

The Extent of Climate Change Education Implementation in Secondary Schools in Cameroon: A Mixed-Methods Analysis of Systemic Gaps

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Abstract: Climate change education (CCE) is increasingly recognized as a critical strategy for developing climate-resilient societies; however, empirical evidence on its implementation in secondary schools across sub-Saharan Africa remains limited. This study examined the extent of climate change education implementation in secondary schools in Cameroon's South West and Littoral Regions. Guided by Transformative Learning Theory, Social Learning Theory, and Ostrom's Institutional Analysis and Development Framework, the study employed an explanatory sequential mixed-methods design. Quantitative data were collected from 800 students across 12 government secondary schools using a structured questionnaire, while qualitative data were obtained through focus group discussions and semi-structured interviews with teachers and policymakers. Descriptive statistics, chi-square analysis, and multiple response set analysis were used to analyse quantitative data, whereas thematic analysis was applied to qualitative data. Findings indicate that although 66.7% of students reported that climate change topics appear in classroom lessons, meaningful implementation remains substantially inadequate across major implementation dimensions. About 91.1% of students reported limited access to learning resources, 94.5% indicated limited use of interactive teaching methods, 93.6% reported inadequate practical engagement, and 94.3% reported limited use of digital teaching tools. Significant differences were observed across regions ($\chi^2 = 36.06$, $p < .001$) and class levels ($\chi^2 = 43.73$, $p < .001$). The aggregate implementation analysis revealed that 80.0% of student responses fell within negative implementation categories. The study concludes that climate change education in Cameroon remains characterised by nominal curriculum inclusion without meaningful pedagogical implementation. Strengthening policy mandates, teacher capacity, institutional support, and resource availability is necessary for effective climate literacy development.

Keywords: Climate Change Education, Curriculum Implementation, Secondary Education, Climate Literacy, Cameroon, Mixed-Methods Research.

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I. INTRODUCTION

Climate change remains one of the most urgent global challenges of the twenty-first century, with profound implications for environmental sustainability, economic development, and human well-being. According to the Intergovernmental Panel on Climate Change, rising global temperatures and increasing extreme weather events are already disrupting ecosystems and human systems worldwide

[1]. These impacts are particularly severe in developing countries, where poverty, weak infrastructure, and limited adaptive capacity heighten vulnerability to climate-related risks [2].

Across Africa, climate change is increasingly manifested through recurrent floods, prolonged droughts, biodiversity loss, and declining agricultural productivity. The World Meteorological Organization reported that climate

variability across the continent continues to intensify, with serious consequences for food security, livelihoods, and social stability [3]. Cameroon reflects many of these vulnerabilities. The World Bank estimated that climate-related shocks could reduce Cameroon's gross domestic product by 4–10% by 2050 if adaptation efforts remain inadequate [4]. The South West and Littoral Regions are particularly exposed to recurrent flooding, coastal erosion, sea-level rise, and disruptions to agricultural activities.

Education has increasingly been recognised as a critical strategy for climate adaptation and resilience. Climate change education (CCE) extends beyond teaching scientific facts; it seeks to develop learners' knowledge, skills, attitudes, and behaviours needed to understand and respond effectively to climate challenges. As noted by United Nations Educational, Scientific and Cultural Organization, climate change education equips learners with competencies for mitigation, adaptation, and sustainable decision-making [5]. Education therefore serves not only as a means of awareness creation but also as a transformative tool for behavioural change and climate action [6, 7].

This educational imperative is reinforced by global policy frameworks. Sustainable Development Goal 4 emphasises inclusive and equitable quality education, while Sustainable Development Goal 13 calls for urgent climate action. Likewise, Article 6 of the United Nations Framework Convention on Climate Change identifies education, training, and public awareness as essential components of climate response [8]. Despite these commitments, translating climate policy into meaningful classroom practice remains difficult, especially in low- and middle-income countries where resource constraints and weak institutional support persist [9].

In Cameroon, climate change education remains weakly institutionalised within formal secondary education. Although environmental sustainability appears in national policy discourse, Law No. 98/004 of 14 April 1998, which governs educational orientation, does not explicitly mandate climate change education [10]. As a result, climate-related teaching in schools often depends more on individual teacher initiative than on structured curriculum implementation.

While global scholarship on climate change education continues to expand, empirical evidence from sub-Saharan African secondary schools remains limited, particularly in Cameroon. Existing research has focused largely on climate vulnerability and environmental policy, with limited attention to how climate change education is implemented in schools. There is little empirical evidence on curriculum delivery, pedagogical practices, resource availability, and institutional support for climate change education in Cameroonian secondary schools [11, 9].

This study addresses that gap by examining the extent of climate change education implementation in secondary schools in Cameroon's South West and Littoral Regions. Specifically, it investigates how climate change education is reflected in curriculum delivery, teaching methods, resource availability, learner engagement, and institutional support.

The study was guided by the following research question: To what extent is climate change education being implemented in secondary schools in Cameroon?

II. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

➤ Literature Review

Climate change education (CCE) has gained increasing scholarly attention as an essential component of sustainable development and climate resilience. Existing literature suggests that effective CCE goes beyond awareness creation and should equip learners with the knowledge, skills, values, and competencies required to engage in mitigation and adaptation practices. According to United Nations Educational, Scientific and Cultural Organization, meaningful climate education requires curriculum integration, trained teachers, supportive policies, and access to relevant teaching resources [9]. Without these conditions, climate-related learning often remains superficial and disconnected from practical action [12].

Empirical studies consistently show that the implementation of climate change education remains uneven across educational systems. Monroe et al. [13], in a systematic review of climate education research, found that instructional approaches centered solely on knowledge transmission were less effective in fostering behavioural change than participatory and experiential learning approaches. Their review showed that inquiry-based learning, project-based activities, and community engagement significantly improve learner motivation and climate action competence. Similarly, Mochizuki and Bryan [14] argued that climate change education should be embedded within Education for Sustainable Development frameworks to promote critical thinking, ethical reflection, and transformative action.

Teacher preparedness remains one of the most widely reported barriers to effective CCE implementation. Research by Shea et al. [15] found that teachers often lack sufficient climate science knowledge and pedagogical confidence to teach climate-related content effectively. Where professional development is absent, teachers tend to rely heavily on traditional lecture-based approaches, limiting learner engagement and critical reflection. Anderson [16] similarly emphasized that teacher training is central to successful climate instruction, particularly in contexts where climate education is not explicitly embedded in formal curricula.

Resource availability also shapes the quality of climate education delivery. Studies show that access to textbooks, digital tools, simulations, field experiences, and locally relevant teaching materials enhances student understanding of climate concepts and strengthens real-world application [17]. In resource-constrained contexts, however, climate topics are often taught theoretically with limited practical engagement. This weakens learner participation and reduces opportunities for experiential learning, which is essential for developing climate-responsive behaviours [13].

Despite growing global scholarship, evidence from sub-Saharan Africa remains limited. Much of the existing African literature focuses on climate vulnerability, adaptation, and environmental policy rather than school-level curriculum implementation. Within Cameroon, research has largely examined environmental sustainability and climate risk, with limited empirical attention given to how climate change education is delivered in secondary schools. This leaves an important knowledge gap regarding curriculum implementation, instructional practices, and institutional support for climate education in Cameroonian schools.

➤ *Theoretical Framework*

This study was guided by three complementary theoretical perspectives: Transformative Learning Theory, Social Learning Theory, and the Institutional Analysis and Development (IAD) Framework. Together, these theories provide a multi-level lens for understanding climate change education implementation at learner, classroom, and institutional levels.

Transformative Learning Theory, developed by Jack Mezirow [18, 19], explains how learning can lead to deep changes in beliefs, attitudes, and behaviours through critical reflection. The theory proposes that meaningful learning occurs when individuals question existing assumptions and reconstruct their understanding of complex issues. In the context of climate change education, transformative learning suggests that merely presenting scientific facts is insufficient. Learners need opportunities for reflection, dialogue, and action to develop meaningful climate consciousness and behavioural change [20].

Social Learning Theory, proposed by Albert Bandura [21, 22], emphasises that learning occurs through observation, modelling, imitation, and social interaction. According to Bandura, individuals acquire knowledge and behaviour by observing others within their environment. Applied to climate education, this theory highlights the importance of teacher modelling, visual resources, demonstrations, collaborative learning, and school culture in shaping students' understanding and environmental behaviour.

The Institutional Analysis and Development Framework, developed by Elinor Ostrom [23, 24], provides a framework for examining how institutional structures influence educational practice. The framework focuses on the "action arena," where actors interact within formal and informal rules. In this study, schools represent the action arena where students, teachers, administrators, and policymakers interact within policy and resource constraints. The framework helps explain why climate change education implementation may remain weak even when climate policy commitments exist, especially when institutional support, curriculum mandates, and monitoring mechanisms are inadequate.

Together, these theoretical perspectives provide a comprehensive framework for analysing the implementation of climate change education in secondary schools. Transformative Learning Theory explains learner transformation, Social Learning Theory highlights pedagogical interaction, and the IAD Framework illuminates the institutional conditions shaping implementation.

III. RESEARCH METHODOLOGY

➤ *Research Design*

This study adopted an explanatory sequential mixed-methods design, in which quantitative data were collected and analysed first, followed by qualitative data to explain and enrich the quantitative findings. According to Creswell and Plano Clark [25], this design is particularly useful when numerical trends require further exploration through participants' lived experiences and contextual explanations. The design was considered appropriate for this study because it enabled both the measurement of the extent of climate change education (CCE) implementation and a deeper understanding of the systemic factors influencing implementation. The study was guided by a pragmatic philosophical stance, which prioritises the use of multiple methods to address real-world research problems [26, 27].

➤ *Study Area*

The study was conducted in the South West and Littoral Regions of Cameroon, specifically in Fako Division and Wouri Division respectively. These regions were purposively selected because they represent ecologically vulnerable areas that increasingly experience the effects of climate variability. The Littoral Region, particularly Douala and surrounding coastal zones, is highly exposed to flooding, coastal erosion, sea-level rise, and urban environmental degradation. The World Bank [4] highlights that coastal cities in Cameroon face growing infrastructure and livelihood risks due to climate change. Similarly, the South West Region experiences irregular rainfall patterns, flooding, land degradation, and agricultural disruption, challenges that are further aggravated by ongoing socio-political instability. These regional characteristics provided an appropriate context for examining differences in CCE implementation.

➤ *Target Population*

The target population comprised secondary school students enrolled in Forms 1 to 5 in government secondary schools within the selected regions. These students constituted the primary unit of analysis because they directly experience classroom teaching and learning processes related to climate change education. Based on the national distribution of secondary school students for the 2023/2024 academic year, the accessible population within the selected regions consisted of 494,575 students, distributed across gender and region as presented in Table 1.

Table 1 Target Population Distribution

Region	Female	Male	Total
Littoral	203,659	197,110	400,769
South-West	51,847	41,959	93,806

National Total	255,506	239,069	494,575
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Source: National Distribution of Secondary School Students by Gender (2024-2025)

- Sample Distribution by School**

The study sample comprised 800 secondary school students selected from 12 government secondary schools across the South West and Littoral Regions of Cameroon. The sampled students included 411 females (51.4%) and 389

males (48.6%), ensuring near-balanced gender representation. Six schools were selected from each region to provide regional comparability and adequate representation of urban and peri-urban school contexts.

Table 2 Sample Distribution by School

Region	School	Female	Male	Total Sampled
South-West	GBHS Limbe	39	36	75
	GHS Bokwango	37	35	72
	GHS Batoke	36	34	70
	GHS Buea Town	33	31	64
	GHS Limbe	30	28	58
	BGS Molyko	31	30	61
	Subtotal (South West)	206	194	400
Littoral	Lycée Bilingue de Deido	38	36	74
	Lycée Bilingue de New Bell	36	34	70
	Lycée Bilingue de Bonaberi	35	31	66
	Lycée Bilingue de Bonassama	27	29	56
	Lycée Bilingue de Nylon	35	33	68
	Lycée Bilingue de Logpom	34	32	66
	Subtotal (Littoral)	205	195	400
Total		411	389	800

Source: Constructed by the Researcher 2025/2026 Academic Year

- Sample Size and Sampling Techniques**

The quantitative sample comprised 800 students selected from 12 government secondary schools, with six schools selected from each region. This sample size was considered sufficiently large to permit reliable statistical analysis and regional comparison.

A stratified random sampling technique was employed to select student participants. Stratification was based on three key criteria: geographical region, administrative division, and school location (urban and peri-urban). This approach ensured proportional representation of relevant subgroups and reduced sampling bias.

For the qualitative phase, purposive sampling was used to identify participants with relevant experience and knowledge regarding climate change education implementation. This included:

- ✓ 12 teachers (six per region) selected for semi-structured interviews
- ✓ 6 focus group discussions with students (three per region, six participants each) and 4 Policymakers

Purposive sampling was appropriate because, as Creswell and Plano Clark [25] explain, qualitative inquiry

seeks information-rich participants capable of providing deep contextual insights.

Quantitative data were collected using a structured questionnaire designed to measure the extent of climate change education implementation across seven implementation dimensions: curriculum integration, teacher capacity, teaching methods, resource availability, practical engagement, assessment practices, and institutional support. Qualitative data were collected using semi-structured interview guides and focus group discussion protocols. These instruments explored participants' experiences, perceptions, and explanations regarding the implementation of climate change education in schools.

IV. INSTRUMENTATION AND DATA ANALYSIS

➤ Research Instruments

To ensure methodological triangulation, multiple data collection instruments were used.

➤ Questionnaire

Quantitative data were collected using a structured questionnaire administered to students. The instrument measured seven dimensions of climate change education implementation: Curriculum integration, Teacher capacity, Teaching methods, Resource availability, Practical

engagement, Assessment practices and Institutional support. Responses were measured on a 4-point Likert scale: Strongly Disagree, Disagree, Agree and Strongly Agree. The questionnaire was designed to capture students' perceptions regarding the extent to which climate change education was meaningfully implemented in their schools.

• *Semi-Structured Interviews*

Semi-structured interview guides were administered to teachers and policymakers to explore institutional and pedagogical realities influencing climate change education implementation. Interview questions focused on teacher preparedness, curriculum delivery, policy support, and implementation challenges.

• *Focus Group Discussions*

Focus group discussions were conducted with students to gain deeper insights into their lived experiences of climate change education. Braun and Clarke [28] note that interactive group discussions often generate richer qualitative data because participants build on one another's experiences and reflections.

• *Validity and Reliability*

To ensure content and construct validity, the research instruments were reviewed by experts in educational research and curriculum studies. Their feedback informed revisions to improve clarity, relevance, and alignment with the study objectives. The quantitative instrument demonstrated acceptable internal consistency, with a Cronbach's alpha coefficient of 0.728, indicating satisfactory reliability for social science research.

• *Data Collection Procedure*

Data collection was conducted in two sequential phases. During the quantitative phase, questionnaires were administered to students across the selected schools with support from school administrators and class teachers. Following preliminary quantitative analysis, qualitative data were collected through interviews and focus group discussions to further explain observed statistical patterns. This sequential procedure allowed qualitative findings to

provide contextual explanations for quantitative trends, particularly regarding resource constraints, teacher preparedness, and institutional support.

• *Data Analysis*

Quantitative data were analysed using SPSS version 18.0. Descriptive statistics, including frequencies and percentages, were used to summarise student responses. Inferential statistics, specifically chi-square tests, were employed to examine regional and class-level differences in perceptions of CCE implementation. Multiple Response Set (MRS) analysis was further used to generate an aggregated measure of overall implementation patterns across the seven implementation indicators.

Qualitative data from interviews and focus group discussions were analysed using thematic analysis following the framework proposed by Braun and Clarke [28]. Responses were coded systematically to identify recurring themes and subthemes related to implementation barriers and enabling factors. NVivo 10 software supported the coding and organisation of qualitative data.

• *Ethical Considerations*

Ethical approval for the study was obtained from University of Buea. Informed consent was obtained from all participants, while assent and institutional consent were secured for minors through school authorities. Participation was voluntary, confidentiality was maintained through anonymisation, and participants were informed of their right to withdraw from the study at any stage without penalty.

V. RESULTS

➤ *Quantitative Findings: Students' Perspectives on Climate Change Education Implementation*

This section presents students' perceptions regarding the extent of climate change education (CCE) implementation in secondary schools across the South West and Littoral Regions of Cameroon. Responses were analysed using descriptive statistics, including frequencies and percentages, to determine the extent to which key dimensions of climate change education were implemented.

Table 3 Extent of Climate Change Education in Secondary Schools: Student Perspectives (N=800)

The extent of climate change education implementation in schools	Strongly disagree	Disagree	Agree	Strongly Agree	N
Climate change topics are included in the lessons I study	63 (7.9%)	204 (25.5%)	438 (54.8%)	95 (11.9%)	800
My teachers talk about climate change in different subjects	65 (8.1%)	413 (51.6%)	250 (31.3%)	72 (9.0%)	800
I have access to books, videos, or other resources that help me understand	105 (13.1%)	624 (78.0%)	58 (7.2%)	13 (1.6%)	800
Students are provided with up-to-date climate change resources	172 (21.5%)	578 (72.3%)	46 (5.8%)	4 (0.5%)	800
Teachers use interactive and participatory teaching methods for climate change	200 (25.0%)	256 (69.5%)	36 (4.5%)	8 (1.0%)	800
Hands-on activities and projects relate to climate change are encouraged in class	261 (32.6%)	488 (61.0%)	40 (5.0%)	11 (1.4%)	800
My teacher use computers, pictures, videos and other digital tools to teach	335 (41.9%)	419 (52.4%)	35 (4.4%)	11 (1.4%)	800
MRS (Multiple response set)	1201 (21.4%)	3282 (58.6%)	903 (16.1%)	214 (3.8%)	2694

The findings reveal a notable contrast between nominal curriculum inclusion and meaningful implementation of climate change education. Although a majority of students (66.7%) agreed that climate change topics were included in classroom lessons, this inclusion did not translate into effective pedagogical practice.

Only 40.3% of students reported that teachers discussed climate change across multiple subjects, suggesting that climate-related content remains largely confined to specific disciplines such as geography and biology rather than being integrated across the curriculum.

More critically, students reported widespread implementation deficiencies across major indicators. A substantial 91.1% indicated limited access to books, videos, or other instructional materials that could support climate learning. Similarly, 93.8% reported inadequate access to updated climate change resources, reflecting severe resource limitations within schools.

Pedagogical practice also appeared weak. An overwhelming 94.5% of students reported that teachers rarely used interactive or participatory teaching methods such as debates, simulations, inquiry-based learning, or collaborative projects. Likewise, 93.6% indicated that hands-on activities such as environmental projects, fieldwork, or school-based sustainability initiatives were largely absent.

The use of digital instructional tools was particularly limited. About 94.3% of respondents reported that teachers rarely used computers, videos, pictures, or other digital resources to support climate change instruction. This finding suggests substantial technological and infrastructural constraints affecting effective climate pedagogy.

➤ *Aggregate Implementation Analysis*

To obtain an overall measure of climate change education implementation, a Multiple Response Set (MRS) analysis was conducted across the seven implementation indicators. The results revealed overwhelmingly negative perceptions regarding implementation.

Of the total aggregated responses, 21.4% fell within the “strongly disagree” category and 58.6% within the “disagree” category, representing a combined negative response rate of 80.0%. By contrast, only 16.1% of responses were classified as “agree,” while 3.8% fell within “strongly agree,” yielding a combined positive response rate of 19.9%.

These findings indicate that while climate change education exists nominally within the curriculum, meaningful implementation remains substantially inadequate across schools.

➤ *Qualitative Findings*

Qualitative findings from focus group discussions, teacher interviews, and policymaker interviews provided deeper insight into the quantitative results. Three major themes emerged: limited curriculum integration, weak pedagogical practice, and systemic institutional barriers.

➤ *Limited Curriculum Integration*

Students consistently reported that climate change topics were taught mainly within Geography and Biology lessons. Climate-related issues such as flooding, global warming, drought, deforestation, and environmental degradation were familiar to many participants, but exposure remained narrow and subject-specific.

One student explained:

“We learn in Geography about floods, drought, and how to protect nature.”

This suggests that climate change education exists primarily through indirect curriculum exposure rather than deliberate cross-curricular integration.

➤ *Weak Pedagogical Practice and Limited Student Engagement*

Focus group discussions revealed that classroom instruction was predominantly theoretical. Students described lessons as heavily dependent on verbal explanations, note-taking, and textbook reading, with limited practical engagement.

One participant remarked:

“Lessons are mostly descriptive; we want field work and outdoor experiments.”

Students reported that lessons became more engaging when teachers linked climate topics to local experiences such as flooding, heat stress, or coastal erosion. However, such contextual teaching appeared inconsistent.

Teachers similarly acknowledged limitations in instructional delivery. Many reported relying on personal initiative to incorporate climate-related discussions due to the absence of structured teaching guidelines, specialised training, and dedicated teaching materials.

➤ *Institutional and Policy Constraints*

Interviews with teachers and policymakers highlighted deeper systemic barriers affecting implementation. Participants consistently noted the absence of explicit national mandates requiring climate change education as a compulsory and examinable component of secondary education.

A policymaker stated:

“The primary legal foundation is Law No. 98/004 of 14 April 1998 lays down general educational guidelines for secondary schools; however, this law does not explicitly mention climate change.”

Policymakers also acknowledged significant regional disparities. Urban schools, particularly in better-resourced regions, were perceived to have relatively stronger implementation capacity than rural or conflict-affected schools.

Another key issue was the absence of formal monitoring systems. Without dedicated implementation benchmarks, climate change education remains largely dependent on individual school leadership or teacher motivation.

VI. DISCUSSION

This study examined the extent of climate change education (CCE) implementation in secondary schools in Cameroon's South West and Littoral Regions. The findings reveal a clear gap between the nominal presence of climate-related content in the curriculum and its meaningful implementation within classroom practice. Although most students acknowledged that climate change topics appear in lessons, evidence from both quantitative and qualitative data suggests that implementation remains fragmented, largely theoretical, and institutionally weak.

➤ *The Gap Between Curriculum Presence and Meaningful Implementation*

One of the most striking findings is the contrast between curriculum inclusion and actual pedagogical practice. While 66.7% of students reported that climate change topics are present in classroom lessons, aggregate implementation analysis showed that 80.0% of responses fell within negative implementation categories. This suggests that curriculum presence alone does not guarantee meaningful learning outcomes. This finding aligns with Mochizuki and Bryan [14], who argued that climate change education often exists rhetorically within education systems without adequate pedagogical transformation. In many contexts, climate issues are acknowledged in policy and curriculum documents but remain weakly integrated into everyday teaching practice. The present study indicates a similar pattern in Cameroon, where climate-related topics are introduced but not sufficiently embedded in structured teaching and learning processes.

From the perspective of Jack Mezirow's Transformative Learning Theory [18, 19], this limited implementation constrains deeper learning. Transformative learning requires critical reflection, dialogue, and opportunities for perspective change. Where climate education remains superficial and fact-based, learners may acquire fragmented awareness without developing the critical consciousness required for behavioural transformation.

➤ *Teacher Capacity as a Critical Implementation Barrier*

Teacher preparedness emerged as one of the strongest barriers to effective implementation. Students consistently perceived teachers as inadequately prepared to deliver climate change education, while interviews confirmed limited formal training in climate-related content and pedagogy. This finding supports earlier work by Shea et al. [15], who found that teacher competence strongly influences the quality of climate education delivery. Teachers require not only scientific understanding of climate systems but also pedagogical competence to communicate complex environmental issues in engaging and contextually relevant ways. Without specialised training, teachers often default to traditional lecture-based instruction.

The findings also reinforce Anderson's [16] argument that teacher professional development remains central to successful climate education implementation. In the absence of structured pre-service and in-service training, instructional delivery becomes dependent on personal motivation and prior exposure. This partly explains why climate teaching in the sampled schools appeared inconsistent and heavily reliant on individual initiative.

➤ *Resource Constraints and Pedagogical Limitations*

The study revealed severe resource deficits, with over 90% of students reporting limited access to climate-related learning materials, digital tools, and practical resources. This resource gap significantly weakens instructional quality and student engagement. The absence of teaching resources has important pedagogical implications. Effective climate education benefits from visual demonstrations, documentaries, simulations, field-based inquiry, and locally relevant case studies. When such resources are unavailable, instruction becomes abstract and heavily theoretical. This pattern was evident in students' descriptions of lessons as largely descriptive and textbook-driven.

Viewed through Albert Bandura's Social Learning Theory [21, 22], resource scarcity limits observational learning opportunities. Bandura argues that individuals learn by observing models, behaviours, and consequences within social contexts. In climate education, visual and experiential tools help learners connect abstract climate science to real-world environmental realities. Their absence reduces motivation, retention, and practical application of knowledge. These findings are consistent with Monroe et al. [13], who found that participatory and experiential climate learning approaches are significantly more effective than passive knowledge transmission. The limited use of such approaches in the sampled schools likely contributes to weak learner engagement and reduced climate action readiness.

➤ *Limited Practical Engagement and Learner Transformation*

Another major finding concerns the near absence of practical activities such as environmental clubs, field projects, community clean-up initiatives, and school-based sustainability programs. More than 93% of students reported limited hands-on engagement with climate-related activities. This is significant because climate change education is not solely about awareness; it also involves agency, participation, and behavioural change [7]. Practical engagement enables learners to connect classroom knowledge with real-world action, strengthening both competence and motivation.

Students' desire for outdoor experiments and field-based learning reflects a need for experiential pedagogy. Such approaches create opportunities for reflection, collaborative problem-solving, and action-oriented learning. From a transformative learning perspective, these experiences can trigger deeper questioning of environmental attitudes and behaviours, thereby facilitating lasting perspective transformation [19]. The limited practical engagement observed in this study therefore suggests that current implementation largely promotes awareness without sufficiently fostering climate action competencies.

➤ *Institutional Analysis of Systemic Gaps*

The systemic nature of these challenges becomes clearer when interpreted through Elinor Ostrom's Institutional Analysis and Development Framework [23, 24]. The framework suggests that implementation outcomes are shaped not only by individual actors but also by institutional rules, incentives, and resource conditions.

In the present study, the weak implementation of climate change education appears rooted in institutional gaps at multiple levels. These include the absence of explicit curriculum mandates, limited teacher training structures, inadequate monitoring mechanisms, and insufficient allocation of instructional resources. Such institutional weaknesses create conditions in which climate education becomes optional rather than systematically enforced [12].

The findings therefore suggest that implementation challenges should not be interpreted solely as teacher-level failures. Rather, they reflect broader systemic weaknesses within policy design, curriculum governance, and educational administration. Without institutional reforms, meaningful implementation of climate change education will remain difficult. Overall, the study demonstrates that climate change education in Cameroon currently operates within a policy-practice gap. Climate-related content may be present within curriculum discourse, but implementation remains constrained by weak institutional support, inadequate teacher capacity, limited resources, and minimal experiential learning opportunities [6]. Addressing these barriers requires systemic interventions that move beyond symbolic curriculum inclusion toward meaningful pedagogical and institutional transformation.

VII. CONCLUSION AND RECOMMENDATIONS

➤ *Conclusion*

This study investigated the extent of Climate Change Education (CCE) implementation in secondary schools within Cameroon's South West and Littoral Regions using an explanatory sequential mixed-methods design. The study sought to determine whether climate change education is meaningfully integrated into teaching and learning processes and to identify systemic factors influencing implementation.

The findings reveal that although climate change topics are present within the curriculum, implementation remains largely superficial and inadequate. While 66.7% of students acknowledged that climate change topics appear in classroom lessons, this nominal inclusion does not translate into meaningful educational practice. The study found that climate change education remains largely theoretical, fragmented across a limited number of subjects, and insufficiently connected to practical climate action.

Quantitative findings showed severe implementation deficiencies across major dimensions of climate change education. Most students reported inadequate access to instructional resources, limited use of interactive teaching methods, minimal practical engagement through projects or field activities, and poor integration of digital learning tools.

The Multiple Response Set analysis further confirmed that 80.0% of student responses fell within negative categories, demonstrating widespread dissatisfaction with the current level of implementation.

Qualitative findings reinforced these results. Students described climate-related lessons as largely theoretical and examination-driven, with little opportunity for experiential learning. Teachers reported insufficient professional preparation and limited pedagogical support for delivering climate change education effectively. Policymakers acknowledged that although climate-related concerns appear within broader environmental policy frameworks, no explicit educational mandate exists to ensure systematic implementation across secondary schools.

Using Transformative Learning Theory, the study demonstrates that current instructional approaches do not sufficiently promote critical reflection, perspective transformation, or behavioural change among learners [18, 19]. Through the lens of Social Learning Theory, the absence of visual resources, modelling opportunities, and experiential activities limits students' ability to internalise climate-responsive behaviours [21, 22]. Furthermore, the Institutional Analysis and Development Framework reveals that weak institutional rules, limited resource allocation, and lack of monitoring mechanisms collectively sustain the policy-practice gap [23, 24].

The study therefore concludes that climate change education implementation in Cameroon is characterised by a significant disconnect between policy aspirations and classroom realities. Without deliberate institutional reform, climate change education will remain symbolic rather than transformative, limiting the development of climate literacy, adaptive capacity, and sustainable behavioural change among secondary school students.

➤ *Recommendations*

Based on the study's findings, several key recommendations are proposed to enhance climate change education in Cameroon's secondary schools. Foremost, the Ministry of Secondary Education should establish a clear policy framework that mandates climate change as a compulsory cross-curricular theme with defined learning outcomes, which would ensure systematic implementation and accountability. To effectively deliver this curriculum, teacher capacity must be strengthened through continuous professional development focused on climate science and innovative teaching methods, as educators are crucial to successful implementation. This should be supported by developing and distributing locally relevant instructional materials, such as textbooks and digital content, that reflect Cameroon's specific climate realities. Furthermore, schools should promote experiential learning through environmental programs like climate clubs and tree-planting campaigns to translate knowledge into action, while also improving digital infrastructure and institutional support to facilitate these initiatives. Finally, a national monitoring and evaluation framework is essential to regularly assess teacher preparedness, resource availability, and student outcomes,

thereby identifying gaps and guiding evidence-based policy improvements.

➤ *Limitations and Future Research*

This study was limited to government secondary schools in the South West and Littoral Regions of Cameroon; therefore, the findings may not fully represent climate change education implementation in all regions or school types across the country. In addition, the study relied partly on self-reported data from students, which may be influenced by perception bias. The cross-sectional nature of the study also limits the ability to examine long-term changes in climate change education implementation. Despite these limitations, the mixed-methods approach provided robust insights into the current state of climate change education in Cameroonian secondary schools.

Future research should extend to other regions of Cameroon, incorporate classroom observations and performance assessments to complement self-reported data, and employ longitudinal designs to track implementation changes and learning outcomes over time. Comparative studies across public and private schools, investigations into teacher professional development effectiveness, policy implementation research examining the absence of explicit CCE mandates, and cross-national comparative studies within sub-Saharan Africa would further strengthen the evidence base for climate change education policy and practice.

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