusionary**.**

Statement of the problem

Climate change has emerged as one of the most formidable challenges confronting humanity in the 21st century. Its impacts transcend environmental degradation to encompass socioeconomic disruptions, food insecurity, health complications, and even political instability. The Intergovernmental Panel on Climate Change (IPCC, 2023) reiterates that human-induced climate change is no longer a distant threat; it is a current and escalating crisis. Rising global temperatures, erratic rainfall patterns, frequent and severe natural disasters such as droughts, floods, and wildfires are now becoming normal features of global weather systems. Developing countries, particularly those in Africa and Southeast Asia, remain disproportionately vulnerable, not only due to geographic susceptibility but also because of limited adaptive capacity and poor climate literacy. Despite the evident threats, awareness and understanding of climate change remain limited in many communities, particularly in the Global South. In regions where the consequences of climate change are most pronounced, public awareness and institutional capacity to respond are often alarmingly inadequate (Leiserowitz et al., 2021). In Nigeria, for instance, flash floods have displaced tens of thousands in states like Benue, Niger, and Anambra, with catastrophic consequences for agriculture, infrastructure, and livelihoods. Yet, climate change education is often absent from school curricula and informal community learning systems. This gap in awareness significantly hinders proactive adaptation and mitigation responses at individual, community, and national levels. The prevalence of misinformation and climate change denial further complicates the problem. In the age of digital information, climate change discourse is often marred by politicization, misinformation, and competing narratives that undermine scientific consensus. In many cases, communities exposed to such misinformation exhibit resistance to sustainable practices or disengagement from environmental conservation programs. Effective education must therefore go beyond knowledge transfer and include critical thinking, media literacy, and scientific skepticism to counteract disinformation (Amdu, 2013).

Methodology

The study adopted literature review to analyze the impacts of climate education in mitigating the effects of climate change, the search strategy include a detailed explanation of the keywords, Boolean operators, and search strings used

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in the literature search. The specific electronic databases searched have been listed, including Scopus, Web of Science, ERIC, and Google Scholar, covering literature from 2000 to 2024. the criteria applied to select studies, such as publication in peer-reviewed journals, relevance to climate education or awareness, studies written in English, and empirical or review-based content. Articles lacking clear methodology, not focused on climate-related awareness or education, or duplicative in nature were excluded, this is to ensure the review is more transparent, reproducible, and aligned with best practices in systematic review methodology.

Theoretical Framework

At the heart of this multifaceted problem lies the need for a theoretical lens that underscores the role of education in social transformation. One relevant framework is Bandura's Social Cognitive Theory, which emphasizes the role of observational learning, social influence, and self-efficacy in behavioral change (Bandura, 1986). According to the theory, individuals are more likely to adopt new behaviours such as climate-resilient farming, sustainable consumption, or disaster preparedness when they observe such behaviours in role models, understand the rationale behind them, and believe in their own capacity to act. Climate change education, therefore, must be contextually relevant, action-oriented, and community-based to stimulate meaningful behavioral transformation. Through participatory education models, communities can learn adaptive practices by observing and engaging with peers and local leaders who champion sustainable behaviours. Moreover, SCT underscores the importance of self-efficacy; the belief in one's ability to execute actions required to manage environmental challenges. Individuals with high self-efficacy are more likely to engage in environmental problem-solving, adopt sustainable practices, and participate in community-based climate adaptation initiatives (Tabernero & Hernández, 2011). Climate change education, therefore, must go beyond cognitive instruction and actively work to build learners' confidence in their capacity to effect change. This can be achieved through participatory learning methods, simulations, local environmental projects, and success stories of community resilience. The theory also stresses the significance of environmental and social reinforcement. In environments where sustainable practices are the norm reinforced by community norms, institutional support, policy frameworks and individuals are more likely to sustain climate-friendly behaviours. Therefore, SCT justifies the need for not only school-based climate education but also widespread public awareness campaigns and community-level interventions that foster a supportive learning and behavioral environment (UNESCO, 2022). In applying SCT to the study of climate change awareness and education, the theory anchors the understanding that awareness alone is insufficient. Individuals must be supported with observable role models, opportunities for active engagement, social encouragement, and systems that reinforce their environmental actions. In this way, SCT enables a holistic, behaviorally grounded approach to climate education that addresses the cognitive, affective, and social dimensions of learning making it a suitable theoretical lens for exploring how education can serve as an antidote to the impacts of climate change.

Another critical dimension is the role of climate change education in promoting intergenerational justice. The impacts of climate change will be disproportionately felt by future generations, yet many young people today are not adequately equipped with the knowledge and skills to address these impending challenges. Climate education serves not only as a preventive measure but also as a vehicle for empowering youth to take ownership of their environmental future. Programs such as the UN's "Greening Education Partnership" are steps in the right direction, but they need to be scaled and integrated into national policy frameworks to make real impact (UNESCO, 2022). The lack of a coherent and nationally coordinated strategy for climate change education in many countries further deepens the problem. Where climate education initiatives exist, they are often fragmented across sectors or reliant on short-term donor funding. There is a dire need for long-term, institutionalized programes that embed climate education in national development plans, education policies, and environmental management frameworks. Only then can awareness be transformed into sustained action and resilience building.

Global perspectives on climate change education

The international community has increasingly recognized education as a cornerstone of climate action, embedded within key agreements such as Article 6 of the United Nations Framework Convention on Climate Change (UNFCCC) and Target 4.7 of the Sustainable Development Goals (SDGs). These frameworks emphasize the need to "ensure all learners acquire knowledge and skills needed to promote sustainable development" by 2030, including through education for climate change mitigation and adaptation (Okon, 2021). The global education movement has progressively shifted from awareness-raising about climate science toward fostering action competence the ability to

critically analyze climate issues and participate in solution-oriented initiatives (Mailumo, 2018). At the planetary scale, climate change education manifests through diverse modalities. Formal education systems increasingly integrate climate concepts across disciplines, with notable examples including Sweden's cross-curricular approach and Costa Rica's national strategy for environmental education.

Informal education channels such as museum exhibits, citizen science projects, and digital platforms complement classroom learning by making climate knowledge accessible to broader demographics (Mailumo, 2018). Higher education institutions globally have established specialized programs in climate science, sustainability studies, and environmental policy, producing graduates equipped to drive innovation in both public and private sectors (Okon, 2021). The cognitive, socio-emotional, and behavioral domains of learning constitute the essential pillars of effective climate education (Afolabi & Abiodun, 2019). Cognitive learning develops scientific understanding of climate systems and anthropogenic influences. Socio-emotional learning addresses psychological responses to climate change, including eco-anxiety and grief, while fostering resilience and hope. Behavioral learning cultivates practical skills for low-carbon living and community adaptation. UNESCO's Global Education Monitoring Report emphasizes that quality CCE programs must integrate all three domains to avoid the pitfalls of "awareness without action" or "action without understanding" (UNESCO, 2022). Despite progress, significant gaps persist in global climate education. A 2021 UNESCO review found that only 53% of national education curricula explicitly reference climate change, with even fewer addressing it as a cross-cutting theme (UNESCO, 2022). Teacher preparedness remains inconsistent, particularly in developing regions where educators may lack subject-matter expertise or pedagogical training for climate topics. The rapid evolution of climate science also creates challenges for curriculum development cycles that traditionally move slower than scientific advances (UNESCO, 2022). These limitations underscore the need for sustained investment in educator professional development and dynamic curricular frameworks responsive to emerging climate knowledge.

Digital technologies present transformative opportunities for scaling climate education globally. Online learning platforms, virtual reality simulations, and mobile applications enable interactive, personalized climate learning experiences across geographies. The COVID-19 pandemic accelerated adoption of digital education tools, demonstrating their potential to reach marginalized communities when combined with offline support systems (Okon, 2021). However, the digital divide remains a persistent barrier, with approximately 3.7 billion people worldwide lacking internet access disproportionately concentrated in climate-vulnerable regions of the Global South (UNESCO, 2022). Youth climate movements have emerged as powerful forces for educational transformation and policy change. Initiatives like Fridays for Future and the Youth Climate Strike, inspired by activists such as Greta Thunberg, demonstrate how young people are leveraging both formal education and informal networks to demand climate action. These movements exemplify the potential of youth leadership in driving societal awareness and holding institutions accountable for climate commitments (UNESCO, 2022). Their impact suggests that education systems must create spaces for student agency and civic engagement on climate issues rather than limiting learning to passive knowledge transmission.

Climate change education in Africa: challenges and innovations

The African continent faces acute climate vulnerabilities that heighten the imperative for robust climate education systems. Temperature increases across Africa have exceeded global averages, with North Africa warming at 0.2-0.4°C per decade since the 1970s and South Africa projected to experience particularly severe warming trends (IPCC, 2021). Changing precipitation patterns including declining rainfall in North and West Africa contrasted with increased rainfall in East and Southern Africa disrupt agricultural systems and water security (Leiserowitz *et al.*, 2013). These physical changes compound existing developmental challenges, with climate impacts potentially affecting 48% of Africa's GDP by 2023 (UNESCO, 2022; Okon, 2021). In this context, climate change education represents both a practical adaptation strategy and a long-term investment in human capital for sustainable development. Higher education institutions (HEIs) in Africa play pivotal roles in climate knowledge production and dissemination. A systematic review identified 41 climate-focused academic programmes across 27 African universities, comprising 18 master's, 15 doctoral, and 6 short course offerings (Okon, 2021). West Africa hosts 44% of these programs, followed by East Africa (27%) and Southern Africa (23%), with Central and North Africa significantly underrepresented at 2% each (Okon, 2021). The distribution reflects historical patterns of educational investment and environmental prioritization, leaving gaps in regions facing severe climate stresses like the Sahel. Program content predominantly

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emphasizes scientific and technical aspects of climate change, with limited integration of social sciences, humanities, and indigenous knowledge systems that could enrich understanding of climate-society interactions (Okon, 2021).
Barriers to effective climate education in African HEIs are multifaceted. Resource constraints—including limited funding, inadequate infrastructure, and scarce teaching materials—hinder program development and delivery. Institutional barriers such as bureaucratic curricula review processes slow the integration of emerging climate knowledge. Socio-political factors, including competing educational priorities and occasional climate skepticism among policymakers, further impede progress (Afolabi & Abiodun, 2019). Perhaps most critically, the majority of African climate programs adopt traditional classroom-based models that Stevenson and Peterson identify as insufficient for fostering the socio-emotional, action-oriented, and justice-focused dimensions essential for transformative climate learning (Okon, 2021). Primary and secondary education systems across Africa exhibit even greater variability in climate education integration. While some countries like Kenya and South Africa have incorporated climate change into national curricula, implementation remains inconsistent due to factors including teacher capacity gaps and examination-driven pedagogies that marginalize non-tested subjects (UNESCO, 2022). A survey of South African secondary school learners found only 59.7% agreed human activity causes climate change, and just 58% recognized climate impacts on human health with female students demonstrating lower knowledge levels than male peers despite expressing greater concern (Okon, 2021). These findings underscore the disconnect between climate awareness and accurate understanding, particularly among youth populations who will bear the greatest climate burdens.

Innovative models are emerging to strengthen climate education across Africa. The Protect Our Planet (POP) Movement in Nigeria represents a youth-led initiative that has reached over 40,700 individuals across 12 states through school programs, community workshops, and stakeholder engagement. By combining scientific education with practical action projects like tree planting and waste management, POP demonstrates how climate learning can bridge knowledge-to-action gaps. Similarly, Ethiopia's Green Legacy Initiative integrates school-based tree planting with environmental education, fostering both ecosystem restoration and student climate literacy (UNESCO, 2022). These approaches align with evidence that experiential, participatory pedagogies are more effective than didactic instruction for climate education outcomes. Technical and Vocational Education and Training (TVET) institutions offer underutilized potential for climate skills development in Africa. A proposed framework for TVET integration includes syllabus incorporation, experiential learning, industry partnerships, and climate-adaptive skills training (Okon, 2021). Given TVET's focus on practical competencies, these institutions could play vital roles in preparing workforces for green jobs in renewable energy, sustainable agriculture, and climate-resilient construction—sectors critical for Africa's low-carbon development (IPCC, 2021). However, realization of this potential requires coordinated policy support and investment in TVET curriculum modernization. Digital technologies present both opportunities and challenges for scaling climate education in Africa. Mobile learning platforms can overcome geographical barriers to reach rural populations, while virtual collaborations enable knowledge sharing across institutions. The University of Cape Town Africa's leading contributor to climate research publications has pioneered online climate courses accessible across the continent (UNESCO, 2020). However, unequal digital access persists, with only 28.2% of Africans using the internet in 2019 (UNESCO, 2021). Hybrid models that combine digital tools with community-based learning may offer the most inclusive pathway for climate education expansion.

Indigenous knowledge systems constitute a vital yet often overlooked resource for African climate education. Traditional ecological knowledge including weather prediction methods, drought-resistant farming techniques, and natural resource management practices has sustained communities through climatic variability for generations 5. Integrative approaches that validate indigenous knowledge while complementing it with scientific understanding can enhance the cultural relevance and effectiveness of climate education, particularly in rural areas where formal education access remains limited (Okon, 2021).

Nigeria's climate education landscape: progress and gaps

As Africa's most populous nation and largest economy, Nigeria's approach to climate change education carries significant regional implications. The country ranks among the world's most vulnerable to climate impacts, with 6% of land area exposed to extreme weather events and coastal zones home to 25% of the population facing severe flooding risks (Okon, 2021). Agriculture which employs about 35% of the workforce and contributes 24% to GDP—is particularly climate-sensitive, with projections indicating potential yield declines of 20% for staple crops due to

changing growing conditions (UNESCO, 2020). These vulnerabilities heighten the urgency for comprehensive climate education strategies that build adaptive capacity across sectors and demographics. Nigeria's policy framework for climate education has advanced in recent years through instruments including the Climate Change Act (2021), National Climate Change Policy (2021-2030), and National Action Plan on Gender and Climate Change (2020) (UNESCO, 2022).

The Climate Change Act established the National Council on Climate Change chaired by the President, mandating climate mainstreaming across sectors including education (Okon, 2021). The Federal Ministry of Environment's Education, Awareness and Outreach Division coordinates public climate education initiatives, while the Nigerian Educational Research and Development Council (NERDC) holds responsibility for curriculum development at primary and secondary levels (IPCC, 2021). Despite this institutional architecture, explicit integration of climate change into national curricula remains limited, reflecting broader challenges in aligning policy with implementation. Higher education offerings on climate change in Nigeria are gradually expanding but remain inadequate to meet national needs. Two Nigerian universities Federal University of Technology, Akure and University of Nigeria, Nsukka have introduced graduate programs on climate change under the West African Science Service Center on Climate Change and Adaptive Land Use (WASCAL) initiative (IPCC, 2021). Several other institutions offer climate-related courses within environmental science, geography, and agriculture programs. However, a systematic review of Nigerian climate research found only 701 relevant publications between 1960-2019, with agriculture being the most studied sector (23 states represented) while northern regions received disproportionately little attention (UNESCO, 2020). These gaps mirror continental patterns of uneven research distribution and highlight needs for targeted capacity building in neglected regions and disciplines. Primary and secondary education systems exhibit significant deficits in climate literacy. A study across six geopolitical zones found that while environmental education concepts appear in curricula, explicit climate change content is minimal and teaching methods often rely on theoretical rather than practical approaches (Okon, 2021). Only 39.6% of Nigerian secondary school students surveyed could correctly identify human activities as drivers of climate change, reflecting systemic gaps in foundational climate knowledge (IPCC, 2021).

The 2015 National Education Policy briefly references climate change under environmental education objectives but provides no detailed implementation framework or assessment metrics (Okon, 2021). This policy ambiguity contributes to inconsistent classroom treatment of climate topics, often dependent on individual teacher initiative rather than systemic design. Civil society and youth-led initiatives are filling critical gaps in Nigeria's climate education landscape. The POP Movement's climate education programme implemented in collaboration with the Federal Ministry of Environment has reached over 40,700 Nigerians across 12 states since 2021 through school workshops, community outreach, and teacher trainings (Okon, 2021). Evaluations indicate positive outcomes including increased youth climate advocacy, improved waste management practices, and heightened stakeholder engagement with climate issues (Okon, 2021). Similarly, the Nigerian Conservation Foundation's school outreach programs integrate climate education with hands-on conservation activities, fostering both knowledge and environmental stewardship values. These initiatives demonstrate the potential of non-state actors to complement formal education systems, particularly in contexts where bureaucratic inertia slows curricular reform. Barriers to effective climate education in Nigeria are multidimensional. At institutional levels, competing educational priorities including focus on STEM subjects and national examination performance marginalize climate topics perceived as non-core. Teacher capacity constraints are acute, with many educators lacking subject matter expertise or pedagogical training for climate concepts (Okon, 2021). Resource limitations affect both urban and rural schools, particularly in northern regions where educational infrastructure is weakest. Perhaps most fundamentally, prevailing instructional paradigms emphasize rote learning over critical thinking and problem-solving approaches needed for climate literacy (Okon, 2021). These challenges are compounded by Nigeria's complex federal system, where education policy implementation varies significantly across states.

Television, radio, and social media platforms offer underutilized potential for scaling climate awareness in Nigeria. With 84% of Nigerians having access to radio and mobile phone penetration exceeding 80%, digital and broadcast media could overcome classroom limitations to reach diverse demographics (Okon, 2021). The Nigerian Meteorological Agency (NIMET) has pioneered climate information dissemination through seasonal forecasts and early warning systems, though educational components could be strengthened. Partnerships between media outlets,

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educational institutions, and government agencies could develop engaging climate content tailored to different regions, languages, and literacy levels; a strategy successfully employed in other developing contexts (Okon, 2021).

Recommendations for strengthening climate education as an antidote

Transforming climate change education from peripheral activity to central strategy requires systemic reforms across global, regional, and national contexts. At the global level, international organizations should prioritize four key actions: First, UNESCO and partner agencies must establish minimum standards for climate literacy and integrate them into Education for Sustainable Development (ESD) monitoring frameworks. Second, development finance institutions should increase funding for climate education in vulnerable countries, with particular support for teacher training and localized curriculum development. Third, the UNFCCC's Action for Climate Empowerment (ACE) framework should be strengthened with binding national commitments and transparent reporting mechanisms. Finally, global climate research networks must enhance support for African scholars and institutions to reduce knowledge production asymmetries and ensure locally relevant solutions (Okon, 2021).

African regional bodies have critical roles in coordinating and scaling effective climate education practices. The African Union's Continental Education Strategy should explicitly incorporate climate change as a cross-cutting priority across all education subsectors. Regional Economic Communities (RECs) can facilitate peer learning through platforms like the West African Climate Change Adaptation Strategy (WACCAS), which Nigeria has helped develop (Okon, 2021). Collaborative degree programs and research networks modeled after WASCAL should be expanded to cover more countries and disciplines. Perhaps most importantly, African nations must dramatically increase domestic education budgets to meet the recommended 20% of national expenditure, ensuring climate education receives adequate resourcing amid competing priorities (Okon, 2021).

Nigeria's path toward robust climate education systems requires concerted action across multiple fronts. The Federal Ministry of Education should lead a comprehensive curriculum review to integrate climate change across subjects and grade levels, moving beyond superficial treatment in environmental studies. This review must emphasize inquiry-based pedagogies, local relevance, and clear learning progressions from basic to tertiary education (Afolabi & Abiodun, 2019). Simultaneously, teacher education programs at colleges of education and universities must incorporate climate modules and practicum experiences to build educator confidence and competence. The National Teachers Institute (NTI) could play pivotal roles in delivering in-service climate training through its nationwide network (Afolabi & Abiodun, 2019).

Higher education institutions require targeted support to expand and enhance climate programs. The Tertiary Education Trust Fund (TETFund) should designate climate change as a priority research area and fund specialized centers at universities across geopolitical zones. Academic partnerships with industries particularly agriculture, energy, and water sectors can ensure curricula address real-world climate challenges while providing student internship opportunities (Anderson, 2012). Nigerian universities should also strengthen community engagement programs that extend climate knowledge beyond campus boundaries, modeling approaches like the POP Movement's school outreach (Amdu, 2013).

Grassroots and non-formal education initiatives warrant greater policy recognition and support. Government agencies should establish grant mechanisms for community-based organizations delivering climate education, with particular incentives for programmes targeting women, rural populations, and other marginalized groups. Faith-based institutions which reach millions of Nigerians weekly could be engaged as partners in climate awareness campaigns, adapting messages to theological frameworks (Afolabi & Abiodun, 2019). Traditional rulers and indigenous knowledge holders should participate in curriculum development to ensure cultural resonance of climate education materials (Afolabi & Abiodun, 2019).

Monitoring and evaluation systems must be strengthened to assess climate education outcomes rather than just inputs. The National Bureau of Statistics (NBS) could incorporate climate literacy metrics into household surveys, while examination bodies like WAEC and NECO should develop assessment items that measure climate understanding across subjects. Longitudinal studies tracking how climate education influences career choices, civic engagement, and personal behaviours would provide valuable evidence for programme refinement (Okon, 2021). Nigeria's vibrant

technology sector could contribute by developing digital assessment tools and learning analytics platforms to personalize climate education delivery.

Conclusion

Climate change education represents one of the most potent yet underutilized antidotes to the escalating impacts of global warming. As this analysis demonstrates, effective CCE transcends simple knowledge transmission to encompass critical thinking development, emotional resilience building, and practical skills acquisition for mitigation and adaptation. The transformative potential of climate education is particularly salient in Africa the continent most vulnerable to climate disruptions despite minimal historical responsibility for emissions. Nigeria's complex climate challenges and dynamic education landscape offer both cautionary tales and promising innovations for how developing nations can cultivate climate-informed citizenries. The path forward demands unprecedented collaboration across sectors and scales. Educators require support to innovate pedagogies that make climate learning engaging and actionable. Policymakers must move beyond rhetorical commitments to concrete investments in curriculum reform, teacher training, and educational infrastructure. Communities deserve opportunities to both contribute indigenous knowledge and access scientific understanding of climate systems. Most fundamentally, youth who will inherit the consequences of today's climate decisions must be recognized not just as learners but as leaders in shaping sustainable futures.

The POP Nigeria represent a promising model of youth-driven climate education, achieving tangible reach and formative behaviour change, especially in underserved states. Its use of interactive and localized sessions aligns well with Africa's diverse educational needs. Yet Nigeria's overall literacy remains inconsistent, reflecting national disparities. When compared to other African nations, POP's strengths lie in grassroots mobilization and multi-zonal outreach. However, examples from Kenya and Zambia highlight the value of embedding climate education formally into national curricula, adapting medium such as music and inclusive accessibility method like sign language .The outcomes of the POP Movement demonstrate that youth-led climate education and awareness can be powerful tools in shaping a sustainable and climate-resilient society. By combining education with action, the movement fosters: A sense of ownership and urgency among Nigerian youth, practical solutions adapted to local environmental challenges, a sustainable platform for climate advocacy, innovation, and leadership. Thus, integrating such initiatives more systematically into Nigeria's educational and community development strategies would significantly strengthen national responses to climate change.

While the challenges are substantial, the costs of inaction are incomparably greater. Climate change threatens to unravel decades of development progress across Africa, exacerbating poverty, inequality, and instability. Education alone cannot solve the climate crisis, but without education, no solution can take root. By making climate change education comprehensive, inclusive, and action-oriented, societies worldwide can cultivate the knowledge, values, and collective will needed to navigate the Anthropocene's greatest challenge. Nigeria with its vast human capital, cultural influence, and climate vulnerabilities has both opportunity and obligation to model this educational transformation for Africa and beyond.

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