SCHOOL ENVIRONMENTAL COMMITMENT AND INSTITUTIONAL FACTORS AS PREDICTORS OF STUDENTS' ENVIRONMENTAL ATTITUDES

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SUMMARY

The present study aims to examine how institutional-level factors influence students' environmental attitudes in the context of environmental education in secondary schools. Using data from 1,197 students from 15 schools in the Biobío Region of Chile, the research employed the "Environmental Challenges and Self" dimension of the ROSE questionnaire. Kruskal–Wallis tests and Spearman correlations identified significant differences in environmental attitudes associated with school enrollment size, teacher-led environmental initiatives, and the inclusion of environmental topics in the Institutional Educational Project (PEI). Multilevel linear modeling demonstrated that institutional environmental commitment is a strong and positive predictor of students' pro-environmental attitudes. In contrast, structural equation modeling revealed significant negative effects of school size and teaching activity intensity. Institutional commitment partially mediated these relationships. These findings highlight the relevance of a consistent and explicit institutional commitment to sustainability in fostering positive environmental attitudes among students, although institutional structural constraints may reduce the magnitude of this influence. The results underscore the central role of organizational culture and institutional coherence in promoting effective environmental education.

Introduction

In recent decades, global environmental challenges have generated growing concern about the impact of the current development model (UNESCO, 2017). Environmental education has become a key tool for the formation of a critical citizenry committed to sustainability (Sterling, 2010; Tilbury, 1995), promoting the development of skills, values and attitudes oriented toward social transformation in favor of more sustainable ways of life (Cebrián and Junyent, 2015).

Various studies have shown that the school environment is a decisive factor in shaping attitudes during adolescence, an essential stage for building values and a sense of agency (Ardoin *et al*., 2017). Its effectiveness depends not only on curricular incorporation, but also on institutional conditions. Factors such as institutional environmental commitment, school size, the School Vulnerability Index (SVI) of students, and environmental activities promoted by teachers are fundamental for the promotion of sustainable attitudes (Aguilar *et al*., 2025; Jensen and Schnack, 2006).

In Chile, the National Environmental Certification System for Educational Establishments (SNCAE) seeks to strengthen institutional commitment through standards that integrate

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school management, participation and curriculum. Although progress has been documented in environmental practices, their impact depends on contextualized and coherent implementation (Aguilar *et al*., 2025; Salazar *et al*., 2024). Additionally, the international Relevance of Science Education Second (ROSES) project highlights a paradox among young people: they express concern for the environment but show skepticism regarding their ability to influence change (Sjøberg and Schreiner, 2019), which reveals the need to strengthen self-efficacy and collective agency.

The present study examines how structural and pedagogical factors in schools affect students' environmental attitudes. Specifically, it evaluates the impact of institutional environmental commitment, school size, the SVI and teacher-led environmental initiatives on 1,197 secondary school students in the Biobío region of Chile. The study applies non-parametric exploratory analyses, Multilevel Models (MLM) and Structural Equation Models (SEM) to investigate direct effects and institutional mediation mechanisms.

From a critical perspective on environmental education, which emphasizes student participation, critical reflection and empowerment (Sauvé, 2005; Sterling, 2010), this research addresses the school factors that influence students' environmental attitudes, with implications for educational policies and sustainable teaching practices. Accordingly, the study addresses the following research question: To what extent do institutional factors—such as environmental commitment, school size, school vulnerability index and teacher-led environmental activities—influence students' environmental attitudes, and what mediating relationships exist among these institutional variables?

Environmental education in the face of the socio-ecological crisis

While the educational approach is crucial, its effectiveness is significantly limited when it relies solely on informational, reductionist or decontextualized methods (Amérigo and García, 2014; Kollmuss and Agyeman, 2002). This critique has led to an evolution in theoretical foundations, recognizing that fostering sustainable attitudes and behaviors requires the integration of cognitive, affective and participatory components (Chérrez *et al*., 2025; Sterling, 2010). Thus, environmental education is conceived as a comprehensive strategy for developing capacities for transformative action that go beyond mere knowledge acquisition.

Traditionally, environmental education was guided by the KAP (Knowledge–Attitude–Practice) model, which assumes a linear relationship between knowledge, attitudes and sustainable behaviors (Pooley and O'Connor, 2000). However, research indicates that knowledge alone does not guarantee environmental engagement or action (Kollmuss and Agyeman, 2002). This disconnect highlights the need to rethink educational approaches, incorporating psychological, social and contextual factors that mediate the relationship between knowledge and action (Amérigo and García, 2014).

The current environmental crisis underscores that ecological issues are intertwined with broader social, economic and cultural dimensions (González-Gaudiano, 2005). The formation of sustainable attitudes therefore involves promoting a critical understanding of the structural causes of environmental degradation and socio-ecological inequalities. Several authors argue that environmental education must integrate interdisciplinary perspectives, enabling students to analyze environmental conflicts through ethical, political and social justice lenses (Jickling and Sterling, 2017). This approach aims to strengthen commitment and capacity for action in addressing sustainable development challenges, advocating for an educational approach that not only informs but also empowers critical reflection, participation and socio-environmental transformation.

Critical approach to environmental education

In environmental education, teachers serve as key mediators, facilitating learning processes by integrating local knowledge, lived experiences and collective deliberation (Stevenson *et al*., 2013). Classrooms become dynamic spaces for dialogue and the co-construction of environmental meanings, fostering student agency and environmental commitment (Gadotti, 2003). Rudsberg and Öhman (2010) emphasize the importance of considering social constructions that are mediated by power relations in education.

In Latin America, this approach is enriched by frameworks that link environmental education with popular education, human rights and social justice (González-Gaudiano, 2020; Jickling and Sterling, 2017). Within this perspective, the environment is not only an object of study but also a field of ethical, political and cultural dispute. Students are viewed as active agents of social transformation (Rickinson, 2001).

This perspective enhances the emancipatory potential of critical environmental education, connecting educational processes to struggles for territory, identity and equity. Barraza and Walford (2002) highlight how engaging with real environmental issues can significantly influence students' attitudes, particularly when these issues are connected to everyday concerns. Mogensen and Schnack (2010) stress the importance of democratic participation and critical thinking in developing students' environmental action competence. Jickling and Wals (2008) advocate for an education that promotes critical reflection and active participation in addressing environmental challenges.

Institutional factors influencing its implementation

The effectiveness of environmental education is heavily influenced by institutional conditions. Studies indicate that factors such as institutional environmental commitment, school size, the School Vulnerability Index (SVI/IVE), teacher-organized environmental activities and their integration into the Institutional Educational Project (PEI) significantly impact educational outcomes (Rickinson, 2001; Salazar *et al*., 2024; Stevenson *et al*., 2013).

In Chile, the SNCAE aims to strengthen schools' environmental commitment through standards encompassing school management, curriculum and community participation. However, research warns that formal environmental policies alone do not ensure meaningful impact without effective pedagogical integration (Husin *et al*., 2025; Salazar *et al*., 2024).

Tilbury and Henderson (2004) highlight that embedding environmental approaches into a school's organizational culture, rather than treating them as add-on initiatives, leads to greater commitment from teachers and students. This requires intentional school management efforts to consolidate a shared vision, establish consistent practices and create authentic participation opportunities, enabling students to incorporate sustainability values into their daily educational experience. Consistency between institutional discourse and teaching practices is crucial for transformative education (Rousell and Cutter-Mackenzie-Knowles, 2020).

Structural factors such as school size and the SVI also affect the capacity to implement critical and participatory environmental education (Stevenson, 2013). Schools with more

resources and staff tend to offer more meaningful projects, while those in vulnerable contexts face significant challenges (González-Gaudiano, 2005). Understanding these institutional factors is key to interpreting students' environmental attitudes and their responses to socio-ecological challenges.

Young people's perceptions and attitudes towards the environment

The international ROSES project, led by Sjøberg and Schreiner (2019), has gathered significant insights into young people's environmental attitudes across more than 40 countries. A key finding is the contrast between high environmental concern and low expectations regarding the possibility of reversing the crisis. This trend, also observed in Latin America, indicates that awareness alone does not ensure active engagement (Benayas and Blanco-Portela, 2019). Contributing factors include low self-efficacy, limited participation opportunities and the belief that crucial decisions are beyond individual control (Guerra *et al*., 2020). Additionally, youth eco-anxiety has emerged as a response to distress over environmental issues and perceived institutional inaction (González-Gaudiano, 2020).

Research emphasizes the importance of empowering youth to translate environmental awareness into action (Chawla and Cushing, 2007; Stevenson *et al*., 2013). Environmental education can be pivotal by fostering spaces that validate student opinions, encourage participation in decision-making and offer transformative experiences within schools and communities. Recognizing young people's perceptions and expectations is vital for developing educational practices that respond to their needs and aspirations, a primary aim of this study's analysis.

While previous research has explored the influence of environmental education on student attitudes, few studies have examined how institutional factors—such as school size, SVI and teacher-led activities—interact with institutional commitment to shape pro-environmental attitudes. This study addresses this gap by integrating MLM and SEM to analyze both direct and mediated effects. By focusing on secondary schools in Chile, it provides context-specific evidence on how structural constraints and institutional coherence affect the effectiveness of environmental education, offering a valuable analytical framework for future research and policy development.

Materials and Methods

The sample consisted of 1,197 secondary school students aged 15 and 16, in their second year of secondary education, from fifteen educational establishments in the Biobío Region of Chile. Although the sample was selected non-probabilistically and for convenience, efforts were made to ensure representation of the three main types of secondary schools in the Chilean education system. The sample included one public school, nine subsidized schools and five private schools.

Section E of the ROSES questionnaire, entitled "Environmental Challenges and Me," was used for this study (Table I). The main question in this section is: "How much do you agree with the following statements about environmental problems (such as air and water pollution, overuse of resources, global climate change, etc.)?"

Data collection was carried out in three stages: (1) application of the ROSES questionnaire to students, authorized by the school administration, with informed consent obtained from parents and assent from students; (2) characterization of educational institutions, including information on SNCAE environmental certification, the declaration of respect and care for the environment in the PEI, institution size, location and SVI; and (3) semi-structured interviews with a science teacher from each school where the questionnaire was administered (n=15), in order to explore how environmental issues are addressed in classroom instruction.

The research protocol was reviewed and approved by the Research Ethics Committee of the Universidad Católica de la Santísima Concepción (approval number 07/2022), in compliance with national regulations on research involving minors.

The data analysis followed three complementary phases: exploratory analysis, multilevel modeling and structural equation modeling. This analytical design addressed the need to examine both initial group differences and the complex relationships

TABLE I
STATEMENTS FROM THE QUESTIONNAIRE

	Statements	Disagree 1	2	3	Agree 4
D1.	Threats to the environment are none of my business				
D2.	Environmental problems make the future of the world look bleak and hopeless.				
D3.	Science and technology can solve all environmental problems				
D4.	I am willing to see environmental problems solved, even if it means doing without a lot of things.				
D5.	I can personally influence what happens to the environment.				
D6.	We can still find solutions to our environmental problems				
D7.	People worry too much about environmental problems				
D8.	Environmental problems can be solved without major changes in the way we live.				
D9.	People should be more concerned about protecting the environment				
D10.	Solving the world's environmental problems is the responsibility of rich countries.				
D11.	Environmental problems should be left to experts				
D12.	I feel optimistic about the future				
D13.	Almost all human activities harm the environment				

Source: extracted from section E of the ROSES questionnaire.

between institutional variables and student attitudes. Robust statistical techniques suitable for non-parametric and hierarchical data were chosen, such as the Kruskal–Wallis test and MLM, while SEM was used to explore mediating effects among variables. Each phase is described below, with an emphasis on its contribution to achieving the study's objectives.

Phase 1: Exploratory analysis of variability of institutional variables

In the exploratory analysis, IBM SPSS Statistics version 23 was used to conduct the non-parametric Kruskal–Wallis test (Kruskal and Wallis, 1952). This test was employed to compare differences in students' environmental attitudes according to various institutional characteristics, such as SNCAE environmental certification, the inclusion of environmental education in the PEI, the SVI and the geographical location of the institution.

As the scale used was ordinal (Likert-type) and exhibited non-normal distribution in several of its dimensions, a robust non-parametric technique was selected, namely the Kruskal–Wallis test, which allows comparison of medians between groups without requiring assumptions of normality or homogeneity of variances (Field, 2013). This approach is widely recommended in social science and educational research when working with ordinal data or unequal group sizes (Conover, 1999). The use of this test ensured analytical rigor and consistency in the treatment of the data.

Furthermore, Spearman's Rho correlation coefficient was used to evaluate the associations among the variables under investigation, following the methodology outlined by Elorza and Medina (1999). This coefficient is particularly useful when measuring monotonic relationships between ordinal variables, thereby providing a more detailed view of the interactions between school characteristics and student attitudes.

Based on the above, methodological choices were made to strengthen the analysis of the six initial independent variables as predictors of students' environmental attitudes. To this end, an analysis of the dispersion and variability of the independent variables was conducted across the 15 schools, as shown in Table II.

Table II presents the categorical dispersion of six institutional-level variables, along with their means and standard deviations for the schools included in the study. Although school size and the level of teacher-led environmental activity showed acceptable variability, variables such as SNCAE certification, inclusion of environmental education in the PEI, location and SVI showed limited variability, which could affect their statistical sensitivity in multivariate models. The participating schools ranged in size from 361 to 1,062 students.

To strengthen the robustness of subsequent analyses, the variables "SNCAE certification" and "inclusion of environmental education in the PEI" were combined into a new composite variable called "school environmental commitment." This regrouping resulted in a more balanced distribution across schools. The construction of this composite variable improved analytical stability by classifying schools with at least one of the two criteria as institutionally committed. This decision aimed to maintain theoretical consistency while reducing distributional imbalance for subsequent modeling.

Considering the results of this exploratory analysis and the observed variability among institutional variables, a consolidated set of predictors was formulated for use in multivariate models:

School environmental commitment: this variable combines two indicators—SNCAE certification and inclusion of environmental issues in the PEI (coding: 0= Low commitment (none); 1= Partial commitment (PEI or SNCAE); 2= High commitment (PEI + SNCAE)).

Teacher-led environmental activities: this variable is derived from semi-structured interviews with science teachers and categorized according to the frequency, scope and integration of environmental activities in curricular and extracurricular contexts (coding: 1= Basic; 2= Proficient; 3= Advanced).

School size: refers to total school enrollment, according to official records from the Ministry of Education (coding: continuous variable, number of students).

School Vulnerability Index (SVI): based on the official socioeconomic vulnerability classification of the Ministry of Education using national indicators (coding: 1= Low; 2= Medium; 3= High).

Phase 2: Multivariate modeling

From this stage onward, R software (version 2025.05.1) was used to apply multivariate models using statistical packages such as lme4 and lavaan. MLM and SEM were employed to assess the effects of institutional variables on students' environmental attitudes, with

TABLE II
DISPERSION OF SCHOOL-LEVEL VARIABLES

Variable	Mean	Standard Deviation	Range	Observations
Certification SNCAE (0= no, 1= yes)	0.312	0.463	1.0	Most schools are not certified (68.8%). Low variability.
PEI Inclusion (0 = no, 1 = yes)	0.267	0.442	1.0	Most do not include environmental education in PEI (73.3%). Low variability.
School size (1= small, 2= medium, 3= large)	2.326	0.62	2.0	Acceptable variability: 8.2% small, 51% medium, 40.8% large.
School location (1= central, 2= peripheral)	1.732	0.443	1.0	Most schools are in peripheral areas (73.2%). Low variability.
School vulnerability index (SVI) (1= low, 2= high)	1.121	0.327	1.0	87.8% of students with low vulnerability. Very low variability.
Teacher activity level (1= basic, 2= competent, 3= advanced)	2.313	0.738	2.0	More variability: 16.4% basic, 35.8% competent, 47.7% advanced.

Source: own elaboration.

particular attention to school environmental commitment. The analysis examined direct relationships, moderation effects of school size and the influence of teacher-led environmental activities, as well as categorical interactions and mediation pathways (Hox *et al*., 2017; Hoyle, 2022). The multilevel models followed a two-level hierarchical structure (students nested within schools), and robust maximum likelihood estimators (MLR) were implemented in the SEM analysis due to the non-normal distribution of the data. Model fit and adequacy were evaluated using the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC).

Phase 3: Structural Equation Modeling (SEM)

In the final phase of the study, SEM was used to analyze mediating effects between institutional factors and students' environmental attitudes. This methodology enabled the simultaneous estimation of direct and indirect effects, offering a deeper understanding of the mechanisms underlying institutional influence. The SEM analysis complemented the MLM by incorporating mediation pathways through school environmental commitment. A weighting procedure was applied to address sampling bias arising from unequal group sizes across schools.

The analysis was conducted in two stages. First, MLM were estimated to account for the hierarchical nature of the data, allowing the estimation of fixed and random effects. Second, SEM was used to model mediation relationships and explore structural associations between institutional variables. In both cases, weighted student responses to the ROSES scale items were used as the dependent variable.

Results

The results obtained from the study are presented below and organized according to the three analytical phases described in the methodology.

Exploratory analysis

The results of the exploratory study reveal several significant trends in the environmental attitudes of secondary school students in the Biobío Region. Table III presents the descriptive statistics for each of the 13 Likert-type items related to students' attitudes toward environmental challenges, adapted from the ROSES questionnaire. The scores are based on weighted responses, adjusted for school size to ensure consistency with the multilevel and structural equation models used in the study. This approach provides a more accurate representation of each school's contribution to the overall results.

Overall, the responses reveal a predominantly pro-environmental attitude among students. Students express agreement with the perception that environmental problems make the future of the world look bleak and hopeless (D2P), while simultaneously indicating strong agreement that it is still possible to find solutions to these problems (D6P). There is also a high level of consensus that people should care more about protecting the environment (D9P).

Conversely, students disagree with the idea that threats to the environment are none of their business (D1P) and reject the statement that people worry too much about environmental problems (D7P). They also disagree with the notion that solving global environmental problems is solely the responsibility of rich countries (D10P).

In contrast, some items reveal more ambivalent attitudes. Students do not show a clear position regarding the belief that science and technology can solve all environmental problems (D3P). Similarly, there is no consensus concerning the idea that environmental problems can be solved without substantial changes in current lifestyles (D8P), nor regarding optimism about the future (D12P).

Figure 1 shows the distribution of student responses to the statement "Environmental problems are not my concern" (item D13P), comparing schools with and without institutional environmental commitment. Higher values on this item reflect greater personal concern about environmental issues (i.e., lower levels of indifference). The boxplot reveals a visible upward shift in the weighted median and mean response (marked by the red diamond) in schools with environmental commitment. This pattern is statistically significant, as confirmed by the Kruskal–Wallis test (χ^2= 239.169, df= 2, p< 0.001). Due to weighting by school size, values may extend beyond the original scale range; this is a statistical adjustment artifact and does not imply a modification of the underlying scale.

Boxplots represent the interquartile range (IQR), with whiskers extending up to 1.5 × IQR, and the red diamonds indicate the weighted mean. This visual pattern, consistent with the statistical test results, reinforces the interpretation that institutional environmental commitment is associated with greater environmental concern among students.

The results of the exploratory analysis (Kruskal–Wallis non-parametric test, used to examine differences in students' environmental attitudes according to institutional variables) revealed statistically significant differences, particularly in items D12P (p= .0003) and D13P (p= 0.001) for groups with and without environmental issues included in the PEI, and in item D7P (p= 0.014) when comparing the level of teacher-led environmental activities (Table IV). These findings suggest that specific institutional factors are associated with more favorable environmental perceptions among students. Similar analytical strategies have

TABLE III
DESCRIPTIVE STATISTICS OF THE ROSES QUESTIONNAIRE (WEIGHTED DATA)

Item	Mean	N	SD
D1P	1.846712	1186	2.550720
D2P	3.230932	1180	4.134228
D3P	2.600085	1176	3.499514
D4P	2.979153	1180	3.859178
D5P	2.747004	1185	3.579025
D6P	3.256661	1186	4.114038
D7P	1.896967	1187	2.584538
D8P	2.322739	1183	3.277307
D9P	3.555126	1190	4.329860
D10P	1.975567	1191	2.911513
D11P	2.072766	1186	2.744687
D12P	2.492432	1176	3.396604
D13P	2.930892	1188	3.877255

Source: own elaboration.

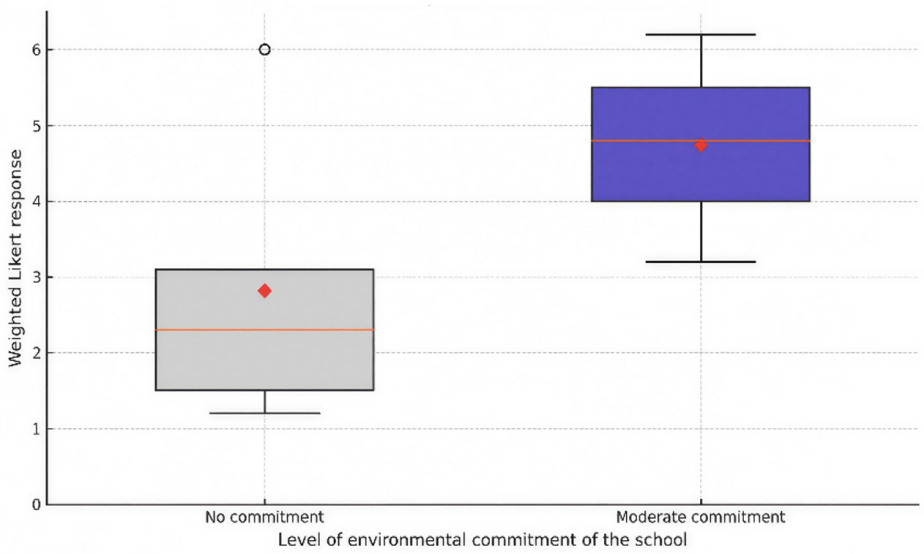

Figure 1. Distribution of responses to item D13P: "Environmental problems are not my concern".

been used in prior environmental education studies, such as Ardoin *et al*. (2012), who reported significant attitudinal differences between schools with different approaches to environmental education.

Table IV presents the questionnaire items that showed statistically significant differences ($p< 0.05$) according to the Kruskal–Wallis test, grouped by institutional variable. Students attending schools with higher levels of teacher-led environmental engagement tended to report more favorable environmental attitudes, with median scores increasing according to the level of teacher participation (Basic → Proficient → Advanced). This trend was consistent across items measuring environmental concern.

Spearman's correlation coefficients were calculated to assess bivariate associations between the institutional variables. A moderate positive correlation ($\rho= 0.309$) was found between teacher-led environmental activities and school size. Significant correlations also emerged between school size and SVI, as well as between school location and SNCAE environmental certification. However, no significant association was identified between SVI and teacher-led environmental actions.

The results indicate that specific institutional characteristics, such as school size, the level of teacher-led environmental activity and the inclusion of environmental topics in the PEI, are associated with variations in students' environmental attitudes. However, these exploratory techniques do not allow for the simultaneous examination of multiple predictors or the identification of mediating relationships among variables. Therefore, more robust multivariate models were applied to evaluate the combined effects of these institutional factors and to explore potential mechanisms of mediation, enabling a more comprehensive and rigorous understanding of the phenomenon.

Results of Multilevel Models (MLM) implementation

MLM allowed a more in-depth analysis of the patterns identified in the exploratory phase by simultaneously considering individual-level and school-level predictors of students' environmental attitudes. This analytical approach accounts for the hierarchical structure of the data (students nested within schools) and estimates the influence of variables operating at different levels.

The effects of school environmental commitment, school size and the level of teacher-led environmental activity were examined, as well as potential interaction effects among these factors. Initially, a model using the untransformed dependent variable was estimated; however, violations of normality and heteroscedasticity assumptions required the use of a logarithmic transformation. For comparative purposes, the results of both approaches are presented.

A three-level mixed linear model was estimated using maximum likelihood estimation to reflect the nested nature of the data. Random intercepts were specified for students, schools and questionnaire items. The intraclass

TABLE IV
ITEMS WITH STATISTICALLY SIGNIFICANT DIFFERENCES BY INSTITUTIONAL VARIABLE (KRUSKAL–WALLIS TEST)

Institutional Variable	Items with significant differences ($p < 0.05$)	Brief Interpretation
School Certification	D12P (p= 0.041), D13P (p= 0.047)	Differences in perception of environmental responsibility
PEI Environmental Education	D12P (p= 0.003), D13P (p= 0.001)	Higher environmental attitudes in schools with environmental PEI
School Size	D1P (p= 0.032), D2P (p= 0.027), D3P (p=0.046), D4P (p= 0.020), D6P (p= 0.015), D7P (p= 0.009), D8P (p= 0.037), D13 (p= 0.028)	Consistent differences, especially in key attitudinal items
School Location	D1P (p= 0.022), D12P (p= 0.048)	Less consistent effects
School vulnerability index (SVI)	D1P (p= 0.017), D3P (p= 0.043), D5P (p= 0.034), D8P (p= 0.046), D11P (p= 0.050), D12P (p= 0.041), D13P (p= 0.044)	Positive trend among students with higher vulnerability

Source: own elaboration.

correlation coefficient (ICC) for schools was approximately 0.798, indicating that a substantial proportion of the variance in student responses was attributable to between-school differences, thereby justifying the use of multilevel modeling to capture institutional-level effects.

Without log transformation

The initial model showed a positive and statistically significant effect of school environmental commitment on students' environmental attitudes (β= 3.1353, p= 0.0243). However, inspection of the residuals indicated violations of normality and heteroscedasticity assumptions.

With logarithmic transformation of the dependent variable

To address these diagnostic issues, the dependent variable was log-transformed. In this adjusted model, school environmental commitment remained a positive and significant predictor (β= 0.1944, p= .0178). The transformed model demonstrated improved statistical fit and greater residual stability, and was therefore selected for the main interpretation of results.

Table V presents the estimated coefficients (β) and p-values for both the original MLM and the logarithmically transformed model. Although the transformation resulted in reduced effect sizes, the direction and significance of the relationships remained consistent. These findings indicate that school environmental commitment is a robust positive predictor of students' environmental attitudes across both models. The interaction term displayed a negative tendency, although it did not reach statistical significance.

MLM provided evidence of the direct influence of institutional factors, particularly school environmental commitment, within the hierarchical structure of the data (students nested within schools). However, because this approach focuses primarily on direct effects, SEM was applied to further explore the underlying relational mechanisms among institutional variables and to examine potential mediating effects.

Results of the SEM

To explore the structural relationships between institutional variables and students' environmental attitudes, Structural Equation Modeling (SEM) was applied. This technique allows for the simultaneous estimation of multiple relationships between latent and observed variables and is particularly useful for evaluating direct and indirect effects in complex educational contexts. The analysis included school environmental commitment, school size and teacher-led environmental activities as predictors. The model confirmed the relevance of institutional commitment as a direct predictor and examined the independent contributions of the other institutional factors to environmental attitudes. Standardized coefficients and their statistical significance were interpreted in accordance with the model fit indicators.

However, it is important to note that traditional SEM does not account for the hierarchical structure of the data (students nested within schools), which can result in inflated statistical significance and an increased risk of Type I errors. This methodological limitation has been widely documented in the literature (Muthén, 2004; Hox *et al*., 2017), as conventional SEM assumes independence among observations—a condition that is often violated in educational settings with clustered data.

Therefore, the results obtained from the SEM should be interpreted with caution, particularly regarding the magnitude and significance of indirect effects. This consideration highlights the importance of triangulating findings with other analytical approaches and the need for longitudinal or multilevel SEM designs in future research.

SEM: direct effects

The SEM analysis confirmed statistically significant direct effects on environmental attitudes. School environmental commitment exhibited a strong positive effect (β= 1.006, p < 0.001), while teacher-led environmental activities (β= −0.330, p< 0.001) and school size (β= −0.707, p< 0.001) showed negative direct effects. However, both institutional variables were also found to be positively associated with environmental engagement, suggesting the existence of a potential mediating mechanism in the institutional pathway influencing students' attitudes.

SEM with mediation

When environmental commitment in schools was included as a mediating variable, positive indirect effects on environmental attitudes were observed: β= 0.142 for teaching activities and β= 0.185 for school size. In both cases, however, the overall effects remained negative, suggesting that while institutional commitment partially attenuates the structural effects, it does not completely reverse them.

Figure 2 provides a comparative analysis of the direct, indirect (through school participation) and total effects of teacher-led environmental activities and school size on students' environmental attitudes. Although the indirect effects were positive, they failed to offset the adverse direct effects. This demonstrates that, although school environmental engagement exerts a mediating effect, it cannot completely neutralize the impact of structural constraints. These constraints include limited resources, institutional priorities, socioeconomic inequalities, and differences in the implementation of environmental initiatives in schools.

The study results show that both teacher-led environmental activities and school size have indirect positive effects on students' environmental

TABLE V
COMPARISON OF COEFFICIENTS IN MLM WITH AND WITHOUT LOG TRANSFORMATION

Predictor variable	MLM (raw) β	p-value (raw)	MLM (log) β	p-value (log)
School commitment	3.1353	0.0243	0.1944	0.0178
School size	-0.8088	0.1074	-0.0508	0.0849
Teacher activity	-0.1108	0.6794	-0.0093	0.5527
Commitment × Size	-0.861	0.1656	-0.0517	0.1539

MLM: Multilevel Modeling. Source: own elaboration.

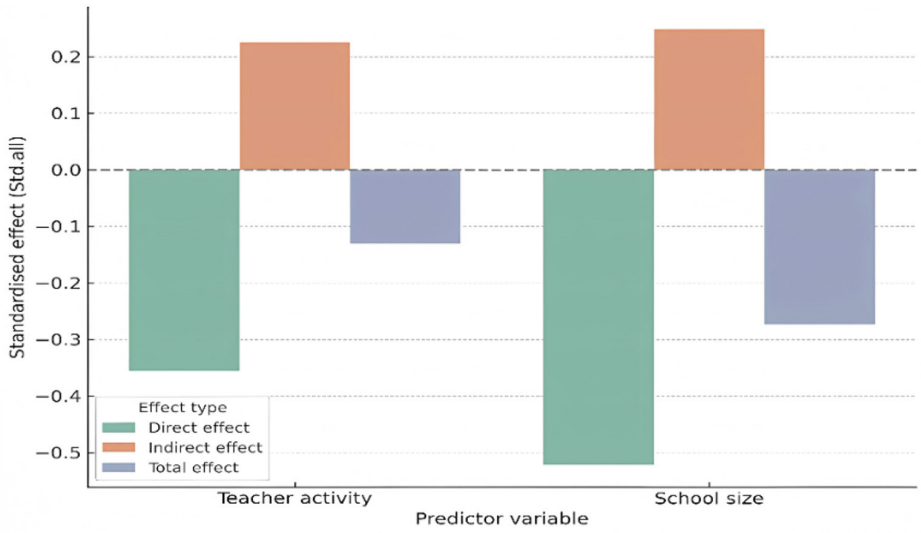

Figure 2. Comparison of standardized effects in SEM with mediation.

attitudes through school environmental commitment. However, the direct effects of these variables remain negative, indicating that although institutional commitment mediates and partially reduces the influence of structural factors, it does not completely counteract their impact.

Discussion

Climate change is transforming ecosystThis study demonstrates that schools' level of environmental commitment significantly influences students' pro-environmental attitudes. Both MLM and SEM confirmed this relationship, highlighting the importance of the institutional context. These findings are consistent with the exploratory results, which revealed significant differences in attitudes depending on school size, the inclusion of environmental topics in the PEI and the level of teacher-led environmental activities.

Teacher participation in environmental initiatives emerged as a particularly influential factor. Students in schools with higher levels of teacher-led environmental action showed more favorable attitudes, especially on positively worded items, which is consistent with previous research on the impact of sustained pedagogical involvement (Barraza and Walford, 2002; Mogensen and Schnack, 2010).

The MLM analysis showed that school environmental commitment has a direct, positive and significant effect on student attitudes, consistent with previous findings that highlight the institutional environment as a key factor in environmental education (Rickinson, 2001). In contrast, SEM indicated that school size and the level of teacher-led activities have direct negative effects on environmental attitudes, although these effects are partially mediated by the school's environmental commitment (Stevenson *et al*., 2017). Although positive indirect effects were identified, the overall impact of these structural variables remained negative, indicating that school environmental commitment, while essential, is not sufficient on its own to overcome the limitations associated with less favorable institutional contexts.

Although teacher-led environmental activities are generally expected to foster positive attitudes, this study found a direct negative effect, which may be attributed to several contextual and pedagogical factors. The literature on environmental education suggests that the impact of such initiatives depends on their depth, continuity and curricular integration (Jickling and Wals, 2008; Stevenson *et al*., 2013). In schools facing structural constraints, these activities may be implemented superficially due to resource shortages or academic overload, which can lead to student demotivation or even resistance. Furthermore, when environmental problems are presented without viable solutions, students may experience eco-anxiety or skepticism (González-Gaudiano, 2020). Likewise, isolated or fragmented activities that lack meaningful integration into the learning process may be perceived as irrelevant by students.

These findings support the idea that developing students' environmental attitudes requires more than institutional discourse or sporadic actions. A coherent articulation between policies, pedagogical practices and structural conditions is needed, in line with the perspective of Jensen and Schnack (2006), who emphasize the importance of environmental education that encourages critical action and democratic participation. Similarly, Salazar *et al*. (2024) found that the level of environmental certification in Chilean schools has a positive impact on student behavior, but only when environmental principles are effectively integrated into daily school functioning.

This convergence of national and international evidence underscores the need to adopt comprehensive institutional approaches that translate environmental discourse into transformative learning experiences. Previous research has also shown that environmental attitudes are consolidated only when educational experiences are participatory, meaningful and connected to students' everyday lives (Rickinson, 2001).

This study contributes to understanding students' environmental attitudinal profiles, showing that they combine critical concern for environmental problems with pragmatic optimism about possible solutions. This combination is key to promoting sustainable behaviors and is influenced by the systematic inclusion of environmental content in the curriculum, active teacher participation and a sociocultural environment that encourages engagement. Previous studies have documented increasing environmental awareness among young people, along with skepticism toward purely technological solutions that fail to address structural causes of environmental degradation (Kollmuss and Agyeman, 2002). The findings of this study reinforce the idea that environmental education should focus not only on knowledge acquisition but also on fostering agency, critical reflection and socio-environmental responsibility.

The policy implications of these results suggest that institutional environmental engagement is essential to reinforce students' pro-environmental attitudes, as isolated teacher efforts may be insufficient without school-wide support. Education policies should promote comprehensive and coherent approaches that integrate environmental values into the curriculum, school culture and teaching practices, while also addressing structural limitations. It is therefore recommended to: (1) implement strategies that embed environmental values in school management and daily practices; (2) ensure that teacher-led environmental activities are meaningful and aligned with institutional

goals; (3) provide resources and professional development for schools in vulnerable contexts; (4) promote a commitment to sustainability that goes beyond formal certifications; and (5) encourage student participation in environmental decision-making processes to strengthen their engagement and sense of belonging.

The study provides relevant evidence on the influence of institutional factors on the environmental attitudes of secondary school students. However, it is crucial to recognize the limitations of the research design and sample. The low variability of some institutional variables, such as the School Vulnerability Index (SVI) and environmental certification, reduces the ability to extrapolate the findings to more diverse educational contexts. Furthermore, the use of non-probability sampling and the regional concentration of the sample in Biobío, Chile, mean that the findings cannot be generalized to the entire Chilean student population.

The reliance on self-reported data introduces potential response bias, especially in items related to socially desirable behaviors. Likewise, cultural and contextual factors may influence students' interpretation of attitude items, which may affect comparability between schools (Barraza and Walford, 2002; Mogensen and Schnack, 2010). Therefore, the results should be interpreted with caution, recognizing that external validity is affected by these limitations.

To improve the generalizability of the findings, future research should expand geographical coverage, incorporate probability-based sampling strategies and consider longitudinal designs that allow for stronger causal inferences. It is also recommended to include schools with greater institutional diversity, particularly public and rural schools, to increase variability and enable more representative comparisons. In addition, triangulation with qualitative or observational data could strengthen the validity of future findings.

The conclusions of this research should therefore be understood as contextual and exploratory, rather than universal. It is hoped that the recommendations provided will help address current limitations and contribute to a more comprehensive understanding of the influence of institutional factors on students' environmental attitudes.

Finally, this study emphasizes that institutional commitment to the environment is not only a contextual factor but also a transformative driver of students' attitudes. Strengthening this commitment through coherent policies, meaningful pedagogical practices and inclusive school cultures represents a strategic pathway to empower young people as active agents of sustainability in the face of global ecological challenges.

Conclusion

This study demonstrates that institutional factors play a significant role in shaping the environmental attitudes of secondary school students. Exploratory analyses revealed that school size, the inclusion of environmental content in the PEI (Institutional Educational Project) and teacher-led environmental activities are associated with significant attitudinal differences. Structural Equation Modeling (SEM) showed that although school size and the intensity of teacher-led environmental activities exerted direct negative effects on student attitudes, these effects were partially mediated by school environmental commitment, highlighting the importance of coherence between institutional discourse and pedagogical practice. Multilevel Modeling (MLM) supported the robustness of these findings.

However, the study has limitations: although the sample included diverse types of schools, it may not be generalizable to other educational levels or regions; the variability of institutional characteristics was limited; and the cross-sectional design restricts the ability to establish causal relationships. It is recommended that environmental education policies promote not only the inclusion of environmental content in curricula but also the development of a coherent institutional culture that supports sustainability. Teacher professional development should prioritize the quality, continuity and pedagogical alignment of environmental initiatives with institutional values. Future research should adopt mixed-method and longitudinal designs to further explore how institutional practices influence students' environmental attitudes over time.

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EL COMPROMISO MEDIOAMBIENTAL ESCOLAR Y LOS FACTORES INSTITUCIONALES COMO PREDICTORES DE LAS ACTITUDES MEDIOAMBIENTALES DEL ESTUDIANTADO

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RESUMEN

El presente estudio tiene como objetivo examinar cómo los factores a nivel institucional influyen en las actitudes ambientales de los estudiantes en el contexto de la educación ambiental en la enseñanza secundaria. A partir de datos de 1.197 estudiantes pertenecientes a 15 establecimientos educacionales de la Región del Biobío, Chile, se empleó la dimensión "Desafíos ambientales y yo" del cuestionario ROSE. Las pruebas de Kruskal–Wallis y las correlaciones de Spearman identificaron diferencias significativas en las actitudes ambientales asociadas al tamaño de la matrícula escolar, las iniciativas ambientales lideradas por docentes y la incorporación de contenidos ambientales en el Proyecto Educativo Institucional (PEI). Los modelos lineales multinivel demostraron que el compromiso ambiental institucional constituye un predictor positivo y significativo de las actitudes proambientales del estudiantado. En contraste, el modelamiento de ecuaciones estructurales reveló efectos negativos significativos del tamaño escolar y de la intensidad de la actividad docente. El compromiso institucional medió parcialmente estas relaciones. Los resultados subrayan la relevancia de un compromiso institucional coherente y explícito con la sostenibilidad para promover actitudes ambientales favorables en los estudiantes, aunque las limitaciones estructurales institucionales pueden reducir la magnitud de esta influencia. Se destaca el papel central de la cultura organizacional y de la coherencia institucional en el fortalecimiento de una educación ambiental efectiva.

O COMPROMISSO AMBIENTAL ESCOLAR E OS FATORES INSTITUCIONAIS COMO PREDITORES DAS ATITUDES AMBIENTAIS DOS ESTUDANTES

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RESUMO

O presente estudo tem como objetivo examinar como fatores institucionais influenciam as atitudes ambientais dos estudantes no contexto da educação ambiental no ensino médio. Com base em dados de 1.197 estudantes de 15 escolas da Região do Biobío, no Chile, foi utilizada a dimensão "Desafios Ambientais e Eu" do questionário ROSE. Os testes de Kruskal–Wallis e as correlações de Spearman identificaram diferenças significativas nas atitudes ambientais associadas ao tamanho da escola, às iniciativas ambientais conduzidas por professores e à inclusão de temas ambientais no Projeto Educativo Institucional (PEI). Os modelos lineares multiníveis demonstraram que o compromisso ambiental institucional é um forte preditor positivo das atitudes pró-ambientais dos estudantes. Em contraste, a modelagem de equações estruturais revelou efeitos negativos significativos do tamanho escolar e da intensidade da atividade docente. O compromisso institucional mediou parcialmente essas relações. Os resultados evidenciam a relevância de um compromisso institucional consistente e explícito com a sustentabilidade para promover atitudes ambientais favoráveis entre os estudantes, embora as limitações estruturais institucionais possam reduzir a magnitude dessa influência. Ressalta-se o papel central da cultura organizacional e da coerência institucional na promoção de uma educação ambiental efetiva.