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RESEARCH ARTICLE

Teachers' Perspectives and Self-Reported Practices in Climate Change Education: Basis for the Development of CEASE Conceptual Model

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Abstract

Climate change remains a critical global challenge requiring integrated responses, with education playing a central role in fostering climate literacy. This study examined the climate change perspectives and self-reported practices of 102 public secondary science teachers and developed a conceptual model to enhance climate change education. Using a descriptive-correlational and comparative design, data were collected through a validated questionnaire (α=.94). Findings revealed highly positive personal and professional perspectives (M = 4.33), while overall reported practices were only moderate (M= 3.40). Teachers demonstrated high engagement in curriculum development (M= 3.64), but only moderate practices in instructional materials development (M= 3.37), teaching strategy innovation (M= 3.18), and the implementation of teaching-learning activities (M = 3.39). A significant positive relationship was found between teachers' perspectives and practices (r=.573, p < .01), with perspectives accounting for 32.9% of the variance (r^2=.329). While no significant differences in practices were observed between male and female teachers overall, a statistically significant difference emerged in instructional materials development (t=3.56, p < .01), with male teachers reporting higher engagement. Key challenges included limited innovative strategies, time constraints, and insufficient training, revealing an "action-practice gap." In response, the Climate Education Action for Sustainable Engagement (CEASE) conceptual model is proposed to enhance pedagogical integration through curriculum alignment, contextualized instructional materials, methodological innovation, participatory learner-centered activities, and research capability building. The study contributes both empirical evidence and practical model aligned with Sustainable Development Goal 13 (Climate Action).

Keywords Climate Change Education · Pedagogical Integration · Teachers' Practices · CEASE Conceptual Model · Sustainable Development Goal 13

1. Introduction

Climate change continues to intensify, posing a threat to human well-being and the planet's ecosystems (National Aeronautics and Space Administration [NASA], 2024; World Health Organization [WHO], 2023), and sustainable development. Addressing this global crisis requires integrated action across multiple sectors (Ballard & Bratosin, 2024; Qi & Terton, 2022) with education playing a critical role in fostering climate literacy, critical thinking, and pro-environmental behavior. Educational institutions are uniquely positioned to equip learners with knowledge, skills, and values to respond to climate-related issues and contribute to long-term sustainability efforts (United Nations Educational, Scientific and Cultural Organization [UNESCO], n.d.; United Nations Office for Disaster Risk Reduction [UNDRR], n.d.). Integrating climate change awareness in

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various educational curricula and promoting climate change action are essential in encouraging children, youth, parents, communities, and other stakeholders to actively participate in and support legislation and programs.

Despite growing global awareness, significant gaps persist among educators and the youth. At the November 2020 Youth Climate Summit, many young people were deeply concerned about the climate crisis, asserting that sufficient action has yet to be taken. Furthermore, reports indicate that 75% of teachers felt they had not received adequate training to educate students about climate change, while 69% of teachers believed there should be more climate change instruction in schools. Similarly, 68% of pupils expressed a desire to learn more about the environment and climate change (Campaign Against Climate Change, 2021). These figures imply the need to strengthen integration of climate change into educational curricula, responding to the call of the Climate Change Commission ([CCC], 2024) for teachers to integrate climate change-related learning areas into their curriculum and aligning this to the Sustainable Development Goal 13, on Climate Action (United Nations, n.d.; International Organization for Standardization [ISO], n.d.).

Recent studies identify knowledge gaps and the need for institutional support. Jaelani and Djayaningrat (2025) reported that the majority of teachers across Southeast Asian countries expressed a positive outlook on the integration of climate change education but faced barriers such as inadequate professional development programs, insufficient instructional materials, and curriculum limitations. Winter et al. (2026) found that Austrian pre-service teachers were more likely to teach climate change if they possessed relevant knowledge, valued its importance, and had access to resources; social expectations and controversy did not influence teaching intentions. Tang (2025) revealed that while positive attitudes strongly predicted willingness to act, teachers continue to demonstrate significant misconceptions about climate change. Chowdhurry et al. (2021) found that Bangladesh teachers' perceptions of the causes and consequences of climate change and its mitigation were influenced by sociodemographic characteristics and academic-related factors, with public school teachers possessing greater awareness and understanding of climate change than private school counterparts.

Philippine studies mirror these global trends. Tero and Lastierre (2025) reported that teachers faced high levels of difficulty in content pedagogy, teaching environment, and instructional resources. Garcia-Vinuesa (2024) identified constraints, including curricular constraints, limited school time, controversy surrounding the phenomenon, and lack of training. Romero (2025) observed that secondary school teachers in Masbate exhibited preparedness and strong positive perception of climate-related content but low familiarity of SDG-13 conceptual model. Among students, Espinosa and Caisip (2023) found knowledge gaps on the impacts of climate change on agriculture, coastal resources, forestry, infrastructures, and health. Diquito (2021) revealed through a qualitative study that teachers used experiential learning in climate change integration to compensate for inadequate preparation.

In response to these gaps, this study examines the perspectives of secondary school teachers in Central Luzon, Philippines, regarding climate change and their reported pedagogical practices. Specifically, it investigated the relationship between teachers' perspectives and their reported practices across four key domains: curriculum development, instructional materials, teaching strategies, and teaching-learning activities, while identifying the challenges encountered in integrating climate change education.

Building on these empirical findings, the study proposed the Climate Education Action for Sustainable Engagement (CEASE) conceptual model. This model is an empirically informed and context-responsive structure designed to bridge the action-practice gap by integrating key pedagogical domains with the challenges experienced by teachers. Rather than engaging with a fully validated framework, the CEASE conceptual model serves as an exploratory guide to support the enhancement of climate change education practices and inform future research, policy, and professional development initiatives.

By positioning teachers as central agents in climate education, this study contributes to the growing body of literature focused on strengthening educational responses to climate change and advancing Sustainable Development Goal 13 (Climate Action).

2. Research Problem

The study examined the secondary school science teachers' perspectives on climate change and the extent of their reported practices in climate change action.

2.1. Research Questions:

1. What are the perspectives of the secondary school teachers regarding climate change in terms of:
   1.1. Personal perspectives; and
   1.2. Professional perspectives?
2. What are the self-reported practices of teachers in climate change education across the following pedagogical domains:
   2.1. Curriculum development;
   2.2. Instructional materials development;
   2.3. Teaching strategy innovation; and
   2.4. Teaching and learning activities?
3. Is there a significant relationship between teachers' perspectives and their reported practices in climate change education?
4. Is there a significant difference between the teachers' reported practices when grouped according to sex?
5. What challenges do teachers encounter in integrating climate change education into their pedagogical practices?
6. Based on the findings, what conceptual model can be developed to enhance teachers' practices in climate change education?

2.2. Null Hypotheses

1. There is no statistically significant relationship between teachers' perspectives on climate change and their self-reported practices in Climate change education.
2. There is no statistically significant difference in teachers' self-reported practices in climate change education when grouped according to sex.

3. Methodology

3.1. Research Design

This study employed a descriptive-correlational and comparative design to examine secondary school teachers' perspectives on climate change and their practices in climate change action. The design enabled the description of teachers' personal and professional perspectives and practices, analysis of the relationship between perspectives and practices, and comparison of practices levels across gender groups.

3.2. Respondents

The study was conducted among public secondary school teachers within a schools division in Central Luzon, Philippines. The respondents were selected using snowball sampling, a non-probability sampling technique appropriate for accessing individuals with specific qualifications — particularly science teachers actively engaged in climate change education.

Initial respondents were identified based on their professional background and were requested to refer other qualified teachers within their networks. This approach enabled the researchers to reach respondents who met the inclusion criteria despite the absence of a comprehensive sampling frame.

A total of 102 teachers participated in the study, consisting of 68 females (66.7%), 30 males (29.4%), and 4 identifying as LGBTQ+ (3.9%). While no formal statistical sample size calculation was applied due to the non-probability nature of the sampling technique, the sample size was deemed adequate for descriptive, correlational, and comparative analysis. Methodological literature suggests that samples exceeding 100 respondents are generally sufficient to detect moderate relationship in correlational studies (Hole, n.d.; Sathyanarayana et al., 2024).

However, the researchers acknowledge that snowball sampling may introduce selection bias, particularly the homophily effect, where the respondents are more likely to refer colleagues with similar characteristics,

experiences, or perspectives. This may limit variability in responses and affect the generalizability of the findings. Therefore, the results are interpreted within the context of non-probability sampling, and future studies are encouraged to employ probability- based techniques to enhance representatives,

3.3. Instrumentation

A self-made questionnaire was developed to gather data, structured into two main parts. Part I consisted of 10 items designed to elicit information on teachers' perspectives. These were categorized into two domains: personal-related perspectives (5 items), focusing on individual beliefs, lifestyle choices, and community roles and teaching-related perspectives (5 items), focusing on professional responsibilities and the school's role as a catalyst of awareness. Part II consisted of 20 items intended to yield data on the teachers' practices in climate change education or actual practices categorized into four key areas: curriculum development and innovation (5 items), developing and utilizing instructional materials (5 items), teaching strategies innovation (5 items), and teaching and learning activities (5 items). A Five-point Likert Scale was used to measure the responses. For Part I, (perspectives), a score of 5 was described as "Strongly Agree" while 1 was "Strongly Disagree." For Part II (practices), a score of 5 was described as "Very High Practice," and while 1 was "No Practice."

It is important to note that the measure of teachers' practices in climate change education was based on self-reported practices using a Likert scale questionnaire. As such, the data reflect perceived or reported engagement rather than direct observation of actual classroom practices.

3.4. Validation of Instrument

A self-developed questionnaire underwent a rigorous process of face and content validation. Five experts in Climate change action evaluated the instrument to ensure appropriateness, clarity, relevance, and alignment of the items with the objectives of the study. Expert validation yielded a mean of 4.56, indicating excellent face and content validation. To establish the reliability of the instrument, a pilot test was conducted among teachers from the Schools Division of Tarlac Province who were not included in the actual study. Data from the dry run were subjected to reliability analysis using Cronbach's Alpha. The computed reliability coefficient was $\alpha = 0.94$, signifying excellent internal consistency and confirming that the instrument is highly reliable.

3.5. Data Gathering Procedure

The validated questionnaire was administered online using Google Forms to facilitate efficient and systematic data collection. The first section of the electronic form contained the informed consent agreement, which detailed the purpose of the study, the voluntary nature of participation, and the participants' right to withdraw at any time. Respondents were required to read and acknowledge this consent before they can proceed to the survey items. This ensured that all data gathered came from individuals who had been fully informed of the study's protocol. To maintain anonymity, no names or any identifying information were collected. After a week, the researchers downloaded the responses, which were then tabulated and subjected to statistical analysis.

3.6. Data Analysis

To analyze and interpret the gathered data, various statistical tools were employed using the Statistical Package for the Social Sciences (SPSS). The following statistical tools were utilized:

3.6.1. Descriptive statistics Weighted mean and standard deviation were used to determine the central tendency and the consistency of the teachers' perspectives (Part I) and the extent of their practices in climate change education (Part II).

3.6.2. Inferential Statistics Pearson Product - Moment Correlation (Pearson's *r*), and linear regression were used to determine the strength and direction of the relationship between teachers' perspectives and their practices. The *p*-value was utilized to test the significance of the relationship at α=0.05 level.

3.6.3. Comparative Analysis Due to the small number of respondents representing the LGBTQ+ group (n=4), comparative analysis of the teachers' practices in climate change education was restricted to male and female respondents. The *t*-test for independent means was used. While the responses of the LGBTQ+ groups were retained for descriptive analysis, they were excluded from inferential testing to ensure robustness and validity of the findings.

3.7. Ethical Consideration

Strict ethical standards were observed throughout the conduct of the study. Informed consent was obtained from the respondents before data collection, explicitly stating that the participation was entirely voluntary and that there were no foreseeable risks involved. Moreover, research protocol received a certificate of ethical clearance from the TSU-Research Ethics Review Committee, ensuring that the study adhered to institutional and national ethical guidelines for human subject research.

4. Results and Discussion

4.1. Teachers' Perspectives on Climate Change

Table 1. Teachers' Climate Change Perspectives

Indicators	Mean	Standard Deviation	Verbal Description
Personal-Related perspectives			
I feel that I have a crucial role in climate change mitigation by observing laws enacted to prevent further environmental pollution that contributes to global warming.	4.64	0.62	Strongly agree
I study climate change to have a better understanding about its causes and effects. I know that greenhouse gases cause global warming and thereby resulting to climate change.	4.32	0.69	Strongly Agree
I am convinced that planting trees or any plant is a very vital in climate change action. Trees effectively absorb carbon dioxide.	4.33	0.65	Strongly Agree
I feel that encouraging my family members to participate in waste recycling, reuse, reduce and segregation at home and in the community are significant climate change mitigation/action.	4.22	0.67	Strongly Agree
I feel that volunteering in my community for any activity that relates to climate change mitigation is a part of my role in climate change action.	4.02	0.67	Agree
Composite mean	4.31		Strongly Agree
Professional -Related Perspectives			
I know that the school is a vital avenue of raising the awareness of students about climate change, so I make sure my students take the initiative in becoming role models among their families and peers in observing laws pertaining to climate change mitigation.	4.71	0.46	Strongly agree
I feel there is a need to integrate climate change in my lessons to include updating students with issues and challenges about global warming.	4.67	0.58	Strongly agree

Table 1 (cont.). Teachers' Climate Change Perspectives

Indicators	Mean	Standard Deviation	Verbal Description
Professional -Related Perspectives			
I should be a teacher that supports clean environment to avoid aggravating global warming and I need to help in leading school stakeholders for active practices in programs or activities geared towards climate change mitigation.	4.63	0.54	Strongly agree
I feel that I am obliged to include programs and activities in the classroom that will make them aware of climate change so they can contribute to the efforts of the government in climate change mitigation.	4.51	0.56	Strongly agree
I am convinced that teachers need to involve in research on climate change mitigation that is why I also want to try to conduct one myself.	3.23	0.62	Neutral
Composite Mean	4.35		Strongly Agree
Grand Mean	4.33		Strongly Agree

The data in Table 1 indicates that teachers generally held positive and favorable perspectives toward climate change and its mitigation, as reflected in a grand mean of 4.33 (strongly agree). This demonstrates a strong level of awareness and a generally affirmative disposition toward engaging in a climate-related practices both at the personal and professional levels.

In terms of personal -related perspectives, the composite mean of 4.31 (strongly Agree) reveals that teachers recognize their individual responsibility in addressing climate change. The highest-rated item (*M=4.64, SD=0.62*) shows that teachers strongly acknowledged their role in complying with environmental laws to mitigate pollution. This implies a high level of environmental accountability among teachers. Additionally, teachers claimed to have adequate conceptual understanding of climate change, particularly greenhouse gases and global warming (*M=4.32; SD=0.69*) and recognized the importance of ecological practices such as tree planting and waste management. However, relatively low scores on community engagement activities (*M=4.02; SD=0.67*) indicate that while awareness was high, active participation in community-based climate initiatives may still require strengthening.

For professional-related perspectives, the composite mean of 4.35 (Strongly Agree) indicates an even stronger inclination toward integrating climate change education into classroom practice. Teachers acknowledged that since schools are vital channels in raising student awareness about climate change, they endeavored to become role models (*M=4.71; SD=0.46*), and they expressed a high level of commitment to embedding climate change concepts into their lessons (*M=4.67; SD=0.46*). These findings highlight the recognition of their pedagogical role in shaping environmentally responsible learners.

However, a notable exception was observed in the teachers' perspectives on climate change research which received a neutral rating (*M* =3.23, SD=0.62). This suggests a potential gap in research engagement, possibly due to constraints such as limited training, time, or institutional support.

Overall, the findings suggest that teachers exhibited strong awareness and positive attitude towards climate change and its integration into teaching. The positive perspectives of the teachers on climate change education are consistent with the results of the study conducted by Ahmed et al. (2021), where teachers were found to have a sound understanding of climate change and there is a consensus among them that climate change is a global challenge caused mostly by anthropogenic activities. However, there remains a need to enhance teachers' capacity for research involvement and community-based engagement. Strengthening these areas could further support the translation of perspectives into sustained and impactful climate action practices, aligning with the broader goals of climate change education and sustainability initiatives.

4.2. Teachers' Self-Reported Practices in Climate Change Education

The teachers' self-reported practices in climate change education was examined along with their participation in integrating climate change in curriculum development, teaching strategies, instructional materials development, and in teaching and learning activities or tasks. The data are shown in Table 2.

Table 2. Teachers' Self- Reported Practices in Climate Change Education

Indicators	Mean	SD	Verbal Description	Extent of Practices
Curriculum Development and Implementation				
I help in gathering data for the needs assessment as inputs to curriculum development and enhancement.	4.04	0.42	Often	High
I help my school head in implementing school programs that realize the integration of climate change in our curricular activities.	4.00	0.37	Often	High
I help my school head in monitoring the implementation of the integration of climate change in the curriculum.	3.80	0.37	Often	High
I update my lesson plan to include latest development about climate change or global warming anchored in our curriculum	3.63	0.77	Often	High
I am actively involved in analyzing the needs assessment survey for effective integration of climate change and global warming in our curriculum.	2.75	0.62	Sometimes	Moderate
Composite Mean	3.64		Often	High
Developing and Utilizing Teaching Materials				
I update my instructional materials to include latest issues about climate change.	4.01	0.22	Often	High
I consider my students' interests on climate change in developing teaching materials.	3.44	0.57	Sometimes	Moderate
We evaluate the instructional materials related to climate change together with my students.	3.39	0.62	Sometimes	Moderate
I/We use environment friendly materials to develop my teaching aids.	3.13	0.40	Sometimes	Moderate
I survey the learning needs of my students relative to climate change in developing teaching materials.	2.87	0.41	Sometimes	Moderate
Composite Mean	3.37		Sometimes	Moderate
Teaching Strategies Innovation				
I use film or video viewing to show to my students the updates related to climate change and global warming.	4.21	0.40	Often	Very high
I innovate my teaching strategies in such a way that I capture the interest of my students on climate change.	4.12	0.32	Often	High
I use portfolio approach in teaching students about climate change. I ask them to document information related to environment, climate change and global warming.	3.68	0.51	Often	High
I use field trip (community, city, provincial, regional, or national) to enhance the learning of my students about environment and effect of climate change.	2.17	0.49	Seldom	Low
I use role playing strategy in explaining to my students about effects of climate change.	1.74	0.79	Seldom	Low
Composite Mean	3.18		Sometimes	Moderate
Teaching-Learning activities				
I ask my students to recycle solid waste and show their products in class.	4.25	0.45	Often	Very high
I lead my students to plant trees, ornamental plants, or vegetables at home and in the community by being an example in doing this in school premises or at home.	4.07	0.32	Often	High

Table 2 (cont.). Teachers' Self- Reported Practices in Climate Change Education

Indicators	Mean	SD	Verbal Description	Extent of Practices
Teaching-Learning activities				
I lead or encourage students joining programs or activities that promote climate change awareness such as slogan -making contests, poster-making, and others in class.	3.98	0.37	Often	High
I guide my students in doing research related to climate change and mitigation.	2.39	0.64	Seldom	Low
I enjoin my students in classroom debates to enhance their awareness of climate change.	2.38	0.63	Seldom	Low
Composite Mean	3.39		Sometimes	Moderate
Grand Mean	3.40		Sometimes	Moderate

Based on the teachers' self-reported practices in climate change education, the grand mean of 3.40 indicates a moderate level of engagement. This indicates that while teachers possessed generally positive perspectives as shown in Table 1, the translation of these perspectives into consistent classroom and school practices remains limited, suggesting a potential theory-practice gap.

In terms of curriculum development and implementation, the composite mean of 3.64 (Often, high extent) suggests that teachers were relatively active in supporting school-level efforts to integrate climate change into the curriculum. Teachers claimed to have often participated in program implementation (*M=4.0, SD=0.37*) and helped gather data for needs assessment studies (*M=4.04, SD=0.42*). However, a lower mean score was observed in teachers' involvement in analyzing needs assessment data (*M=2.75, SD=0.62*), implying that while teachers were engaged in procedural aspects, their participation in more technical or analytical tasks was less consistent. The findings align with the results of the study by Vergara and Sublay (2024) that teachers faced challenges in research practices due to heavy workload, lack of support, limited knowledge of the research process, lack of confidence, and insufficient skills.

Teachers' reported practices in developing and utilizing instructional materials that integrate climate action had a composite mean of 3.37, indicating moderate practice. The highest self-reported practices involved updating materials with the latest climate change issues (*M=4.01, SD=0.22*). However, teachers had lowest involvement in surveying student learning needs prior to development of instructional materials (*M=2.87, SD=0.41*). This reflects a teacher-centered approach where content is updated based on global news rather than specific student diagnostic data.

Similarly, teachers reported moderate involvement in innovating teaching strategies to integrate climate change, with a composite mean of 3.18. This domain exhibited the greatest variability in teachers' practices. Technology-driven using film/video (*M=4.21, SD=0.40*) and strategy innovation capturing students' interests (*M =4.12, SD=0.32*) were high. These are manageable within a classroom setting. Field trips (*M=2.17, SD=0.49*) and role-playing (*M =1.74, SD=0.49*) were the lowest scores. Teachers had shown low implementation of field trips because of strict requirements in securing permits from authorities, high cost, safety protocols, and time requirements. On the other hand, role-playing was reported to be difficult to facilitate and time-consuming.

The composite mean for integrating climate change action into teaching and learning activities was 3.39, also indicating moderate practices. Under this category, the highest self-reported practices was in asking students to recycle solid waste and show their products in class (*M =4.25, SD=0.45*), followed by leading students to plant trees, ornamental plants, or vegetables at home and in the community (*M=4.07, SD=0.32*). These activities are aligned with action-oriented climate education. However, more cognitively demanding activities, such as guiding students in research (*M=2.39, SD=0.64)* and facilitating classroom debates (*M=2.38, SD=0.67)*, were less frequently practiced. This indicates that while teachers emphasize behavioral and participatory activities, there comparatively less focus on critical thinking, inquiry-based learning, and higher-order skills development.

Overall, the results indicate that although teachers were actively involved in certain aspects of climate change education, there remains a need to enhance depth, consistency, and diversity of instructional practices.

This finding align with the study of Delos Reyes (2025) who found that teachers' proficiency in collaborative work and applying scientific concepts in real-world setting were moderately low.

Increasing teacher capacity in research facilitation, learner-centered material development, and experiential learning strategies may help bridge the gap between positive perspectives and actual classroom implementation. Consequently, there is a pressing need for administrative support and targeted professional development to translate these positive teachers' perspective into more consistent and diverse climate change action.

4.3. Relationship of Teachers' Perspectives and their Self- Reported Practices in Climate Change Education

The examine the relationship between teachers' perspectives on climate change and their corresponding pedagogical practices, a Pearson Product - Moment Correlation (Pearson's r) was performed. This was followed by a Simple Linear Regression analysis to determine the extent to which perspectives significantly predict the frequency of climate change education practices. All statistical tests were two tailed, with the level of significance established at α=0.05 level. The following sections present the correlation matrix and the regression model parameters.

Table 3. Relationship between Teachers' Perspectives and their Climate Education Practices

Parameter	Value
Pearson Correlation Coefficient (r)	0.573
r^2	0.329
p	< .01**

Table 3 presents a moderate, positive, and statistically significant correlation between the two variables *(r=.573, p < .01),* suggesting that teachers with more favorable perspectives toward climate change were more likely to report higher levels of engagement in climate change education practices. The positive direction indicates a stronger awareness, sense of responsibility, and positive attitudes toward climate change. This supports the assumption that cognitive and affective dispositions served as important drivers of pedagogical behavior.

The moderate magnitude of the relationship suggests that perspectives account for 32.9% of the variance in practices. This indicates that 67.1% of the variance remains unexplained. This indicated that factors beyond individual perspectives substantially influenced pedagogical practices in climate change education. The residual influences may include institutional factors such as administrative support, school policies, and curriculum mandates; resources availability, including access to instructional materials and digital resources; professional development opportunities, particularly training in climate change pedagogy; time constraints and workload, which limit teachers' capacity to innovate or implement additional activities; and pedagogical competence and self-efficacy, especially in facilitating higher-order learning tasks such as research debates.

The findings align with the challenges identified in Table 5, particularly the lack of teaching strategies and limited time, suggesting that structural and systemic barriers play critical role in shaping classroom practices. This reinforces the argument that improving teachers' perspectives alone is insufficient. Multilevel interventions are necessary to enhance actual practice. These insights directly informed the CEASE model, which incorporates both individual and systemic components to address this complexity.

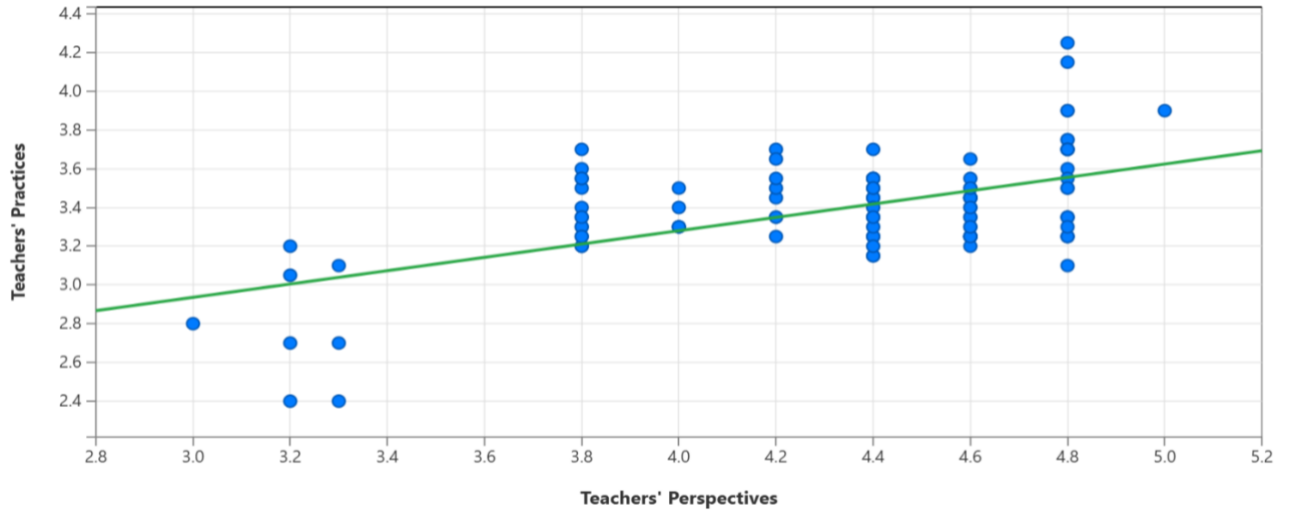

Figure 1. Scatter Plot Diagram of the Linear Regression Analysis of Teachers' Perspectives and Practices

The scatterplot visually represents the relationship between teachers' perspectives (X-axis) and practices (Y-axis). The regression equation is expressed as Y= 1.90 + 0.33 X, indicating a positive linear relationship between the variables. The intercept (1.90) represents the baseline level of practices when perspectives are zero. The slope coefficient (0.33) indicates that for every one-unit increase in teachers' perspectives, their reported practices increase by 0.33 units. The upward slope of the line indicates a positive relationship between the two variables (perspectives and practices). Teachers with higher perspective scores tend to report higher practices scores. However, as earlier emphasized, the relationship is only moderate, indicating that while perspectives predict practices, other factors may also influence practices.

Overall, while the findings revealed a significant relationship between teachers' perspectives and their reported engagements, the results should be interpreted as indicative rather than predictive due to self-reported nature of data. The observed "action-engagement gap" indicate that positive perceptions alone may not be sufficient to translate into consistent pedagogical practices, highlighting the role of structural and institutional constraints such as time, training, and resource availability.

4.4. Comparison of the Teachers' Reported Practices on Climate Change based on Sex

The reported practices of the teachers in climate change action was compared based on their sex using an Independent Samples t-test. The LGBTQ+ group (n=4) was excluded from inferential analysis due to insufficient sample size and retained only for descriptive purposes to ensure statistical robustness. The data are shown in Table 4.

Table 4. Comparison of the Teacher's Practices in Climate Change Education Grouped by Sex

Area of Practices	*t*-value	*p*-value	Decision	Interpretation
Curriculum Development	0.59	.554	Accept H_o	Not significant
Development of Instructional Materials	3.56	.005**	Reject H_o	Significant
Teaching Strategies Innovation	1.55	.131	Accept H_o	Not significant
Teaching and Learning Activities	0.10	.923	Accept H_o	Not significant

***** Significant at 0.01 level (2-tailed)

The results indicate that there is no significant difference between the practices of the male and female teachers in curriculum development (t=0.59, p=.554), innovation of teaching strategies (t=1.55, p=.131), and implementation of teaching -learning activities (t=0.10, p=.923). However, a significant difference was found

in the development of instructional materials (t=3.56, p=.005). Male teachers had a higher mean score on the development of instructional materials (M=3.77) than the female (M=3.38) teachers. The findings indicate that while teachers demonstrated a relatively uniform level of practices in climate change education in most pedagogical domains, male and female teachers differed in how they developed or utilized instructional materials for climate change education.

Overall, findings indicate that sex play a role in certain pedagogical practices but not in others. The lack of significant differences in other pedagogical domains may imply that common factors, such as shared institutional policies, similar training backgrounds, or standardized curriculum requirements, shape teachers' practices in climate change action. However, for instructional materials development, it appeared that male and female practices were not comparable. The finding is consistent with Xu (2025), who argued that women are often underrepresented in climate governance and face systematic biases that limit their participation in decision-making and resource allocation. This gap is further explained by the findings of Adeoye (2023), whose study on STEAM educators revealed that a higher percentage of male teachers possessed advance digital skills and personal computing devices compared to their female counterparts. Hence, the "Action-Practive Gap" observed among female teachers in this study may be associated with variations in access to digital resources, technical skills, or institutional support, as suggested related literature, highlighting the need for gender-responsive initiatives with the CEASE Model.

4.5. Challenges in Climate Change

The challenges of teachers in participating in climate change action were identified. The data are shown in Table 5.

Table 5. Teachers' Challenges in Climate Change Action.

Indicators	Mean	SD	Verbal Description
Limited integration in teaching strategies.	4.56	0.86	Always
Lack time to develop lessons or instructional materials about climate change.	3.95	0.67	Often
Lack of training in integrating Climate Change in the lessons.	3.14	0.97	Sometimes
Limited knowledge about climate change	2.81	0.98	Sometimes
Uncertainty on how to bring about change in educators' practices to ensure climate change education.	2.81	0.97	Sometimes
Unable to identify areas where to integrate climate change.	2.73	0.86	Sometimes
Unaware of the directive from DepED of the need to integrate climate change in the curriculum.	2.68	0.76	Sometimes
Students not interested in climate change topics.	2.21	0.67	Rare
Climate change is not a priority in schools.	2.10	0.88	Rare
Low interest in climate change.	1.74	0.65	Never
Unaware of the existing programs of DepEd for climate change integration.	1.45	0.88	Never

The highest ranked challenge is "limited integration in teaching strategies" (*M=4.56, Always*), followed by a "lack of time to develop lessons or instructional materials" (*M =3.95, Often*). These findings suggest that while teachers were willing to teach climate change, they struggled with the how and the when. The high mean for limited integration strategies indicates a "pedagogical roadblock." Teachers had the awareness, but they lacked specific methodological tools to weave complex climate concepts into their existing subject matter.

The identified intermediate challenges such as lack of training (*M=3.14, Sometimes*) and limited knowledge (*M =2.81, Sometimes*) suggest that while teachers possessed baseline understanding, they felt inadequately equipped to handle the specialized nature of climate science. These findings indicate a need for capacity - building initiatives, such as professional development programs, and training workshops, to enhance teachers' competence and confidence.

Notably, items related to policy awareness and interest ranked the lowest. The "lack of awareness of the Department of Education initiatives" (*M=2.68, Sometimes),* "Unaware of existing programs" (*M=1.45*, *Never*), and "low interest" (*M=1.74, Rare*), indicate that policy and motivation were not hindrances in integrating climate change into classroom teaching. These findings confirm that the "Action Gap" is structural. Teachers knew that they were supposed to integrate climate change, and they believed that it is a priority. However, they were overwhelmed by workload and strategy limitations. This highlights the importance of institutional support, targeted professional development, and provision of ready-to-use instructional materials to strengthen climate change education in schools.

4.6. Proposed Conceptual model to Enhance Teachers' Integration of Climate Change Education

4.6.1. The CEASE Conceptual model: A Pedagogical Response to Climate Action Gap The **C**limate **E**ducation **A**ction for **S**ustainable **E**ngagement (CEASE) is a multidimensional conceptual model designed to bridge the "translation gap" between climate awareness and classroom practice. Grounded on the Transformative Learning Theory by Mezirow (1997) and Social Cognitive Theory by Bandura (2012), the model positions teachers as critical agents of change who can translate climate awareness into meaningful and sustained classroom action.

Figure 2 illustrates the CEASE conceptual model.

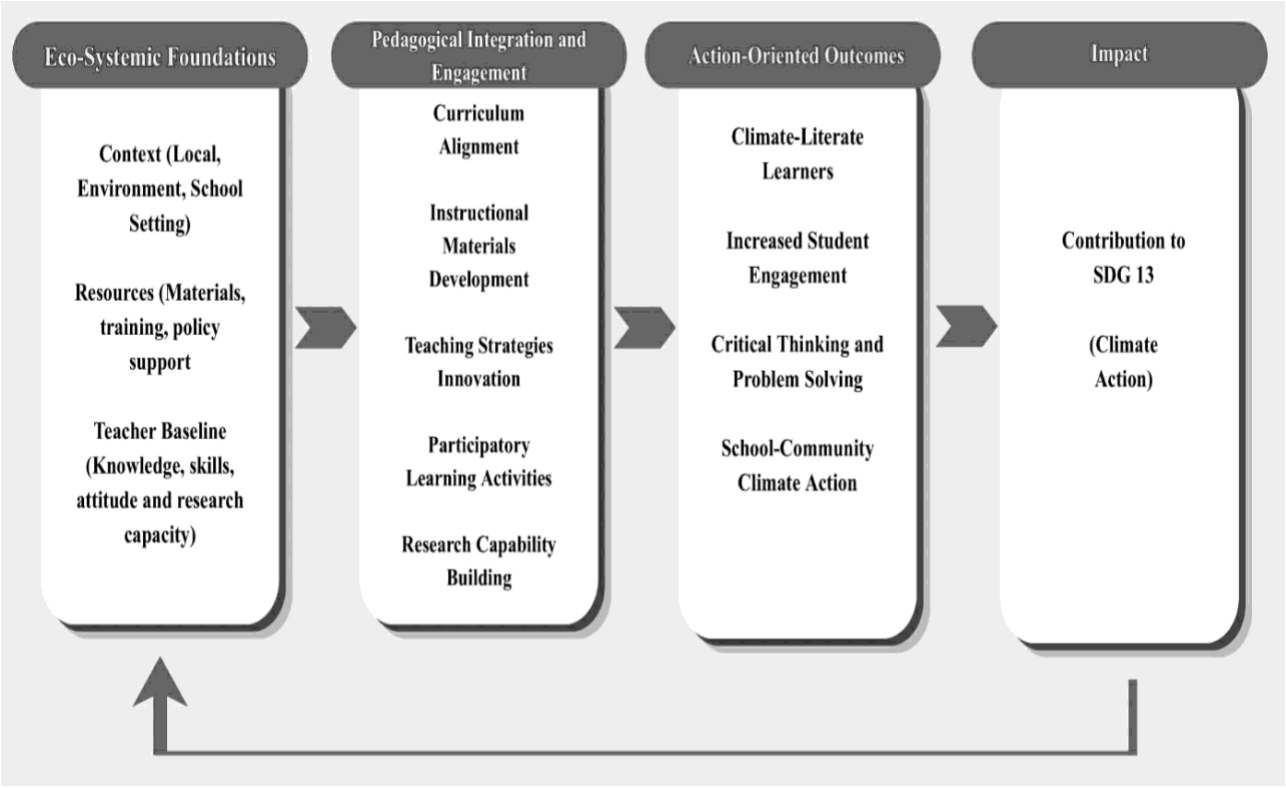

Figure 2. The Proposed CEASE Conceptual model

Note: The CEASE conceptual model illustrates the process of enhancing teachers' integration of climate change education by linking awareness, pedagogical practices, and sustained classroom action.

The CEASE conceptual model was developed through a systematic translation of empirical findings into pedagogical components. Each domain of the model corresponds directly to identified strengths, gaps, and challenges in teachers' perspectives and practices.

First, the high-level teachers' climate change perspectives (M=4.33) indicated strong awareness and willingness to engage in climate change education, forming the foundational basis for the model's eco-systemic foundations. However, the moderate level of over-all practices (M=3.40) revealed a gap between awareness and implementation, needing structured pedagogical interventions.

Specifically, the high engagement in curriculum development (M=3.64) informed the inclusion of curriculum alignment as a core domain, reinforcing teachers' existing strengths. In contract, the moderate mean score in instructional materials development (M=3.370 and teaching strategy innovation (M=3.18) highlighted the need for contextualized instructional materials and methodological innovation within the model.

Moreover, the low engagement in higher-order practices, such as facilitating research (M=2.39) and debates (M=2.38), emphasized the need for participatory and learner-centered activities that promote critical thinking and inquiry-based learning.

Furthermore, the neutral rating on research engagement (M=3.23) directly informed the inclusion of research capability building as a distinct component of the model. This element addressed the identified gap in teachers' confidence and involvement in climate-related research.

Finally, the challenges identified, particularly limited teaching strategies (M=4.56) and time constraints (M= 3.95), guided the integration of support mechanisms within the model's foundational and feedback structures.

Through this empirical-to-conceptual alignment, the CEASE model is grounded not only in theory, but also in the actual instructional realities experienced by teachers.

The CEASE Model follows a cyclical, yet progressive structure composed of three major stages: (1) Eco-systemic Foundations, (2) Pedagogical Integration and Engagement, (3) Action-Oriented Outcomes and Impact.

The first phase, Eco-Systemic Foundations, establishes the conditions necessary for effective climate education. This includes three core elements, comprising (a) contextual realities, referring to environmental, socio-cultural, and institutional settings; (b) available resources, which include instructional materials, administrative support, and policy alignment; and (c) teacher baseline capacity, encompassing prior knowledge, skills, attitudes, and research engagement. This phase recognizes that teaching practices are shaped by both internal competencies and external conditions.

The second phase, Pedagogical Integration and Engagement, represents the core operational mechanisms of the model. It integrates five key domains derived from empirical findings of the study: curriculum alignment, contextualized instructional materials development, innovative teaching strategies, participatory and learner-centered activities, and research capability building. These domains collectively enable teachers to move beyond awareness toward active pedagogical implementation. The inclusion of research capability building distinguishes the model by emphasizing teachers' role not only as implementers but also as knowledge producers in climate change education.

The third phase, Action-Oriented Outcomes and Impact, reflects the intended results of effective integration. These include the development of climate-literate learners, increased student engagement in environmental practices, and the promotion of critical thinking and problem-solving skills. Ultimately, these outcomes contribute to broader societal goals, particularly Sustainable Development Goal 13 (Climate Action), by fostering environmentally responsible behaviors and community participation.

The iterative feedback loop is a defining feature of the CEASE model. The outcomes generated in the third phase inform and refine eco-systemic foundations, ensuring continuous improvement and sustainability of climate change education practices. This cyclical process allows schools to adapt to emerging environmental challenges, evolving policies, and changing learner needs.

The CEASE conceptual model provides a structured yet flexible framework that bridges the gap between knowledge and action. It serves as a practical guide for educators, school leaders, and policymakers in enhancing the integration of climate change education within the curriculum while promoting long-term environmental sustainability.

Beyond its functional definition, the term CEASE carries a symbolic meaning—to cease or mitigate the impacts of climate change. This dual significance reinforces the model's broader purpose: not only to improve instructional practices but also to inspire collective action toward sustainability. This positions the CEASE model as both a pedagogical framework and strategic response to the climate education gap.

5. Conclusions

Findings of the study indicate that teachers demonstrated positive perspectives toward climate change, except in relation to research practices. This neutral stance on research involvement is attributed to time constraints, financial resources, and inadequate research capability. These challenges were corroborated in the study of Tindowen et al. (2019) who reported that teachers encountered difficulties in conducting research due to increased workload, writing anxiety, lack of time, and inadequate methodological knowledge.

Additionally, the study revealed a positive relationship between the teachers' perspectives and their practices. This suggests that more informed and favorable perspectives are associated with higher levels of participation in climate-related initiatives. This finding aligns with the work of Serroussi et al. (2019), which demonstrated that teachers' knowledge and concern about climate change significantly influenced their readiness to act on it.

Furthermore, no significant differences were found in teachers' practices when grouped according to sex, with the notable exception of instructional materials development. This indicates that while sex is generally not a barrier to inclusive climate action, specific pedagogical tasks like resource development may still be influenced by gendered constraints. While the findings contrast with the study of Mohammed et al. (2025), who reported limited women practices in higher-level decision-making where quotas resulting in superficial involvement, the present study implies a more inclusive and equitable participation across genders in foundational climate action initiatives.

In light of these findings, the proposed CEASE (Climate Education Action for Sustainable Practices) Conceptual model is advanced as a data-driven pedagogical response to the identified climate action gap. This conceptual model directly addresses the moderate level of teacher practices and the constraints in research participation and instructional innovation by providing structured and context- responsive strategies across curriculum integration, instructional materials development, methodological innovation, participatory learning, and research capability building.

5.1. Study Limitations

Despite significant insights, several limitations must be acknowledged. The use of self-reported measures of climate change education practices does not provide evidence of actual classroom implementation. Prior research suggests that discrepancies may exist between reported and observed practices due to social desirability bias or differences in self-perception. Therefore, findings related to teachers' climate change education practices should be interpreted as indicative of perceptions rather than definitive measures of actual pedagogical behavior.

In addition, the use of snowball sampling may introduce selection bias, as the participants were initially drawn from graduate students of a State University, potentially over-representing educators with advanced academic interests. In addition, the study was confined to public secondary schools within a single Division of a province in Central Luzon, which may limit the generalizability of the findings. These constraints suggest that while the findings are robust for the specific context, further research with broader, randomized samples is encouraged.

5.2. Recommendations

1. Apply the CEASE conceptual model by institutionalizing the inclusion of climate change topics in curriculum design and instructional materials to ensure systematic integration across subject areas. Schools should identify cross-curricular entry points and ensure alignment with national education standards.
2. Utilize CEASE-guided strategies to equip teachers in developing high-quality instructional resources, including multimedia content, instructional plans, and digital repositories that reflect learners' context and local environmental challenges.
3. Provide professional development workshops to strengthen teachers' capacity to design and implement learner-centered teaching strategies and activities that integrate climate change education across multiple learning modalities such as those suggested in the CEASE conceptual model.

4. Promote experiential and student-led learning initiatives, such as environmental projects, advocacy campaigns, and digital portfolios, to foster active participation in climate action.
5. Provide structured opportunities aligned with CEASE for teachers to engage in climate related research through workshops, mentoring, dedicated time, and resource allocation.
6. Implement continuous professional development to ensure that teachers are updated with the latest climate status. Programs may include updates on local environmental data, pedagogical innovations, and research opportunities.
7. Future studies may employ broader, randomized sampling across diverse public and private secondary school and complement self-reported data with observational or evidence-based assessments of classroom practices. This approach will minimize selection and social desirability biases, enhance generalizability, and provide robust evidence to guide effective implementation of the CEASE conceptual model in climate education.

The recommendations support the institutionalization of climate education and the implementation of the CEASE conceptual model across educational settings.

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Data Availability The data that support the findings of this study are available from the corresponding author upon reasonable request.

Declarations

Competing Interests The authors declare no competing interests.

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