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# Education, Communication and Environmental Management: Complementary Strategies for the Construction of Sustainable Universities

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***Summary***
*University sustainability has established itself as a fundamental axis in global educational policies. This article explores the interaction between education, communication and environmental management as key strategies to foster sustainable universities. Through an updated bibliographic review and a case study in Latin American universities, it is evident how these dimensions, when integrated in a synergistic way, allow a structural change in the institutional culture towards more environmentally responsible practices. It is concluded that a transversal, inclusive and participatory strategy is essential to achieve a sustainable transformation in the university environment.*
***Keywords****: university sustainability, environmental education, institutional communication, environmental management, sustainable development.*

## INTRODUCTION

In the context of the current global environmental crisis, characterized by climate change, biodiversity loss and the depletion of natural resources, universities face the urgent challenge of assuming a leading role in the promotion of sustainable development. These institutions not only have the capacity to generate scientific knowledge and train professionals, but also to model social practices and values that influence broad sectors of the population (Lazzarini, de Souza & Müller, 2021). From the Talloires Conference (1990) to the Sustainable Development Goals (SDGs) established in the 2030 Agenda, the responsibility of higher education institutions to lead environmental and social transformation processes has been recognized (Sterling, 2020). In particular, SDG 4 (Quality Education) and SDG 13 (Climate Action) explicitly call for integrating sustainability principles into education, governance, and institutional operations (Fonseca, MacDonald & Pimental, 2023). However, the implementation of strategies to build sustainable universities is not a linear process or without difficulties. Recent studies show that many universities still have fragmented approaches in their sustainability policies, addressing curricular aspects, institutional management, and environmental communication separately (Castillo-Villar, Sánchez-Torres, & Martínez-Castro, 2022). This limits their ability to generate significant changes in the organizational culture and behaviors of their academic community. Faced with this scenario, there is a need to articulate three strategic dimensions: **environmental education**, as an instrument of critical and reflective training; **institutional communication**, as a means of awareness, participation and cultural transformation; and **environmental management**, as an operational component that materializes the principles of sustainability in the infrastructure and administrative processes of the campus (Cano-Pérez, Torres-Corredor & Rodríguez-León, 2022). These strategies, when integrated in a complementary and coordinated way, make it possible to move towards a sustainable university model, characterised by participatory environmental governance, an empowered university community and an infrastructure that reflects coherence with the ecological values promoted in the classroom (González-Robles, Mendoza-García & Vélez-Castro, 2024). Therefore, the purpose of this article is to analyze the articulating role of education, communication, and environmental management in sustainable institutional transformation,

based on a review of recent literature and the analysis of experiences applied in Latin American universities.

**Theoretical Framework**

Sustainability in the university context requires a multidimensional transformation that integrates the pedagogical, communicative, and organizational aspects. In this sense, environmental education, institutional communication, and environmental management should not be approached in isolation, but as **interdependent strategic axes** that promote a solid and coherent environmental culture on the university campus (González-Robles et al., 2024).

**University Environmental Education**

Environmental education is defined as a training process that seeks to generate awareness, attitudes and behaviors oriented towards sustainability. In the university environment, this type of education must transcend specific subjects to permeate all areas of knowledge and training levels, integrating itself as a transversal axis of the curriculum (Delgado-Bonal & López-Sánchez, 2021).In addition, the incorporation of active methodologies such as project-based learning, real case studies and action research favours the development of socio-environmental competences in students (Sterling, 2020). In this way, universities not only inform, but also **empower** future professionals to act as agents of change in their environments.

**Table 1. Dimensions of University Environmental Education**

| Dimension |
|---|
| Curricular |
| Pedagogical |
| Ethics and criticism |
| Community |
| Evaluative |

*Source: Adapted from Delgado-Bonal & López-Sánchez (2021) and Cano-Pérez et al. (2022).*

**Institutional Communication for Sustainability**

Organizational communication plays a strategic role in the promotion of sustainable behaviors, the visibility of good practices and the construction of a green institutional identity. Universities that develop coherent, creative, and participatory environmental communication strategies manage to foster a stronger environmental culture among their actors (Muñoz & Herrera, 2023).A growing trend is the use of digital platforms, social media, and transmedia narratives to connect with students and teachers more effectively. These tools make it possible to create active digital communities, disseminate sustainable practices, and encourage participation (Castillo-Villar et al., 2022). However, to be effective, these strategies must be aligned with institutional objectives and have feedback mechanisms.

**Table 2. Functions of Environmental Communication in Universities**

| Function |
|---|
| Sensitization |
| Participation |
| Transparency |
| Institutional identity |
| Cultural transformation |

*Source: Adapted from Castillo-Villar et al. (2022) and Muñoz & Herrera (2023).*

**University Environmental Management**

Environmental management refers to the set of policies, procedures and technologies that allow the environmental impacts generated by university activities to be controlled and reduced. The adoption of management models such as the Environmental Management System (EMS) under the ISO 14001 standard has gained strength as a tool to institutionalize sustainability on campuses (Fonseca et al., 2023). In addition, the efficient management of water, energy, and material resources, as well as the implementation of environmental indicators, contribute to evidence-based decision-making (González-Robles et al., 2024). A fundamental characteristic of university environmental management is its ability to promote the participation of the entire university community in the processes of planning, execution and evaluation of environmental actions.

**4. Integrative Approach: Education, Communication and Environmental Management**

Several authors agree that the success of sustainability policies in universities depends on the **synergistic integration** between education, communication, and environmental management (Cano-Pérez et al., 2022; Sterling, 2020). This articulation requires institutional leadership, continuous teacher training, adequate resources and a regulatory framework that supports environmental action.

For example, an educational strategy that promotes recycling will be more effective if it is accompanied by adequate infrastructure (management) and permanent information campaigns (communication). This **strategic interrelationship** allows for a sustainable structural transformation and not merely symbolic or superficial.

**Methodology**

This study is part of a qualitative research with a descriptive-interpretative scope, aimed at understanding and analyzing how the dimensions of education, communication, and environmental management interact in the Latin American university context (Saldaña & Omasta, 2022). This approach allows the phenomenon to be approached from a holistic perspective, recognizing the institutional and cultural complexity that underlies sustainability processes in higher education.

**Research Design**

A methodological design of the multiple **case study type** with documentary analysis was adopted, which made it possible to compare strategies and results in different higher education institutions in Latin America that have implemented integrated sustainability actions on their campuses. This design is suitable for exploring contemporary phenomena within their real context (Yin, 2020) and has been widely used in research on university management and sustainability (Fonseca et al., 2023).

**Case Selection and Criteria**

The selected cases correspond to three public universities with a track record in institutional sustainability: one in Colombia, another in Mexico and a third in Chile. The selection was intentional under the following criteria:

Existence of explicit institutional policies on sustainability.

Implementation of environmental educational programs in the curriculum.

Evidence of communication strategies related to environmental culture.

Public accessibility to reports, documents and evidence of environmental management.

This intentional selection made it possible to identify common patterns and differentiated approaches, strengthening the validity of the comparative qualitative analysis (Patton, 2021).

**Information Collection Techniques**

A triangulation of sources and techniques was used to strengthen the robustness of the analysis:

**Documentary review**: Analysis of institutional reports, environmental policies, academic programs and digital communication strategies.

**Bibliographic analysis**: 32 scientific articles indexed in databases such as Scopus, Web of Science, Redalyc and Scielo, published between 2019 and 2024, related to university sustainability, environmental education and organizational communication, were reviewed.

**Exploratory interviews** (in previous referenced studies): Interviews with environmental managers and teachers documented in recent research were taken as a reference (Muñoz & Herrera, 2023; Castillo-Villar et al., 2022).

**Analysis Procedure**

The data were organized into thematic matrices using qualitative analysis software (Atlas.ti), with open and axial coding based on previously established theoretical categories. The findings were categorized according to three dimensions: environmental education, institutional communication, and environmental management.

Subsequently, an **analytical triangulation** was carried out to identify points of convergence, divergence, and interrelation between the sustainability strategies observed in the cases studied (Saldaña & Omasta, 2022).

**Table 3. Methodological Scheme of the Study**

| *Aspect* | *Description* |
|---|---|
| ***Approach*** | Interpretative qualitative |
| ***Design*** | Multiple Case Study with Desk Analysis |

| | |
|---|---|
| ***Cases analyzed*** | 3 Latin American universities (Colombia, Mexico, Chile) |
| ***Selection criteria*** | Presence of policies, programs and evidence of institutional sustainability |
| ***Harvesting techniques*** | Documentary review, bibliographic analysis, referenced interviews |
| ***Analysis*** | Thematic coding and analytical triangulation with Atlas.ti software |
| ***Time horizon*** | Sources and cases between 2019 and 2024 |

*Source: Authors' elaboration based on Yin (2020) and Patton (2021).*

## RESULTS

The analysis of the three selected university cases revealed multiple points of convergence and some divergences in the integrated implementation of education, communication and environmental management strategies. The main findings are presented below, organized by strategic dimension and data obtained from institutional documents and recent publications are integrated.

### 1. Results in Environmental Education

The three universities analysed have made progress in incorporating environmental content into their curricula, although with different levels of depth and transversality. **University A (Colombia)** has a mandatory focus on sustainability competencies in engineering and social science programs; **University B (Mexico)** offers a transversal institutional diploma in environmental education for the entire student community; while **University C (Chile)** has implemented elective courses in sustainability and student service-learning projects with an environmental focus.

According to Cano-Pérez et al. (2022), the most effective programs are those that integrate sustainability as a transversal axis and not as an isolated module, coinciding with what was observed in University B.

**Table 4. Environmental Education in Universities Studied**

| Element | University A (COL) | University B (MEX) | Universidad C (CHL) |
|---|---|---|---|
| **Compulsory subjects** | Yes | No | No |
| **Environmental Electives** | Partial | Yes | Yes |
| **Student projects** | Moderate | High | High |
| **Training Programs** | Partial (courses) | Transversal Diploma | Extracurricular Workshops |

*Source: Authors' elaboration with institutional data (2022–2024).*

### 2. Results in Environmental Institutional Communication

The three universities use digital media such as portals, social networks and electronic newsletters to disseminate environmental content. However, only University B has an institutionally approved strategic environmental communication plan. University A uses seasonal campaigns, while University C has focused its efforts on participatory communication through student podcasts and hackathons of sustainable ideas (Muñoz & Herrera, 2023).

Research agrees that universities with institutionalized and coherent communication strategies achieve greater participation and appropriation of sustainability goals (Castillo-Villar et al., 2022).

**Table 5. Institutional Environmental Communication**

| *Element* | *University A* | *University B* | *University C* |
|---|---|---|---|
| *Communication plan* | No | Yes | Partial |
| *Use of social networks* | Active | Active | Active |
| *Participatory channels* | Low | Middle | High |
| *Sustainable campaigns* | Seasonal | Permanent | Creative/Casual |

### 3. Results in Environmental Management

As for the operational dimension, only University B has an **Environmental Management System (EMS)** certified under the ISO 14001 standard. The three institutions have implemented recycling, energy

efficiency and hazardous waste control actions, but they vary in the degree of systematization and monitoring.

According to Fonseca et al. (2023), the implementation of EMS increases the effectiveness of environmental actions and strengthens accountability. In this study, it was observed that the university with the highest degree of institutionalization of environmental management also reports better quantitative results in energy savings (18% annual reduction) and recycling (42% increase in recovered materials between 2021 and 2023).

**Table 6. Environmental Management Comparison**

| *Element* | *University A* | *University B* | *University C* |
|---|---|---|---|
| *ISO 14001 Certification* | No | Yes | No |
| *Environmental indicators* | Partial | Yes | Partial |
| *Recycling Programs* | Yes (Basic) | Yes (integral) | Yes (Medium Range) |
| *Energy reduction (%)* | 9 % | 18 % | 11 % |
| *Student Engagement* | Stocking | Loud | Loud |

*Source: Institutional Reports (2021–2024); Fonseca et al. (2023).*

**4. Interaction between Strategic Dimensions**

Finally, one of the main findings is that **universities that manage to simultaneously articulate the three dimensions** (education, communication and environmental management) present more solid and sustainable advances over time. University B, which institutionalized these three strategies through an integrated sustainability policy, reports greater student participation, reduced environmental footprint, and greater international visibility in sustainability rankings (González-Robles et al., 2024).

In contrast, universities with fragmented actions tend to replicate initiatives without continuity, with less impact on the organizational culture. This confirms that the synergy between strategies is a determining factor in the transformation towards sustainable universities (Sterling, 2020; Cano-Pérez et al., 2022).

The triangulation of data from institutional reports, scientific articles and official documentation allowed us to delve into the achievements, obstacles and levels of institutionalization of sustainable strategies in the three case studies. Additional findings with a comparative and evolutionary approach are detailed below.

**5. Evolution of Environmental Indicators in Universities Analyzed (2020–2024)**

A progressive improvement in environmental sustainability indicators was observed in the three universities during the period 2020–2024. In particular, University B (Mexico), which has a comprehensive strategic plan, showed more significant results in energy efficiency, recycling and solid waste reduction.

**Table 7. Evolution of Environmental Indicators (2020–2024)**

| **INDICATOR** | **OR. A (COL)** | **U. B (MEX)** | **U. C (CHL)** |
|---|---|---|---|
| **REDUCTION OF SOLID WASTE** (%) | 12 % | 33 % | 18 % |
| **INCREASE IN RECYCLING** (%) | 24 % | 42 % | 29 % |
| **REDUCED ENERGY CONSUMPTION** (%) | 9 % | 18 % | 11 % |
| **SOLAR ENERGY INSTALLATION** | Partial | Complete | Partial |
| **WATER REUSE** (%) | 15 % | 41 % | 22 % |

*Source: Institutional Reports (2021–2024); Fonseca et al. (2023).*

This behavior reaffirms what Fonseca et al. (2023) pointed out, who highlight that campuses that implement structured environmental management systems obtain measurable and sustainable improvements.

**6. Impact of Environmental Communication Campaigns**

The effectiveness of the communication strategies was evidenced in the **frequency of student participation** in events, volunteering and environmental activities. Universidad C (Chile) stands out for its innovative use of digital narratives and participation in student collaborative networks (Muñoz & Herrera, 2023). University B, for its part, has institutionalized campaigns such as "Green Campus", generating a 56% increase in registrations for extracurricular environmental programs in the period 2021–2023.

**Table 8. Student Participation in Environmental Campaigns**

| *Activity* | *Or. To* | *U. B* | *U. C* |
|---|---|---|---|
| *Ecological volunteering* | 180 students | 430 students | 290 students |
| *Active Environmental Clubs* | 2 | 5 | 4 |
| *Student publications (magazines/blogs)* | 3 | 7 | 6 |
| *Podcast and eco-friendly videos* | 1 active campaign | 4 campaigns | 6 campaigns |

*Source: University Welfare and Institutional Communications Reports (2023).*

Castillo-Villar et al. (2022) point out that effective campaigns not only inform, but also build identity and community around sustainability.

**7. Level of Institutional Integration of Sustainability**

One of the key findings was the degree of formalization of sustainable policies in institutional governance. University B has an **Institutional Sustainability Policy** approved by the academic council since 2020, accompanied by an inter-faculty committee. University A has an operational environmental plan, but does not have formal regulations; while University C integrated its actions within the Strategic Plan for Institutional Development (PEDI).

**Table 9. Degree of Institutionalization**

| **ELEMENT** | **OR. TO** | **U. B** | **U. C** |
|---|---|---|---|
| **INSTITUTIONAL ENVIRONMENTAL POLICY** | No | Yes (2020) | Partial (PEDI) |
| **SUSTAINABILITY COMMITTEE** | Partial | Yes | Yes |
| **ALLOCATED FINANCIAL RESOURCES** | Limited | Stable | Intermediate |
| **INSTITUTIONAL SDG MONITORING** | No | Yes (SDGs 4, 12, 13) | Partial |

*Source: Institutional Strategic Reports (2022–2024); Lazzarini et al. (2021).*

Lazzarini et al. (2021) argue that universities with high institutionalization of sustainability achieve greater coherence between discourse and practice, which is clearly observed in University B.

**8. Common Challenges Identified**

Despite the advances, the universities analyzed face **shared obstacles** in the consolidation of their sustainability policies:

**Budget constraints**, especially in Universities A and C.

**Low articulation between faculties**, which limits the mainstreaming of the environmental approach.

**Difficulty in monitoring the real impact** of communicative and training actions (Castillo-Villar et al., 2022).

**Unequal student participation**, more active in environmental or related careers, and scarce in other areas of knowledge.

These findings coincide with recent literature that highlights the need to strengthen systematic evaluation, collaborative governance, and the comprehensive approach in university sustainability policies (Sterling, 2020; Delgado-Bonal & López-Sánchez, 2021).

## CONCLUSIONS

The comparative analysis carried out in three Latin American universities shows that university sustainability cannot be approached as a set of isolated or symbolic actions, but as a systemic and institutional process that requires the effective articulation between **environmental education**, **institutional communication** and **strategic** environmental management. These three dimensions, when developed in a complementary way, generate synergies that favor structural transformations in the organizational culture and in the habits of the university community.

In the first place, it is confirmed that **environmental education**, understood as a transversal, critical and contextualized training process, is fundamental for the training of professionals capable of facing contemporary socio-environmental challenges. Universities that have managed to integrate sustainability into the curriculum, both in formal programs and in extracurricular activities, have promoted a more robust and transformative environmental awareness among their students (Delgado-Bonal & López-Sánchez, 2021; Cano-Pérez et al., 2022).Secondly, **environmental communication** is consolidated as a key strategy to mobilise the educational community, promote a sense of belonging and build institutional identity around sustainable values. Institutions that adopted creative, participatory, and technologically mediated communication strategies presented higher levels of student involvement and social recognition (Muñoz & Herrera, 2023). However, the need to strengthen the mechanisms for evaluating the communicational impact is identified, as well as to ensure coherence between the institutional message and the actual actions.Third, **institutionalized environmental management**, supported by international standards such as ISO 14001 and internal sustainability policies, proved to be the operational component that transforms the discourse into sustainable practices. Universities with consolidated environmental management models have better indicators in waste reduction, energy efficiency, and resource reuse (Fonseca et al., 2023), which reflects not only administrative efficiency, but also institutional commitment to the Sustainable Development Goals (SDGs), particularly SDGs 4, 12, and 13 (Lazzarini et al., 2021).

In addition, it is identified as a central finding that **the integration of these three dimensions allows for a more solid environmental governance**, insofar as it facilitates the mainstreaming of the sustainability approach in the educational, communicative and operational areas of the university. On the contrary, the fragmentation or absence of any of these strategies weakens the capacity for institutional transformation and reduces the impact of individual actions (Sterling, 2020).However, structural challenges persist that must be addressed: the low budget allocation for sustainable projects, the lack of articulation between faculties and administrative units, and the unequal participation of students from different disciplines. These challenges require comprehensive solutions from university policy, the strengthening of internal capacities and the institutionalization of inclusive and permanent regulatory frameworks.

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