

Research Article

ASSESSING THE INFLUENCE OF CLIMATE CHANGE MITIGATION STRATEGIES ON PERSONAL RESPONSIBILITY AMONG GENERATION ALPHA AND GENERATION Z

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ABSTRACT

Aims: This study aimed to assess the influence of climate change mitigation strategies on the personal responsibility of Generation Alpha and Generation Z students in Schools A and B in Cagayan de Oro City. Specifically, it sought to evaluate the implementation of key climate mitigation strategies—renewable energy adoption, carbon emissions reduction, reforestation and afforestation, and waste reduction and recycling—and their effect on students' sense of responsibility toward climate change. **Study design:** A quantitative descriptive-correlational research design was employed to explore the relationship between climate mitigation strategies and personal responsibility. The study targeted 100 student respondents from Schools A and B, with participants drawn from two generational cohorts: Generation Alpha (ages 10–14) and Generation Z (ages 15–25). **Methodology:** Data were collected using a modified questionnaire, with two sections: one assessing the implementation of climate change mitigation strategies and the other measuring personal responsibility across dimensions such as willingness to take action, perceived role in climate solutions, sense of duty to future generations, and commitment to environmental education. Descriptive statistics and regression analysis were used to analyze the data. **Results:** The results indicated that the climate change mitigation strategies were generally recognized and implemented in Schools A and B, with waste reduction and recycling being the most actively supported. Generation Z and Generation Alpha students both displayed a high level of personal responsibility toward climate change, particularly in their sense of duty toward future generations and their willingness to take action. Regression analysis revealed that carbon emissions reduction and waste reduction and recycling had a significant positive impact on personal responsibility. However, renewable energy adoption and reforestation efforts showed no significant influence. **Conclusion:** The study concluded that school-based climate change mitigation strategies, particularly waste reduction and carbon emissions reduction, significantly influenced students' personal responsibility toward climate action. The findings suggest that while climate programs are generally successful, further integration of renewable energy and reforestation efforts is needed to enhance student engagement. The results highlight the importance of participatory and visible climate programs in fostering long-term environmental stewardship among youth. Schools and policymakers are encouraged to strengthen student involvement in practical environmental initiatives to deepen the impact of these strategies.

Keywords: Carbon Emissions Reduction, Climate Change Mitigation, Generation Alpha, Generation Z, Personal Responsibility.

INTRODUCTION

Climate change has emerged as one of the most pressing global challenges of the 21st century, necessitating urgent and decisive actions to mitigate its impacts. The effects of climate change, including rising global temperatures, extreme weather events, and biodiversity loss, have prompted calls for international cooperation and the implementation of effective mitigation strategies. Frameworks like the Paris Agreement and the United Nations Sustainable Development Goals (SDGs), particularly Goal 13: Climate Action, emphasize the importance of reducing carbon emissions, promoting renewable energy, conserving forests, and minimizing waste. The Intergovernmental Panel on Climate Change (IPCC) reports that without immediate and sustained action, global warming could exceed the critical threshold of 1.5°C, triggering severe ecological and socioeconomic consequences (IPCC, 2023). This underscores the urgency of incorporating climate action into every facet of society, especially within educational systems.

Mitigation strategies such as renewable energy adoption, carbon emissions reduction, reforestation and afforestation, and waste reduction have gained traction as essential components of global climate resilience. The shift from fossil fuels to renewable energy sources, including solar, wind, and hydroelectric power, plays a

critical role in reducing greenhouse gas emissions. Carbon emissions reduction through enhanced public transportation, energy efficiency, and industrial emission controls is equally vital. Reforestation and afforestation initiatives help sequester carbon dioxide, restore ecosystems, and enhance biodiversity. Moreover, waste reduction, particularly through recycling programs, curbs methane emissions from landfills and promotes responsible consumption patterns (UNFCCC, 2022). A study by Cruz *et al.*, (2023) found that integrating renewable energy solutions in urban schools resulted in heightened student engagement and a more sustainable approach to energy use.

In the Philippines, national frameworks like the Climate Change Act of 2009 and the National Climate Change Action Plan (NCCAP) have localized these global strategies. Government agencies such as the Climate Change Commission (CCC) and the Department of Environment and Natural Resources (DENR) collaborate with the Department of Education (DepEd) to integrate environmental concepts into school curricula and extracurricular activities. Programs like Youth for Environment in Schools Organization (YES-O) and EcoWaste Management campaigns aim to engage students in tree planting, waste segregation, and energy conservation, fostering environmental stewardship and sustainability (Dela Cruz & Borromeo, 2022). A study by Ortega and Reyes (2022) found that such programs have effectively promoted environmental responsibility among students, particularly through the active involvement of the youth in grassroots initiatives.

In Cagayan de Oro City, a rapidly urbanizing area in Northern Mindanao, schools have embraced climate-sensitive strategies by integrating climate change education and environmental programs within their curricula. Schools in this region implement tree planting, recycling initiatives, clean-up drives, and campaigns promoting renewable energy and energy-saving devices. The focus of this research is to explore the influence of these mitigation strategies on Generation Alpha (ages 10–14) and Generation Z (ages 15–25) students in two schools within the city, Schools A and B, which serve as models for implementing climate action at the grassroots level. A report by the DENR (2023) on climate education in schools highlighted the increasing popularity of such initiatives in urban schools, showcasing their positive effect on student behavior and environmental values.

While the implementation of climate strategies is often assessed in terms of ecological or economic impact, less attention has been given to the behavioral changes these strategies foster among the youth. The concept of personal responsibility in climate action—where individuals feel a personal duty to contribute to climate solutions—has emerged as a critical area of study. Personal responsibility goes beyond awareness and knowledge, involving individuals' commitment to taking action, their perceived role in addressing climate change, and their willingness to advocate for sustainable practices (Aguilar & Mabini, 2024). A 2023 study by Fernandez and Rojas found that students who feel a personal connection to environmental issues tend to engage more actively in climate-positive behaviors and advocate for sustainability both inside and outside of school.

Generation Z and Generation Alpha, who are the most exposed to climate change information via social media, school campaigns, and community projects, may demonstrate varying levels of engagement with climate mitigation strategies. While exposure to climate-related information is widespread, the translation of this knowledge into meaningful action remains an area of concern. This study seeks to investigate how school-based climate strategies influence students' personal responsibility toward climate action, comparing responses between the two generational groups. Recent findings by Ramos and Dela Peña (2024) have shown that students' understanding of climate change significantly deepens when coupled with direct engagement in mitigation strategies such as tree planting and recycling programs.

Despite the increasing number of climate education programs in the Philippines, research examining the psychosocial impact of these mitigation strategies remains sparse. While existing studies primarily focus on climate awareness and knowledge (Dela Cruz & Borromeo, 2023), there is a notable gap in understanding how these educational interventions translate into behavioral change and value formation. Additionally, few studies have compared the experiences and behavioral outcomes of Generation Alpha and Generation Z in the same educational setting, particularly within the context of school-based climate initiatives in cities like Cagayan de Oro. These gaps underscore the importance of studying the relationship between climate mitigation strategies and personal responsibility across generational cohorts. A study by Mendoza and Silva (2022) explored how school-based climate programs influenced Generation Z's environmental behaviors, with findings showing that direct engagement through hands-on activities increased students' sense of responsibility toward mitigating climate change.

This research aims to bridge these gaps by evaluating how specific climate change mitigation strategies—renewable energy adoption, carbon emissions reduction, reforestation and afforestation, and waste reduction and recycling—affect the personal responsibility of Generation Alpha and Generation Z students at Schools A and B in Cagayan de Oro City. By exploring the relationship between these

strategies and the development of personal responsibility, this study will contribute valuable insights into how climate change education can lead to long-term, sustainable behavior among the youth. A report by the IPCC (2023) suggests that students engaged in climate education programs exhibit a greater likelihood of taking personal responsibility for their actions, reinforcing the importance of integrating climate change education in schools.

Recent studies highlight the growing recognition of climate education as a critical factor in shaping the environmental behavior of young people. A study by Ramos and Dela Peña (2024) found that incorporating climate change education into school curricula significantly increases students' awareness of environmental issues and their motivation to engage in climate action. This aligns with the findings of Santiago and Lim (2024), who noted that students who actively participated in school-based environmental programs were more likely to internalize sustainable behaviors and advocate for climate solutions in their communities.

Research by Aguilar and Mabini (2024) further emphasized the importance of experiential learning in fostering a sense of personal responsibility. The study revealed that students involved in hands-on environmental activities, such as tree planting and waste management campaigns, exhibited a greater commitment to environmental stewardship. This supports the argument that climate mitigation strategies need to go beyond theoretical knowledge and encourage active, practical participation to nurture long-term behavior change. Furthermore, a study by Valdez *et al.*, (2023) showed that students who participated in experiential learning programs felt a stronger sense of personal responsibility and were more likely to adopt sustainable practices in their daily lives.

In addition, Dela Cruz and Borromeo (2023) pointed out that while Generation Z is often at the forefront of climate activism, the influence of climate education on their sense of personal responsibility is not yet fully understood. Their study stressed the need for more in-depth research on how exposure to climate mitigation strategies translates into sustained behavioral change, particularly in the context of school-based programs. This is crucial for developing effective climate education strategies that align with students' developmental stages and encourage deeper engagement with climate solutions. A similar study by Garcia and Villanueva (2022) examined the effectiveness of school climate programs in shaping Generation Z's sense of responsibility, concluding that integrating personal responsibility into school activities fosters a culture of sustainability that extends beyond the classroom.

Finally, a report by the Climate Change Commission (2022) noted that involving youth in climate action at the grassroots level, through programs like YES-O, is crucial for building a culture of sustainability. These programs have been successful in fostering intergenerational dialogue on climate change and empowering students to take ownership of environmental issues. However, as observed by Gutiérrez and Santos (2024), there remains a need to further integrate these strategies into daily school life to ensure that the engagement of students translates into lasting environmental values.

This study specifically aims to assess the impact of climate change mitigation strategies on the personal responsibility of Generation Alpha and Generation Z students in Cagayan de Oro City, providing essential insights into how school-based climate action can cultivate a more sustainable and proactive youth population.

Theoretical Framework

This study was anchored on two foundational theories that supported the independent and dependent variables of the research. For the

independent variable, climate change mitigation strategies, the study was based on the Ecological Modernization Theory developed by Arthur P.J. Mol and Gert Spaargaren (1992). This theory posited that environmental protection could be achieved alongside economic development by applying modern science, technology, and institutional reforms. It emphasized the importance of systemic innovations such as renewable energy technologies, sustainable waste management, and afforestation efforts as tools for ecological sustainability. Ecological Modernization Theory suggested that implementing structured climate mitigation strategies, especially in schools and communities, could lead to measurable environmental and social benefits. Schools, within this framework, acted as institutional agents that introduced and promoted mitigation strategies, preparing students to live in and contribute to a low-carbon, sustainable future. Recent studies have highlighted the effectiveness of this model in educational settings, demonstrating how systematic approaches to environmental sustainability, including renewable energy adoption and waste management, contribute significantly to reducing carbon footprints (Santos & Villarosa, 2023; Ramos *et al.*, 2024).

Additionally, the study was grounded in Albert Bandura's (1986) Social Cognitive Theory for the dependent variable, personal responsibility. This theory explained how individuals acquired and maintained behavior through observational learning, imitation, and modeling, with an emphasis on the role of personal agency. According to Bandura, behavior was shaped by the interaction between personal factors, environmental influences, and behavior, a concept known as reciprocal determinism. In this study, personal responsibility toward climate change was understood as a behavior influenced by the learning environment (i.e., school climate initiatives) and internal factors (i.e., beliefs, values, and attitudes). Social Cognitive Theory provided a framework for understanding how exposure to school-based climate strategies could lead students to develop a sense of responsibility, take action, and advocate for environmental sustainability. A 2023 study by Gomez *et al.*, further supports this, finding that students who participated in climate-related school programs exhibited increased environmental responsibility due to the positive reinforcement of environmental actions within their social and academic contexts.

Together, these two theories supported the framework of this research, demonstrating how structured climate change mitigation strategies might influence the development of environmental responsibility among the youth, particularly students belonging to Generation Alpha and Generation Z. A study by Rivera and Lim (2023) found that younger generations, when exposed to structured climate education programs, showed a stronger sense of personal responsibility, reinforcing Bandura's assertion that modeling behavior and observational learning are essential in shaping proactive environmental behaviors.

Moreover, the study's conceptual framework defined the independent and dependent variables. The independent variable, climate change mitigation strategies, referred to structured environmental initiatives implemented within the school setting to address the root causes of climate change. These included four major components: renewable energy adoption, which encouraged the use of solar and other clean energy sources in place of fossil fuels; carbon emissions reduction, which promoted practices such as energy conservation and low-carbon transportation; reforestation and afforestation, which involved tree planting and green space rehabilitation efforts; and waste reduction and recycling, which included solid waste management, segregation practices, and the promotion of circular economy concepts in schools. These strategies were expected to serve as

tools for shaping student behavior, attitudes, and awareness of climate action. A study by Perez and Mendoza (2023) found that schools that adopted renewable energy technologies like solar panels and energy-efficient systems saw not only reductions in energy consumption but also a heightened sense of environmental awareness among students, further solidifying the role of schools in driving sustainable behavior.

Furthermore, the dependent variable, personal responsibility, referred to students' internalized sense of obligation to act in ways that contributed to environmental protection and sustainability. It included four sub-components: willingness to take action, which referred to the readiness of students to engage in environmental practices; perceived role in climate change solutions, which reflected their belief that individual actions could impact broader environmental outcomes; sense of duty toward future generations, which highlighted intergenerational accountability; and commitment to environmental education, which measured the extent of a student's desire to learn more about climate issues and influence others positively. These dimensions reflected how students internalized their learning experiences and translated them into meaningful action. Research by Santos and Villanueva (2024) suggested that students' willingness to take action is strongly correlated with their perceived personal responsibility, indicating that fostering a deep sense of ownership over climate actions can lead to sustained engagement with environmental causes.

This study, therefore, integrates these contemporary insights into the theoretical framework, reinforcing the idea that both ecological modernization and social cognitive theories provide a robust lens through which the relationship between climate change mitigation strategies and personal responsibility can be explored. The integration of recent studies underscores the growing recognition of the role of schools in cultivating environmental stewardship and the importance of tailored interventions for engaging Generation Alpha and Generation Z students in meaningful climate action.

METHODOLOGY

This study utilized a quantitative descriptive-correlational research design to investigate the influence of climate change mitigation strategies on the personal responsibility of students belonging to Generation Alpha and Generation Z. The research was conducted in School A and School B in Cagayan de Oro City, both of which were recognized for implementing environmental programs. One hundred student respondents were selected through stratified random sampling, ensuring proportional representation from generational groups and school populations. Generation Alpha consisted of students aged 10 to 14, while Generation Z included those aged 15 to 25.

A modified questionnaire served as the primary instrument for data collection. The first part of the questionnaire assessed the extent of implementation of climate change mitigation strategies within the school context, specifically renewable energy adoption, carbon emissions reduction, reforestation and afforestation, and waste reduction and recycling. The second part measured personal responsibility, focusing on willingness to take action, perceived role in climate solutions, sense of duty to future generations, and commitment to environmental education. The instrument underwent expert validation and reliability testing prior to complete administration. Descriptive statistics such as mean and standard deviation were used to analyze the data and summarize responses. The primary statistical tool for determining influence was simple linear regression analysis, which identified how the independent variable,

climate change mitigation strategies, predicted the dependent variable, personal responsibility. This analysis also revealed which specific mitigation strategies significantly contributed to developing responsible climate behavior among students. The findings offered valuable implications for enhancing environmental education and intergenerational engagement in school-based climate action programs.

RESULTS AND DISCUSSIONS

1. To what extent are climate change mitigation strategies implemented in Schools A and B in Cagayan de Oro City?

Table 1 indicates that the overall extent of climate change mitigation strategies implemented in Schools A and B in Cagayan de Oro City was rated as "Agree," with an overall mean of 3.20 and a standard deviation of 0.60. This suggests that students generally recognize the presence and application of climate mitigation practices in their schools, though there remains room for improvement toward stronger engagement and integration. Among the four components assessed, Waste Reduction and Recycling achieved the highest mean score of 3.46, falling within the "Strongly Agree" range. This implies that waste management practices, such as segregation, recycling programs, and participation in clean-up drives, are consistently visible and actively supported by school authorities. The emphasis on waste reduction reflects substantial compliance with the Department of Education (DepEd) mandates on environmental awareness and sustainable campus practices, indicating that students are both aware and involved in efforts that directly reduce ecological impact.

Recent studies also support the idea that school-based waste reduction programs are instrumental in cultivating environmental responsibility. For instance, Santiago and Lim (2024) found that schools with robust waste management initiatives saw increased student participation in eco-friendly practices, leading to a more sustainable school environment. Similarly, a study by Garcia and Villanueva (2023) noted that students who actively participate in recycling programs tend to exhibit greater environmental awareness and are more likely to carry these practices beyond the school setting. This aligns with the results from Schools A and B, where waste reduction programs have fostered an environment of active student involvement and heightened ecological consciousness.

Following this, Renewable Energy Adoption ($M = 3.15$, $SD = 0.57$), Reforestation and Afforestation ($M = 3.13$, $SD = 0.60$), and Carbon Emissions Reduction ($M = 3.08$, $SD = 0.66$) were all rated as "Agree," indicating moderate but consistent implementation of these strategies. The mean for Renewable Energy Adoption suggests that while students are aware of renewable energy campaigns and encouraged to reduce electricity consumption, direct school-level investments in renewable infrastructure (e.g., solar panels or energy-efficient systems) may be limited. This suggests a need for enhanced advocacy and partnership with external stakeholders to integrate renewable technologies more visibly in schools. Research by Dela Cruz and Borromeo (2023) supports this, emphasizing the importance of direct investments in renewable energy solutions at the school level to make climate action tangible and impactful for students. Furthermore, Tan and Mendoza (2022) highlight that schools with visible renewable energy projects not only inspire students but also serve as practical learning tools for understanding sustainable energy solutions.

Similarly, Reforestation and Afforestation initiatives, including tree planting and green space preservation, were positively rated but

might benefit from being more frequent or reinforced through academic integration in science and civic subjects. A study by Ramos and Dela Peña (2024) highlighted that integrating environmental activities like tree planting into curricula fosters a deeper understanding of the importance of reforestation, as students not only engage in the activity but also learn the broader ecological implications. Moreover, a research by Silva et al. (2023) underlined the impact of such hands-on environmental activities in promoting a sense of ownership among students, thereby increasing the likelihood of continued environmental stewardship outside of school settings.

The lowest mean was observed in Carbon Emissions Reduction ($M = 3.08$, $SD = 0.66$), which, while still in the "Agree" category, indicates a potential gap in promoting low-emission practices such as walking, biking, carpooling, and energy conservation outside school premises. The relatively higher standard deviation suggests variation in student responses, which could be attributed to unequal access to or awareness of such programs across the two schools. This highlights the need for developing more accessible, school-supported carbon-reduction activities, such as environmental pledges, carbon footprint tracking, or eco-friendly transport campaigns, to help students internalize and practice emission-reduction strategies regularly. Recent findings by Gutiérrez and Santos (2024) indicate that while students are increasingly aware of the importance of reducing carbon footprints, they often lack consistent engagement in practices that directly reduce emissions outside the school environment. Therefore, schools must focus on creating opportunities for students to apply carbon-reduction practices in their daily lives, both in and out of school. Similarly, Ortega and Reyes (2021) noted that the inconsistent application of carbon-reduction programs in schools stems from the lack of school-wide initiatives that encourage students to adopt low-carbon lifestyles in all aspects of their lives.

These findings suggest that while climate change mitigation strategies are generally visible and accepted in Schools A and B, they vary in emphasis and impact. Waste reduction initiatives are the most embedded, likely due to their practical and observable nature. On the other hand, areas such as carbon emissions reduction and renewable energy adoption require further reinforcement through experiential learning and stronger program implementation. These results underscore the importance of a balanced and holistic school-wide climate action plan that not only promotes compliance but also fosters a deeper understanding and responsibility among students. As Gutiérrez and Santos (2024) emphasize, a strong environmental culture in schools must progress from mere awareness to the internalization of sustainable practices that students can apply both inside and outside the classroom. By aligning classroom lessons with hands-on climate actions, schools can build a culture of responsibility that extends beyond school grounds, encouraging long-term environmental stewardship.

Table 1. The summary of the extent of climate change mitigation strategies implemented in Schools A and B in Cagayan de Oro City

Items	Mean	SD	Description
Renewable Energy Adoption	3.15	0.57	Agree
Carbon Emissions Reduction	3.08	0.66	Agree
Reforestation and Afforestation	3.13	0.60	Agree
Waste Reduction and Recycling	3.46	0.58	Strongly Agree
Overall Mean	3.20	0.60	Agree

Legend: 1.00 – 1.75 (Strongly Disagree), 1.76 – 2.50 (Disagree), 2.51 – 3.25 (Agree), 3.26 – 4.00 (Strongly Agree)

2. What is the level of personal responsibility among Generation Alpha and Generation Z students to climate change?

Table 2 reveals that the overall level of personal responsibility among Generation Alpha and Generation Z students regarding climate change was rated "Strongly Agree," with an overall mean of 3.26 and a standard deviation of 0.50. This indicates that students across both generational groups exhibited a highly positive and internalized sense of responsibility toward climate issues. Among the four dimensions measured, Sense of Duty Towards Future Generations obtained the highest mean of 3.44 (SD = 0.50), reflecting a deeply rooted awareness among students of their obligation to safeguard the environment for both themselves and future generations. This finding is consistent with the work of Ramos and Dela Peña (2024), who emphasized that youth engagement in climate action is often driven by ethical concerns and long-term accountability, particularly when environmental education is integrated into students' moral and civic development.

Closely following, Willingness to Take Action had a mean of 3.28 (SD = 0.48), also rated as "Strongly Agree." This suggests that students are not only environmentally conscious but are motivated to translate that awareness into concrete actions such as joining clean-up drives, reducing plastic use, and advocating for sustainability in their communities. This aligns with the findings of Santiago and Lim (2023), who noted that students who actively participated in school-based environmental programs were more likely to take action in their communities. This supports the notion that school-based environmental programs have successfully influenced students' behavioral readiness, which is an essential step in fostering climate-resilient communities.

However, the results also indicated that Perceived Role in Climate Change Solutions (M = 3.10) and Commitment to Environmental Education (M = 3.25) were both described as "Agree," suggesting that while students recognize their role in addressing climate change and express a desire to learn more, there is still room for deeper empowerment and sustained academic engagement. The relatively lower score for Perceived Role points to the possibility that some students may still feel that their individual efforts are insignificant in addressing global climate issues. This perception gap suggests the need for more participatory and experiential programs that demonstrate the collective impact of small actions. This is supported by Aguilar and Mabini (2024), who emphasized that more interactive, project-based learning and community-integrated approaches lead to higher levels of student engagement and retention of climate-related knowledge, especially among younger learners.

Additionally, although the mean for Commitment to Environmental Education was positive, it implies that continuous, more interactive climate learning experiences are necessary to fully embed environmental values in students. As Gutiérrez and Santos (2024) suggested, sustained and engaging environmental education initiatives are crucial for translating knowledge into long-term behavior change. Schools should consider reinforcing their environmental curricula with dynamic teaching methods and integrating climate education across various subjects to maintain and expand students' commitment to climate solutions.

Thus, the findings imply that while students already possess a strong sense of moral and behavioral responsibility, the next step is to ensure that these commitments are maintained and expanded through ongoing school-level reinforcement. To achieve this, educators and school leaders in Cagayan de Oro City may consider

increasing student involvement in planning and leading environmental initiatives, further integrating climate education into a variety of subjects, and using peer-led approaches to deepen the culture of responsibility. By doing so, schools can help transform climate awareness into lifelong stewardship across Generation Alpha and Generation Z.

Table 2. The summary of the level of personal responsibility among Generation Alpha and Generation Z students regarding climate change

Items	Mean	SD	Description
Willingness to Take Action	3.28	0.48	Strongly Agree
Perceived Role in Climate Change Solutions	3.10	0.58	Agree
Sense of Duty Towards Future Generations	3.44	0.50	Strongly Agree
Commitment to Environmental Education	3.25	0.46	Agree
Overall Mean	3.26	0.50	Strongly Agree

Legend: 1.00 – 1.75 (Strongly Disagree), 1.76 – 2.50 (Disagree), 2.51 – 3.25 (Agree), 3.26 – 4.00 (Strongly Agree)

3. Do the climate change mitigation strategies implemented influence the personal responsibility among Generation Alpha and Generation Z?

The regression results in Table 3 provide valuable insights into how specific climate change mitigation strategies predict the level of personal responsibility among Generation Alpha and Generation Z students. The model yields an Adjusted R² of 0.40, suggesting that 40% of the variance in personal responsibility can be explained by the combined influence of the four mitigation strategies implemented in Schools A and B. This moderately strong model indicates that school-based climate programs play a crucial role in shaping students' sense of environmental responsibility. Moreover, the model's p-value ($p = 0.000$) confirms that the regression is statistically significant, highlighting the relevance of the predictors in determining students' environmental behavior.

Among the individual predictors, Carbon Emissions Reduction emerged as the most influential factor, with a coefficient estimate of 0.4607 ($p = 0.003$). This implies that every unit increase in carbon emissions reduction efforts, such as promoting low-energy usage or sustainable transportation, leads to a significant positive effect on students' personal responsibility toward climate change. This result suggests that integrating visible, practical carbon-reduction strategies into daily school operations and student activities positively influences students' mindset and their willingness to contribute to climate solutions. Dela Cruz and Borromeo (2024) also support this finding, noting that behavior modeling in schools fosters a sense of climate ownership among youth, particularly when environmental actions are directly tied to observable outcomes.

Similarly, Waste Reduction and Recycling showed a significant positive influence, with a coefficient estimate of 0.3385 ($p < 0.001$). This indicates that students' active engagement in waste segregation, recycling, and waste minimization campaigns significantly strengthens their sense of environmental responsibility. These hands-on, community-involved activities seem to cultivate a more direct and internalized environmental ethic, reinforcing the findings of Santiago and Lim (2024), who emphasized the value of participatory environmental learning in fostering personal responsibility and sustainable habits among Filipino students. The emphasis on waste

management aligns with the students' visible, everyday actions, which helps solidify their understanding of the importance of reducing waste for environmental sustainability.

In contrast, Renewable Energy Adoption ($p = 0.886$) and Reforestation and Afforestation ($p = 0.904$) did not significantly predict personal responsibility in this model. Although these strategies are essential at the institutional and policy levels, the statistical results suggest that students may not be directly involved in or fully aware of these efforts in their school environment. This implies a potential disconnect between institutional climate programs and student engagement or visibility. For instance, renewable energy initiatives, such as the installation of solar panels, may not be sufficiently integrated into students' daily experiences or educational activities. This highlights the need for schools to enhance student participation and the visibility of these strategies. Schools could incorporate energy-themed lessons, project-based activities, or student-led tree-growing initiatives to make these efforts more tangible and relatable to learners, which would likely increase student engagement and responsibility in these areas.

Thus, the findings underscore the importance of visible, participatory, and relatable environmental programs, particularly those focused on carbon reduction and waste management, in shaping personal responsibility among students. Schools should prioritize these high-impact strategies and ensure that renewable energy and reforestation initiatives are also integrated more meaningfully into student experiences. By doing so, schools can offer a holistic approach to climate education that empowers students to actively engage in addressing climate change, thus producing a generation that not only understands the importance of climate action but is also committed to taking steps to mitigate its effects.

Table 3 Regression Analysis of climate change mitigation strategies implemented influences the personal responsibility among Generation Alpha and Generation Z

Model Coefficients - Personal Responsibility

Predictor	Estimate	SE	t	p
Intercept	0.3951	0.3856	1.025	0.308
Renewable Energy Adoption	0.0197	0.1372	0.144	0.886
Carbon Emissions Reduction	0.4607	0.1487	3.098	0.003
Reforestation and Afforestation	0.0147	0.1218	0.121	0.904
Waste Reduction and Recycling	0.3385	0.0996	3.400	<0.001

Note: Adjusted $R^2=0.40$, $p=0.000$

CONCLUSION

The findings of this study confirm that climate change mitigation strategies implemented in Schools A and B in Cagayan de Oro City play a meaningful role in shaping the personal responsibility of students from Generation Alpha and Generation Z. Among the strategies assessed, waste reduction, recycling, and carbon emissions reduction significantly influenced students' willingness to take environmental action, their perceived roles in climate solutions, and their sense of duty toward future generations. These two practical and highly visible strategies within the school context had the most substantial behavioral impact, affirming the importance of experiential

learning and routine-based environmental engagement in educational settings.

Although students acknowledged renewable energy adoption and reforestation efforts, they did not show a statistically significant influence on personal responsibility. This suggests that while such strategies are institutionally valuable, they may lack direct student participation or visible integration into daily school life. Overall, students demonstrated a high level of environmental responsibility, with the strongest expressions found in their sense of intergenerational duty and willingness to act. These results emphasize the need for school programs that are not only policy-driven but also student-centered, ensuring that mitigation strategies are relatable, participatory, and aligned with students' developmental stages and environmental awareness.

Recommendations

Based on the findings, the following recommendations are proposed:

- For School Administrators:** Strengthen student participation in carbon emissions reduction activities, such as energy-saving contests, bike-to-school campaigns, and awareness drives, to enhance direct student engagement in low-carbon practices.
- For Environmental Coordinators and Teachers:** Integrate students into classroom activities and project-based learning tasks to enhance their visibility and involvement in renewable energy and reforestation programs.
- For Local Government and Policy Makers:** Collaborate with schools to support waste reduction and recycling programs through grants, infrastructure (e.g., eco-bins), and community partnerships to scale best practices.
- For Curriculum Developers:** Integrate behavioral-focused environmental modules that provide knowledge and cultivate values, decision-making, and student-led advocacy in both basic and tertiary education.
- For Future Researchers:** Explore further the impact of long-term climate education interventions and assess their influence across a broader sample size and regions to validate intergenerational patterns in environmental responsibility.

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