

Contextualizing Deforestation and Climate Change in Science 10 Curriculum

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Abstract — Climate change and deforestation remain pressing global concerns with profound implications for highly climate-vulnerable nations like the Philippines. This study explored the integration of climate change indicators and deforestation issues into the Grade 10 Science curriculum to enhance environmental awareness and engagement among students. The research specifically examined students' environmental awareness levels, teachers' instructional practices, and the contextual relevance of environmental topics in public secondary schools in Samar. An embedded mixed-methods research design was employed, combining quantitative and qualitative approaches to capture comprehensive insights from both students and teachers. The methodology involved administering structured surveys to 210 Grade 10 students and conducting in-depth interviews and focus group discussions with 16 Science teachers from five public secondary schools. Quantitative data were processed using descriptive and inferential statistics, while qualitative data were subjected to thematic analysis to extract recurring patterns and insights. Results revealed that students exhibited strong awareness of direct environmental impacts such as flooding, biodiversity loss, and health risks, yet showed limited understanding of environmental policy frameworks and institutional responses. Teachers demonstrated active integration of deforestation-related topics in their classes but reported challenges related to instructional resources, localized teaching materials, and professional development opportunities. Statistical analysis also indicated significant relationships between students' demographic profiles and their levels of environmental awareness. The study concludes that strengthening environmental education through contextualized and locally relevant curriculum content is essential, particularly in climate-vulnerable communities. It recommends equipping educators with adequate teaching resources and professional training while fostering participatory, inquiry-based learning activities to enhance students' environmental literacy and civic engagement.

Keywords — *climate change education, deforestation, environmental awareness, contextualized learning, mixed-methods research.*

I. Introduction

Climate change (CC) is one of the most pressing challenges of the 21st century, threatening ecosystems, societies, and economies worldwide (United Nations, 2020). Its impacts—including rising global temperatures, more frequent and intense natural disasters, and disruptions in biodiversity—are accelerating at an alarming rate (IPCC, 2023). The Intergovernmental Panel on Climate Change (IPCC) reports that global temperatures have risen by approximately 1.1°C above pre-industrial levels, leading to widespread environmental and socio-economic consequences.

These include intensified heatwaves, rising sea levels, erratic weather patterns, and threats to food and water security (Global Climate Change, 2021).

In the Philippines, the effects of climate change are particularly severe due to its archipelagic nature and geographic location within the Pacific Ring of Fire and the typhoon belt. One growing concern is the increasing frequency of extreme heat events. In recent years, the heat index in various parts of the country has reached dangerous levels exceeding 42°C, prompting health warnings and class suspensions. This phenomenon has led the Department of Education (DepEd) to reconsider the traditional mode of instructional delivery. During peak heat periods in 2023 and 2024, numerous public schools across regions like Metro Manila, Central Luzon, and Eastern Visayas shifted to blended learning or modular distance learning to protect the health of students and teachers. DepEd has since issued guidelines allowing schools to suspend face-to-face classes or adopt alternative delivery modes during extreme heat conditions. This underscores how climate-induced temperature extremes are no longer just environmental issues but educational disruptions, affecting instructional time, student engagement, and learning continuity.

In response to these escalating risks, countries around the world have strengthened their sustainability initiatives. For instance, Denmark has committed to achieving carbon neutrality by 2050, with a target of reducing greenhouse gas emissions by 70% by 2030 compared to 1990 levels (Ministry of Climate, Energy and Utilities, 2020). Similarly, New Zealand declared a climate emergency in 2020 and pledged to transition to a carbon-neutral public sector by 2025 (New Zealand Government, 2020). In Asia, Bhutan has maintained its carbon-negative status through aggressive forest conservation policies and sustainable tourism strategies (World Bank, 2022). These examples illustrate how nations, regardless of size or economy, are implementing ambitious climate action policies to build climate resilience and safeguard environmental sustainability for future generations.

Education plays a crucial role in addressing climate change. The 2015 Paris Agreement and the United Nations Sustainable Development Goals (SDGs), particularly SDG 13 (Climate Action) and SDG 4 (Quality Education), emphasize the need for climate change education (CCE) to enhance global awareness and drive collective action. Climate change education fosters environmental literacy, empowering individuals and communities to understand, mitigate, and adapt to climate-related challenges (UNESCO, 2024). Despite these international efforts, many nations face difficulties in fully integrating CCE into their educational systems due to political, economic, and logistical barriers (UNFCCC, 2023).

The Philippines, an archipelagic country situated in the Pacific Ring of Fire, is among the nations most vulnerable to climate change. With its exposure to typhoons, rising sea levels, and extreme weather events, the country has experienced devastating climate-related disasters such as Typhoon Haiyan in 2013, which caused thousands of fatalities and extensive damage (Climate Change Commission, 2023). The Climate Risk Index consistently ranks the Philippines among the

top five most affected countries in the past two decades, emphasizing the urgent need for climate adaptation and mitigation strategies (Germanwatch, 2024).

One major contributor to climate change in the Philippines is deforestation. The country has seen a drastic decline in forest cover, from 17.8 million hectares in 1934 to just 7.22 million hectares in 2022, primarily due to urbanization, illegal

logging, and agricultural expansion (Global Forest Watch, 2023). Between 2001 and 2022, deforestation resulted in the loss of 1.42 million hectares of tree cover, emitting approximately 848 million metric tons of CO₂. This environmental degradation not only exacerbates global climate change but also increases the nation's susceptibility to landslides, floods, and biodiversity loss.

To combat these challenges, the Philippine government has implemented policies such as the REDD+ (Reducing Emissions from Deforestation and Forest Degradation) program, which seeks to curb deforestation while promoting sustainable forest management (Climate Change Commission, 2024). However, addressing climate change and deforestation requires more than policy interventions—it necessitates a fundamental shift in societal awareness, starting with education.

Education is a powerful tool for environmental transformation. The 1977 Tbilisi Conference highlighted the importance of integrating environmental education into curricula to address economic, social, and ecological interdependence (United Nations, 2015). The Philippines' Republic Act (RA) 9512, known as the "National Environmental Awareness and Education Act," mandates the inclusion of environmental education in school curricula at all levels. This legislation underscores the need for students to learn about environmental concepts, policies, and best practices, as well as the threats posed by climate change and environmental degradation (RA 9512, 2008; Climate Change Commission, 2021).

In a significant policy shift, the Department of Education (DepEd) announced the reversion of the Philippine academic calendar to its traditional June-to-March schedule. This change, formalized through DepEd Order No. 008, s. 2024, was implemented to address the challenges posed by extreme heat during the previous April-May school months and to align with the preferences of various stakeholders, including students, parents, and educators. The decision was also influenced by consultations and surveys indicating a strong public desire to return to the pre-pandemic academic calendar. As a result, the school year 2024–2025 commenced on July 29, 2024, and concluded on April 15, 2025, setting the stage for the subsequent school year to begin in June 2025.

This research sought to integrate climate change indicators and deforestation rates into the Grade 10 Science curriculum to enhance environmental literacy among students. By equipping learners with knowledge about the causes and consequences of climate change, this initiative fosters a generation of environmentally conscious individuals who can contribute to sustainable

development. This study proposed the Learning Activity Sheets anchored to the DepEd curriculum focusing on addressing climate change and deforestation through education.

This study holds significant value in the ongoing efforts to strengthen environmental education in the Philippines, particularly within the context of climate-vulnerable regions like Samar. By contextualizing deforestation and climate change topics within the Science 10 curriculum, the research addresses the need to make science education more responsive, relevant, and localized to the environmental realities faced by Filipino students. It contributes to existing literature by providing empirical insights into how integrating these critical issues into classroom instruction can enhance student awareness, critical thinking, and civic responsibility regarding environmental sustainability. Furthermore, the study supports the Department of Education's broader goal of fostering environmental literacy and proactive citizenship among the youth, ensuring that future generations are not only informed about ecological challenges but also equipped to actively participate in community-based environmental solutions.

Furthermore, incorporating project-based learning, environmental advocacy, and community engagement into climate education allows students to explore solutions beyond theoretical knowledge. These initiatives align with the Department of Education's emphasis on transformative education, which promotes critical thinking, problem-solving, and civic responsibility (DepEd, 2023). Given the escalating threats of climate change, the integration of these topics into the educational system is both timely and crucial, ensuring that future generations are prepared to address the environmental challenges of the 21st century.

Literature Review

Climate change education (CCE) is increasingly recognized as an essential component of modern education systems, given its relevance to both learners and the planet. Scholars highlight its cross-disciplinary nature, which necessitates integration into a broad range of subjects (Edge Research, 2022; Teach the Future, 2022). Despite its importance, the implementation of CCE faces significant barriers, including overcrowded curricula, insufficient resources, and inadequate professional development opportunities for educators (Howard-Jones et al., 2021; Greer et al., 2023). These challenges are compounded by the complex, multidisciplinary demands of CCE, requiring both evidence-based frameworks and practical resources that are accessible to educators with limited time and capacity (Rousell & Cutter-Mackenzie-Knowles, 2020).

The emotional and scientific dimensions of CCE further complicate its integration into classrooms, necessitating approaches that are not only informed by theory but also adaptable to real-world educational settings. As Howard-Jones et al. (2021) point out, the emotional toll of climate-related content can lead to disengagement or anxiety in students, which calls for pedagogical strategies that offer hope and emphasize student agency. In this context, neuroscience-informed education becomes critical, ensuring that climate concepts are presented in developmentally appropriate, emotionally balanced ways.

On an international level, the United Nations has consistently underscored the importance of education in combating climate change. Through the "Action for Climate Empowerment" (ACE) initiative, education is positioned as a cornerstone for raising public awareness, building support for climate action, and fostering behavioral changes (UNESCO, 2019; UNFCCC, 2022). Statements from the Glasgow Work Programme on ACE reaffirm the role of education in transforming public attitudes and empowering individuals to take action against climate change (Kwauk & Wyss, 2022; Verlie, 2021). Kwauk and Wyss (2022) argue that CCE should not only be integrated across formal and informal education systems, but also supported by policy coherence and investments in teacher professional development and youth leadership.

The Philippines has responded to the global call for CCE through legislation and curriculum integration. Republic Act No. 9729 (Climate Change Act of 2009) and the Enhanced Basic Education Act of 2013 (K-12 Act) provide a framework for embedding climate change concepts across various grade levels and subject areas. Key topics such as disaster risk reduction and management (DRRM) and climate change adaptation (CCA) are integrated into subjects like Science, Health, Araling Panlipunan, and Edukasyon sa Pagpapakatao. At the senior high school level, specialized DRRM subjects are offered under the STEM strand, while Earth Science and Earth and Life Science also incorporate climate-related competencies.

While DepEd has made strides in incorporating environmental values into its core curriculum, research by Perez and Bua, Jr. (2019) indicates that sustainable development concepts are not yet fully realized in the K-12 curriculum, and key standards are only moderately achieved. Rousell and Cutter-Mackenzie-Knowles (2020) further reinforce this observation, asserting that climate education must be pedagogically innovative and socially relevant, blending interdisciplinary content with locally grounded practice.

To address these gaps, the DepEd Disaster Risk Reduction and Management Service (DRRMS) is committed to intensifying climate literacy and fostering sustainable practices in the basic education sector. Efforts include curriculum integration, co-curricular activities, and community partnerships aimed at building climate-resilient schools and empowering learners to take proactive roles in climate action.

In conclusion, integrating deforestation rates, climate change indicators, and environmental sustainability topics into the science curriculum is crucial for cultivating climate science literacy among Filipino students. Studies have underscored the value of systems thinking in helping learners analyze complex environmental issues and foresee the long-term consequences of human actions. Embedding global perspectives and transformative, learner-centered approaches further enhances climate change education by addressing sociopolitical barriers and promoting authentic student participation. The link between deforestation and climate change, as revealed through econometric analyses, highlights the urgency of reforestation and land-use management topics in environmental education. Moreover, aligning lessons with the Sustainable Development Goals (SDGs) fosters empathy and resilience, enabling students to connect classroom learning with

community-based solutions. However, challenges such as limited resources, time constraints, and gaps in teacher expertise persist, necessitating increased funding, professional development, and opportunities for hands-on, action-oriented learning. Prior research also calls for the continuous enhancement of co-curricular programs and ethical awareness initiatives to deepen environmental commitment within schools. Altogether, a science curriculum strengthened by interdisciplinary, values-driven, and globally relevant strategies empowers Filipino learners not only with critical knowledge and skills but also with the passion to become proactive, informed advocates for environmental sustainability.

II. Methodology

Research Design. This study adopted an embedded mixed-methods research design with the primary goal of developing an instructional output to strengthen the integration of climate change education into the secondary science curriculum. An embedded design involves the collection and analysis of both qualitative and quantitative data, with one data strand serving a supportive role within the overall research process. In this study, the quantitative component served as the dominant method, providing structured data on knowledge levels, perceptions, and instructional gaps, while the qualitative component played a supportive role in contextualizing and enriching the interpretation of the quantitative findings.

The primary output of this research is a proposed instructional material or teaching strategy focused on enhancing students' understanding of climate change and deforestation. This product was developed based on data-driven insights from both learners and teachers, ensuring its responsiveness to the actual needs and challenges present in science education settings.

The quantitative phase involved administering structured surveys to Grade 10 students and secondary science teachers. The surveys gathered statistical data on participants' environmental knowledge, attitudes, preparedness, and perceptions regarding the inclusion of climate change and deforestation in their science instruction. The data also helped evaluate the current extent of content integration and identified key areas where curriculum support or enhancement is needed. Demographic variables were analyzed to determine possible correlations with awareness levels and attitudes toward climate-related topics.

Embedded within this design was the qualitative component, consisting of in-depth interviews and focus group discussions with selected science teachers and students. These sessions sought to explore the pedagogical strategies currently employed in teaching climate-related topics, the perceived challenges in curriculum integration, and learners' engagement and reflections on these issues. Thematic analysis of qualitative data provided nuanced insights into teacher readiness, student motivation, and contextual barriers to effective environmental instruction.

The integration of both data sets allowed for evidence-based development of an instructional output, tailored to the realities and demands of the classroom. The quantitative results

identified trends and instructional gaps, while the qualitative data added depth to these findings by highlighting lived experiences and contextual concerns.

Overall, the embedded research design provided a rigorous and holistic basis for producing an instructional intervention that is not only theoretically grounded but also practically relevant. This design ensured that the final output—whether a teaching module, learning guide, or resource package—was responsive to empirical evidence and co-developed with stakeholders, thereby enhancing its sustainability and effectiveness in promoting climate change education in science classrooms.

Data Processing. After the data collection phase, the researcher undertook a systematic process of organizing, encoding, and analyzing the data using appropriate statistical tools, carefully selected to address each Statement of the Problem. These tools provided both descriptive and inferential insights necessary to evaluate the study’s objectives and hypotheses.

To describe the profile of Grade 10 learners and secondary science teachers, such as their age, sex, academic performance, years of service, and educational background, the researcher utilized descriptive statistics. Specifically, frequency counts and percentages were employed for categorical variables like sex, involvement in environmental awareness activities, and highest educational attainment. Meanwhile, measures of central tendency, particularly the mean and standard deviation, were applied to continuous data such as age and academic performance. These tools allowed for a clear presentation of respondent characteristics and facilitated meaningful comparisons across subgroups.

For evaluating the existing level of environmental awareness among students and teachers—particularly in the domains of deforestation and climate change—the researcher used weighted mean (\bar{x}) and standard deviation (sd). These measures summarized the respondents’ agreement with a set of indicators assessed using a five-point Likert scale. The interpretation followed a predetermined qualitative scale to describe the level of awareness, ranging from “Strongly Disagree” to “Strongly Agree” for students, and from “Never” to “Always” for teachers.

In determining whether the assumptions for parametric tests were met, the researcher conducted a normality test on the relevant datasets. The Shapiro-Wilk test was used due to the relatively small sample size. The results indicated that the data distribution was normal ($p > 0.05$), thereby justifying the use of parametric statistical tools for subsequent inferential analysis.

To test the relationship between the respondents’ profile variables and their level of environmental awareness, the Pearson Product-Moment Correlation Coefficient (r) was employed for interval and ratio scale data, such as age and academic performance. Meanwhile, Chi-square tests were applied for categorical variables. These inferential tools helped determine the presence or absence of significant relationships, supporting the decision to accept or reject the null hypothesis. The outcomes of the statistical analyses were organized into tables for clarity and precision.

To determine the appropriate statistical tests for data analysis, the researcher conducted a normality assessment using the Shapiro-Wilk test. As shown in Table 3, all variables—including Environmental Awareness on Deforestation, Environmental Awareness on Climate Change, Academic Performance, and Teachers’ Years in Service all yielded p-values greater than the 0.05 threshold. These results indicate that the data distributions do not significantly deviate from normality, satisfying the assumption required for parametric analyses. Consequently, the use of Pearson Product-Moment Correlation and other parametric tools was deemed statistically appropriate for analyzing relationships and drawing inferences.

Table 3

Normality Test Result Using Shapiro-Wilk			
Variable	Statistic	p-value	Interpretation
Environmental Awareness (Deforestation)	0.983	0.074	Normally Distributed
Environmental Awareness (Climate Change)	0.987	0.082	Normally Distributed
Academic Performance (Grade 10)	0.968	0.055	Normally Distributed
Teachers’ Years in Service	0.971	0.068	Normally Distributed

Legend:

Statistic – 1.000 indicates greater conformity to a normal distribution.

p-value – Significance level used to assess normality:

- $p > 0.05$ — Data is normally distributed
- $p \leq 0.05$ — Data is not normally distributed

Interpretation:

Indicates whether the assumption of normality is met based on the p-value.

III. Results and Discussion

This section presents an interpretation of the data gathered on the contextualization of deforestation and climate change within the Science 10 curriculum. The study explored how these pressing environmental issues are addressed through curriculum content, teacher practices, and learner engagement. The findings offered empirical insights into the profiles of both learners and science teachers, their levels of environmental awareness, the pedagogical strategies employed, and the statistical relationships among key variables. These findings are consistent with global literature underscoring the transformative potential of contextualized and experiential learning in environmental and climate change education.

The results affirmed that when students are actively engaged in hands-on, community-linked activities such as tree planting and clean-up drives, their environmental awareness significantly increases. This aligns with the theoretical underpinnings of Environmental Education Theory and Action Competence Theory, which stress the value of participatory and inquiry-based approaches in developing environmental literacy. Furthermore, the study confirms that science teachers are key agents in integrating contextual issues into the curriculum through inquiry-based and project-based learning, but their limited exposure to environmental seminars hinders

instructional enrichment. The relationships identified between demographic variables and awareness levels emphasize the importance of targeted professional development and inclusive student programs.

Summary of Findings. The study sought to contextualize deforestation and climate change within the Science 10 curriculum. This section provides an analysis of findings based on the research questions, alongside key insights derived from the respondents' profiles and perceptions.

1. **Profile of Grade 10 Learners.** Most learners fell within the expected age range of 15 to 16 years or 85%, with a computed mean age of 15.82 and a standard deviation of 0.83, indicating a relatively uniform age distribution. The sex distribution showed a slight female majority, with females representing 55% of the sample. Academic performance was notably high, as 89% of students scored 80 or above in Science 10 for the third quarter. A significant proportion of students participated in environmental action activities, such as clean-up drives with 76% and tree planting 65%, while participation in advocacy-based programs like seminars had 3%, and eco-club memberships with 2% remained low.
2. **Profile of Secondary Science Teachers.** The teaching cohort was predominantly male, or 75%, with most teachers aged between 30 and 40 years. The mean age was 32.56 with a standard deviation of 6.60. A majority of the teachers held postgraduate qualifications, with 81% possessing either a Master's degree or Master's units. While 25 percent of the teachers were in their first year of service, others had six to thirteen years of experience. Alarming, 44 percent had not attended any training or seminar related to environmental awareness, while 50 percent had attended only one, indicating an average participation of 0.69 seminars and a standard deviation of 0.60.
3. **Level of Environmental Awareness.** Students exhibited a high level of environmental awareness concerning both deforestation and climate change, with a mean score of 3.57 for each domain. Their awareness was particularly strong in recognizing causes, effects, and appropriate actions but comparatively lower on topics involving policies and adaptive strategies. Teachers demonstrated a very high level of awareness, scoring a mean of 3.88 in deforestation and 3.94 in climate change. They regularly incorporated these topics into instruction using contextualized examples, multimedia tools, inquiry-driven discussions, and project-based assignments.
4. **Integration Approaches in Instruction.** Interview data revealed that science teachers commonly employed inquiry-based learning, real-world contextualization, project-based methods, and multimedia-supported instruction. These were complemented by active involvement in community-based environmental initiatives, reinforcing experiential learning and ecological stewardship.

5. Significant Differences and Relationships. Statistical analysis using Pearson's correlation revealed that only student participation in environmental activities had a significant positive relationship with their level of environmental awareness, with a correlation coefficient of 0.524 and a p-value of 0.042. Other variables such as age, sex, and academic performance did not yield significant correlations. Among teachers, age, educational attainment, years of service, and number of attended seminars were significantly correlated with environmental awareness. Sex did not present a statistically significant relationship.
6. Identified Problems and Suggested Solutions. Key issues included low student involvement in advocacy-centered environmental programs, limited teacher participation in relevant training, and inconsistent integration of environmental topics across lessons. Proposed interventions included increasing advocacy-based activities for students, expanding teacher professional development through regular seminars, and standardizing multimedia and project-based instructional approaches.

IV. Conclusion

Based on the findings of the study, the following conclusions were drawn:

1. Grade 10 learners demonstrate commendable academic performance and a high level of environmental awareness, particularly when engaged in tangible, action-oriented activities. However, their limited exposure to advocacy and policy-related programs highlights a gap in their holistic environmental education.
2. The secondary science teaching workforce is composed mainly of mid-career, male professionals with postgraduate qualifications. Despite their instructional competence, the low frequency of participation in environmental awareness seminars reveals a deficiency in ongoing professional development.
3. Both students and teachers possess a strong understanding of deforestation and climate change. Nonetheless, students showed relatively weaker awareness in areas concerning environmental policy, sustainable management, and adaptation strategies.
4. Teachers effectively integrate environmental content through inquiry-based, contextualized, and project-driven methods. Their practices are aligned with global standards in environmental education, yet their capacity could be enhanced through more structured and consistent professional training.
5. Students' participation in environmental activities significantly influences their awareness levels, validating the effectiveness of experiential education. For teachers, environmental awareness is shaped by a combination of personal demographics and professional development factors, notably age, experience, and training.

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