# Uncovering Students' Understanding on Climate Change, Vulnerability, and Disaster Risk Management among Selected Secondary Schools in the Philippines

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**Abstract.** This study explored students' understanding of climate change vulnerability and disaster risk management in selected secondary schools in the Philippines, surveying 522 students. The findings revealed significant knowledge gaps, particularly in specific adaptation and mitigation strategies. While 49.5% of students recognized causes like CO2 emissions, fewer understood impacts such as ocean acidification (23.9%). The internet (81.6%) and formal education (65.6%) were primary information sources, yet only 41.3% felt partially prepared for natural hazards. Significant relationships were identified between latent variables and observed variables, such as Endogenous1 to A ($\beta = 0.1567$, $Z = 13.151$, $p < 0.001$) and Endogenous2 to D ($\beta = 0.0727$, $Z = 14.735$, $p < 0.001$), though variable C showed no significant relationship ($\beta = 0.0009$, $Z = 0.407$, $p = 0.684$). The covariance between Endogenous1 and Endogenous2 was significant (3.818, SE = 0.24133, $Z = 15.821$, $p < 0.001$). The study recommends enhancing the climate change curriculum with detailed modules on lesser-known impacts, using interactive learning tools, conducting teacher training, and increasing disaster simulations. A comprehensive climate education program, featuring a digital platform for interactive learning and real-time updates, is proposed to improve students' climate literacy and preparedness.

**Keywords:** Climate Change Education, Disaster Risk Management, Student Knowledge Gap.

## 1 Introduction

Climate change refers to long-term alterations in temperature and weather patterns that result from both natural processes and human activities [1]. It poses significant threats across multiple domains, impacting both living and non-living systems. As the severity of climate change escalates, it crosses various security thresholds, affecting people's vulnerability and risk exposure. Understanding the intricate dynamics between risk, exposure, and vulnerability is essential to effectively addressing the challenges posed by climate change.

This study operates under the assumption that individuals or communities exposed to greater levels of risk become more vulnerable over time. The vulnerability of a population or system is defined by various factors such as socioeconomic conditions,

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preparedness, resilience, and the quality of infrastructure. Education plays a pivotal role in mitigating climate risks by equipping individuals with knowledge, empowering communities to adopt sustainable practices, and preparing them for future challenges.

In recognizing the importance of education, this research aims to investigate students' understanding of climate change, vulnerability, and disaster risk management in secondary schools in the Philippines. By uncovering these insights, the study hopes to contribute to the development of a more comprehensive climate change education framework that enhances both student knowledge and resilience to climate impacts.

## 2 Review of Related Literature

Risk is the product of three primary factors: hazard, exposure, and vulnerability [2]. Hazards refer to potential threats—both natural and man-made—such as earthquakes, floods, or hurricanes. Exposure involves the presence of people, infrastructure, or valuable assets in areas prone to hazards, while vulnerability is the susceptibility of those elements to damage or harm. By multiplying these three factors, the equation:

Risk= Hazard × Exposure × Vulnerability

underscores that the likelihood and magnitude of risk can be altered by addressing any of these components. Reducing exposure or strengthening resilience can lower overall risk, a concept that underscores the importance of educating communities about climate change and disaster preparedness.

### 2.1 The Role of Media in Shaping Climate Change Awareness

Media coverage plays a critical role in shaping public understanding of climate change. According to Antilla [3], media portrayals vary across regions, influencing public engagement and awareness. For instance, Billett [4] highlighted how different reporting styles in India shaped public perception, often leading to divergent levels of engagement with climate issues. Similarly, Anderson [5] emphasized the media's role in influencing discourse on climate change by either amplifying or minimizing the scientific consensus.

In recent years, media coverage has shifted towards more urgent language during global events such as the 2021 United Nations Climate Change Conference. MeCCO reported that terms like "climate catastrophe" and "climate emergency" became more prevalent, reflecting a growing recognition of climate risks. Accurate media coverage remains essential in fostering public understanding of climate tipping points and promoting informed decision-making [6].

**Integrating Climate Change into Education Systems.** Education is a powerful tool for mitigating the impacts of climate change. UNESCO has been a leader in promoting climate change education (CCE) across the globe, advocating for its inclusion within formal education systems. According to UNESCO's "Getting Climate-Ready" initiative, integrating climate action into school curriculums fosters both ecological consciousness and resilience. UNESCO's approach emphasizes the need for comprehensive educational reforms that incorporate sustainability into every aspect of school life [7].

Furthermore, the United Nations Framework Convention on Climate Change (UNFCCC) underscores the importance of embedding climate education into formal education systems. By fostering climate change literacy, education can prepare individuals, particularly the youth, to take informed action against climate challenges [1].

### 2.2 Disaster Preparedness and Resilience in Philippine Schools

In the Philippine context, disaster preparedness is a crucial part of climate education. The Department of Education (DepEd) has implemented policies to integrate disaster risk management (DRM) into the curriculum through the Philippine Disaster Risk Reduction and Management Act of 2010. Mac Mamon (2017) emphasized the importance of equipping students and educators with the knowledge needed to respond to hazards effectively. This law mandates schools to play an active role in preparing students for disaster scenarios.

However, despite these initiatives, gaps remain in the implementation of disaster preparedness programs. Tan et al. [8] found that many schools in the Philippines still lack adequate safety facilities and preparedness protocols, leaving students and teachers vulnerable to disasters. The study noted that while earthquake drills are frequently conducted, other preparedness programs, such as fire drills, are often neglected.

Collaboration between DepEd, Save the Children, and other organizations has led to the development of the "Education Safe from Disasters" initiative, aimed at digitalizing disaster preparedness systems in schools (Mateo, 2019). Nevertheless, the lack of resources continues to impede full implementation.

The role of teachers is critical in building students' climate literacy and disaster preparedness. Salita et al. [9] explored the effectiveness of lay responder disaster training (LRDT) programs in improving teachers' disaster preparedness. The study demonstrated that teachers who received specialized training were better equipped to integrate disaster risk reduction strategies into their lessons.

Further evidence suggests that teacher training programs need to be expanded to cover climate change topics comprehensively. Research by Johnson (2019) revealed that teachers who are more knowledgeable about climate change not only enhance students' understanding but also foster resilience in the face of climate-related challenges.

The literature underscored the interplay between media, education, and policy in shaping public understanding of climate change. While global initiatives, such as those led by UNESCO and the UNFCCC, have made strides in promoting climate literacy, gaps remain in how this knowledge is conveyed and applied at the local level. In the Philippines, disaster preparedness and climate education are integrated into the national

curriculum, but issues such as inadequate resources and inconsistent implementation continue to hamper progress. Ensuring that educators are well-equipped with the necessary knowledge and tools is essential for fostering resilience among young learners. By addressing these challenges, education can play a pivotal role in mitigating the risks associated with climate change and empowering communities to take informed action.

## 3 Methodology

This study employed a quantitative research design to collect and analyze data from 522 students using descriptive, correlational, and causal-comparative methods. Descriptive research was used to describe participant demographics, while correlational research examined the relationships between students' understanding of climate change, preparedness, risks, and vulnerabilities. Causal-comparative research identified differences in these areas, analyzed using Structural Equation Modeling (SEM). A census method was used to survey the entire student population via a Google Forms questionnaire, which collected data on their demographics, climate change knowledge, and preparedness. The instrument was validated through expert review and a pilot study, achieving a Cronbach's Alpha value of 0.959, indicating high reliability. Ethical considerations were observed, including participant consent and confidentiality. Data analysis was conducted using statistical software, applying methods such as weighted mean, standard deviation, and SEM to explore relationships between variables, with ANOVA used to assess group differences based on demographic factors.

## 4 Results

### 4.1 Demographic Profile of Students

The demographic profile of the students showed a diverse sample of 522 participants, including 248 males, 267 females, and 7 identifying as others, indicating strong gender diversity. The age range of the students spanned from 12 to 35 years, covering both secondary and higher basic education levels. Geographically, most students (447) were from Region IV-A (Calabarzon), followed by 44 students from Region IV-B (MIMAROPA), with smaller numbers from other regions.

### 4.2 Students' Knowledge on Disaster Risk

A significant percentage of respondents (56.2%) could accurately identify key causes of climate change, such as greenhouse gas emissions, deforestation, and industrial activities. Additionally, 48.7% of respondents understood the consequences of human influence on climate change, including rising temperatures, sea-level rise, and increased frequency of extreme weather events. Approximately 42.5% of respondents were knowledgeable about the evidence used to verify the occurrence of global climate change, such as temperature records, ice core samples, and observed changes in weather patterns. Furthermore, 53.8% of respondents could describe measures for mitigating climate change, including reducing carbon emissions, increasing renewable energy use, and implementing energy efficiency practices. The most recognized adaptation strategy

among students was water storage and conservation techniques, acknowledged by 61.3% of respondents.

### 4.3 Students' Knowledge and Preparedness on Climate Change

A comprehensive understanding of global climate change, including its causes, effects, and scientific consensus, was possessed by 46.9% of students. The Internet was identified as the primary source of information on climate change for 81.6% of students, followed by formal education at 65.6%. There was a significant relationship between students' knowledge and their preparedness for climate-related disasters. For instance, higher awareness of climate change's impact on health, such as the increase in serious infectious diseases, was recognized by 26.9% of students.

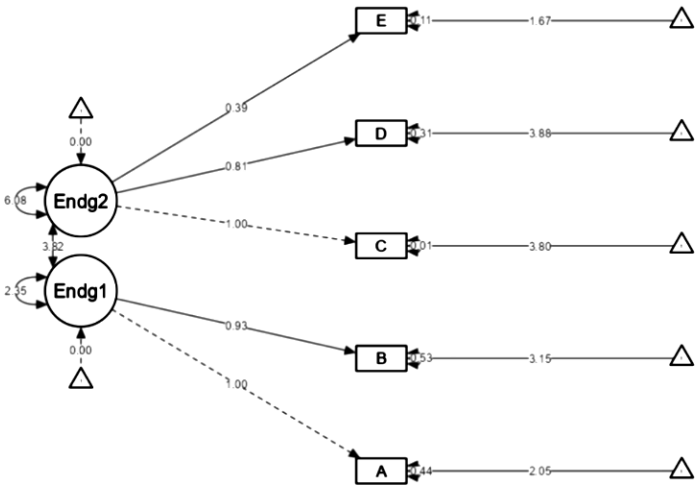


**Figure 1. Relationship Between Latent and Observed Variables**

The figure above illustrates the analysis using Structural Equation Modeling (SEM) which showed significant relationships between latent variables (Endogenous1 and Endogenous2) and observed variables (A, B, D, E), except for variable C. The path coefficients were significant with p-values less than 0.001, indicating strong causal effects for most variables (see figure below)

**Table 1. Correlation Between Endogenous 1 and Endogenous 2**

| | | Path Coefficients & Co-variances | P-Value | Interpretation | Conclusion |
|---|---|---|---|---|---|
| Is there a significant relationship between latent and observed variables? | Ho1: There is no significant relationship between latent and observed variables. | A: β = 0.1567, Z = 13.151<br>B: β = 0.2056, Z = 14.477<br>C: β = 0.0009, Z = 0.407<br>D: β = 0.0727, Z = 14.735<br>E: β = 0.1081, Z = 15.635 | A: <.001<br>B:<.001<br>C: .684<br>D: <.001<br>E: <.001 | There is significant relationships between latent variables (Endg1 and Endg2) and observed variables (A, B, D, E).<br>No significant relationship for variable C. | Ho1 is rejected for A, B, D, E, except for C, (<0.05) |
| Is there a significant correlation between Endogenous 1 and Endogenous 2 in observed variables? | Ho2: There is no significant correlation between Endogenous 1 and Endogenous 2 in observed variables. | Endogenous1 and Endogenous2: Estimate= 3.818, SE= 0.24133, Z= 15.821 | <.001 | There is significant correlation between Endogenous1 and Endogenous2. | Ho2 is rejected |

***Note: p-value should be = or <0.05***

Table 1 summarized the study's key findings, focusing on the relationships between latent and observed variables and the correlation between latent variables Endogenous1 and Endogenous2. The results revealed significant path coefficients for variables A (β = 0.1567, Z = 13.151, $p < 0.001$), B (β = 0.2056, Z = 14.477, $p < 0.001$), D (β = 0.0727, Z = 14.735, $p < 0.001$), and E (β = 0.1081, Z = 15.635, $p < 0.001$), indicating strong relationships. However, variable C (β = 0.0009, Z = 0.407, $p = 0.684$) shows no significant relationship.

The significant path coefficients align with the general principles of structural equation modeling (SEM), which emphasized the importance of identifying robust relationships between variables. The significant findings for variables A, B, D, and E support previous research indicating that these factors are critical in understanding climate change impacts and preparedness. The non-significant result for variable C suggests that this measure might not be as reliable or relevant in this context, indicating an area for further investigation and model refinement.

The significant relationships between the latent variables (Endogenous1 and Endogenous2) and most observed variables (A, B, D, and E) validated the study's hypotheses and emphasized the importance of these factors in climate change education and disaster risk management. The significant covariance between Endogenous1 and Endogenous2 (3.818, SE = 0.24133, Z = 15.821, $p < 0.001$) further underscores the interconnection between students' understanding of climate change and their preparedness. This strong correlation suggests that improvements in understanding are likely to enhance preparedness, supporting the study's recommendations for comprehensive climate change education programs. The non-significant result for

variable C highlights the need for ongoing model adjustments to account for unexplained variances and ensure the reliability of the findings.

### 4.4 Proposed Climate Change Education Program

Based on these findings, a Climate Change Education Program may be proposed to enhance students' understanding and preparedness. This program should focus on increasing awareness of climate change causes, effects, and mitigation strategies, utilizing reliable sources of information, and improving preparedness for natural hazards. The proposed program could include modules/topics on program summary, background, objectives, significance, focal persons, methodology, costs, monitoring and evaluation strategies, next steps, and a detailed program work plan.

## 5 Conclusions

Considering the significant findings of this study, it can therefore be concluded that: First, a balanced gender distribution among the students, with a significant age range from 12 to 35 years. Most students were from Region IV-A (Calabarzon), highlighting a representative sample from the target demographic. This diverse demographic profile is crucial for understanding the varied perspectives on climate change and disaster risk management.

Second, findings indicate that 56.2% of students could accurately identify key causes of global climate change, such as greenhouse gas emissions and deforestation. However, only 26.9% understood the health impacts, like the increase in serious infectious diseases. Approximately 42.5% of students could identify evidence of global climate change, such as temperature records and observed weather pattern changes. A significant portion, 53.8%, were aware of mitigation measures like increasing renewable energy use, and 61.3% recognized adaptation strategies, including water conservation techniques.

Third, the study found that while 46.9% of students demonstrated a comprehensive understanding of global climate change, the primary source of information was the internet (81.6%), followed by formal education (65.6%). Despite this, only 41.3% of students felt partially prepared for natural hazards, indicating a gap in practical preparedness measures and highlighting the need for improved educational strategies to enhance preparedness.

Fourth, the SEM analysis revealed significant relationships between the latent variables (Endogenous1 and Endogenous2) and observed variables A, B, D, and E, with strong path coefficients. However, the non-significant relationship for variable C suggests an area for further investigation.

Fifth, there was a significant correlation between Endogenous 1 and Endogenous 2 with the observed variables. The computed overall r value of 0.720 with a p-value of 0.000 indicates a high positive and significant relationship between the latent variables.

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