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ENVIRONMENTAL EDUCATION AND TRANSITIONS TOWARD STRONG SUSTAINABILITY IN CHIHUAHUA, MEXICO: A SYSTEMATIC REVIEW (1990–2025)

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ABSTRACT

Environmental education (EE) is a strategic field for advancing sustainability in contexts of socio-ecological crisis; however, its development is uneven and often remains limited to approaches focused on raising awareness and individual change. Chihuahua, Mexico, is home to high ecosystemic and sociocultural diversity, as well as critical challenges associated with the availability of strategic resources such as water, making it relevant to analyze the actual contribution of EE experiences to territorial sustainability. This article presents a systematic literature review, based on PRISMA, of scientific and gray literature published between 1990 and 2025. Fifty-three documents were selected from a total of 140 for qualitative interpretive-critical analysis, employing three complementary analytical frameworks: pedagogical orientations from Paulo Freire, dimensions of sustainability and environmental rationality from Enrique Leff, and Lucie Sauv e's mapping of EE currents. The results show a predominance of cross-sectional and diagnostic studies, with limited short-term evaluation, as well as a concentration on resolute and conservationist currents and a majority orientation toward weak sustainability. The economic and political dimensions are only marginally addressed, which limits the transformative potential of EE by disconnecting it from debates on environmental governance, socio-environmental inequalities, and development models. Nevertheless, emerging critical, territorial, and biocultural experiences associated with strong sustainability approaches are identified. It is concluded that EE in Chihuahua is in a transitional phase and requires the strengthening of longitudinal methodological designs, critical pedagogies, and situated approaches that articulate territory, sociocultural diversity, and governance to contribute to transitions toward strong and transformative sustainability.

KEYWORDS: PRISMA; education for sustainability; strong and weak sustainability; environmental governance; socio-territorial approach; environmental rationality; critical pedagogy; mapping of environmental education.

1. INTRODUCTION

Environmental education (EE) and education for sustainability have established themselves as strategic fields for addressing the contemporary socio-ecological crisis and promoting cognitive, ethical, and practical transformations aimed at sustainable ways of life. From the perspective of environmental rationality, this crisis reflects the unsustainability of dominant models of society–nature relations, as well as the need to reconfigure the processes of production, consumption, and social organization that underpin environmental degradation (Leff, 1998, 2004). Within this framework, EE is not limited to the transmission of information about the environment, but rather involves the formation of socio-environmental citizenship, critical reflection on development models, and the collective construction of situated alternatives.

The international significance of environmental education is reflected, among other instruments, in the 2030 Agenda and its Sustainable Development Goals, particularly in the interconnection between education, climate, and ecosystems (ONU, 2015). However, there remains a persistent gap among countries and territories regarding its implementation, institutionalization, and effectiveness. This inequality manifests itself in institutional capacities, resource availability, program continuity, and structural conditions of sociocultural, economic, and environmental inequality. In Latin America, moreover, EE unfolds in contexts marked by poverty, unequal distribution of power, environmental degradation, and extractivist models, which strains its transformative potential and places it in a terrain of political, epistemological, and cultural disputes (Leff, 2004; Sauv e, 2004; Torres, 2015). In this context, a key discussion for sustainability research is distinguishing between approaches compatible with weak sustainability (focused on educational adjustments and individual changes without questioning structures) and approaches oriented toward strong sustainability, which recognizes non-substitutable ecological limits, incorporates dimensions of justice, territory, and power, and seeks deeper socio-ecological transitions.

In Mexico, environmental education (EE) is grounded in regulatory and programmatic frameworks that recognize its permanent nature and its focus on understanding the interrelationships between society and nature, in addition to instruments such as the National Strategy for Environmental Education for Sustainability (SEMARNAT, 2006) and guidelines related to mainstreaming in education. The national literature has highlighted progress in legal and discursive recognition, but also persistent weaknesses in implementation, evaluation, and monitoring, as well

as tensions between approaches to content delivery and perspectives on citizenship, participation, and social advocacy (Bravo, 2022; Crisp n, 2013; Gonz lez Gaudiano & Arias Ortega, 2009; Ram rez Beltr n, 2015). Recently, inter-institutional coordination has gained momentum through coordination mechanisms between environmental and educational agencies, which opens up opportunities but also poses the challenge of having systematized and territorially situated evidence to guide educational-environmental governance programs, models, and mechanisms, particularly in developing countries where a clear framework in this regard is lacking.

The state of Chihuahua is a particularly relevant case for discussing education for sustainability from a socio-territorial perspective. On the one hand, it is home to a high diversity of ecosystems and faces significant vulnerabilities related to the availability of strategic resources such as water; on the other hand, it exhibits sociocultural diversity, including indigenous, rural, and urban contexts with distinct socio-environmental challenges. In this context, ES initiatives have been developed by government, educational, and civil society sectors; however, these initiatives remain scattered across scientific articles, theses, and technical reports, lacking a systematic framework that would allow for a comprehensive understanding of methodological and pedagogical trends, as well as their effective contribution to territorial sustainability.

This lack of synthesis is significant for two reasons. First, it limits the ability to assess whether the documented EE experiences are predominantly oriented toward forms of weak sustainability (awareness-raising, attitudinal change, and instrumental approaches) or whether they are moving toward strong sustainability (critical, territorial, biocultural, and environmental governance-related approaches). Second, it reduces the capacity to design and strengthen context-specific policies, programs, and educational models, with mechanisms for monitoring and evaluating impacts in the medium and long term. Consequently, having systematized evidence at the state level not only has descriptive value but also contributes to sustainability debates on socio-ecological transitions, governance, and education as a lever for change (Sterling, 2010b; UNESCO, 2020; Wals & Corcoran, 2023).

Therefore, the objective of this article is to conduct a systematic review of publications on EE initiatives carried out in the state of Chihuahua in both formal and non-formal settings—including school, community, and institutional management contexts—to analyze their characteristics, contributions, limitations, and

trends, with an emphasis on their contribution to strong sustainability and the challenges of transitioning toward territorial, critical, and transformative approaches, using complementary analytical frameworks such as pedagogical orientations from Paulo Freire, dimensions of sustainability and environmental rationality from Enrique Leff, and the mapping of EE currents by Lucie Sauvé.

2. MATERIALS AND METHODS

2.1. Study Design and Scope

This study involves a systematic literature review of information regarding environmental education (EE) initiatives carried out in the state of Chihuahua, Mexico, focusing on the identification, classification, and systematization of available evidence. The aim is to provide input for strengthening locally grounded and culturally relevant educational proposals within the state through the subsequent development of an Environmental Education Model for the State. In addition, it critically analyzes their methodological, pedagogical, and epistemological trends in relation to their contribution to sustainability.

2.2. Protocol for Research in Systematic Reviews (PRISMA)

The focus of the study was on the state of Chihuahua, Mexico, through a search, selection, and reporting of results in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Page et al., 2021), incorporating both scientific literature and gray literature. The use of PRISMA ensured transparency in the process of identifying records, removing duplicates, screening (titles and abstracts), assessing eligibility, and making the final selection of documents for qualitative synthesis.

2.3. Research Question

To organize the available evidence and to understand the diversity, scope, and limitations of environmental education in Chihuahua, the following research question was posed: To what extent do the environmental education experiences, programs, projects, strategies, or research conducted in the state of Chihuahua (1990–2025) contribute to sustainability—particularly in terms of weak or strong sustainability—and what are their thematic, methodological, sociocultural, territorial, and governance characteristics?

2.4. Search strategy and information sources

The search period was from January to November

2025, using combinations of keywords in Spanish and English and employing Boolean operators (“environmental education” + Chihuahua, allintitle: “environmental education” + Chihuahua, “environmental education” AND “Sierra Tarahumara”, “environmental education” + Tarahumaras / Rarámuris, “environmental education” + Chihuahua, “environmental perception” AND Chihuahua). The review was conducted in the Google Scholar, Dialnet, RedALyC, SciELO, ERIC, Scopus, Web of Science, and Latindex databases, as well as institutional repositories, covering the period from 1990 to 2025.

2.5. Eligibility criteria (inclusion and exclusion)

The inclusion criteria consisted of considering documents that provided an explicit description of an experience, program, project, or intervention related to early childhood education; that were carried out in the state of Chihuahua or presented direct evidence related to the state; include relevant methodological, conceptual, sociocultural, or curricular information, as well as being available in various dissemination sources such as scientific journals, institutional repositories, conference proceedings, symposia, theses, books, and other miscellaneous texts. The exclusion criteria were studies not linked to the state of Chihuahua and duplicate records.

2.6. Study Selection Process

Figure 1 shows a diagram illustrating the selection process for the phases established by the PRISMA method, in which 140 documents were identified across all the databases consulted, 18 duplicate records were excluded, titles and abstracts were reviewed, 66 documents were excluded for failing to meet the eligibility criteria, and 53 documents were selected for in-depth qualitative analysis:

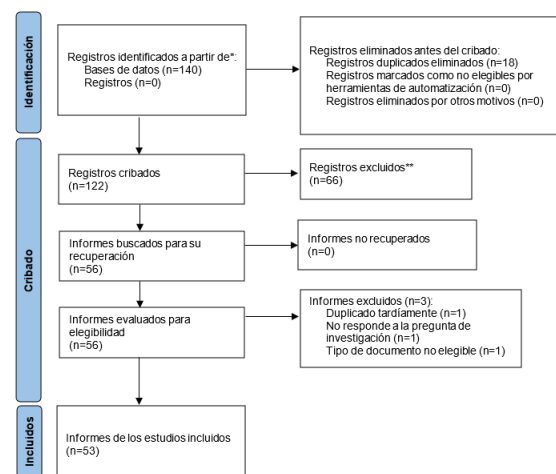


Figure 1. Illustration of the face selection process using the PRISMA method.

2.7. Study Selection Process

The systematization and analysis were conducted using a qualitative approach of an interpretive-critical nature, aimed at understanding the rationales, pedagogical orientations, and conceptions of sustainability present in the documented EE experiences.

The analysis was conducted using a theoretical-deductive categorization process, based on three complementary analytical frameworks:

1. Enrique Leff’s environmental rationality and dimensions of sustainability, to identify the orientation of the experiences in terms of sustainability (dominant dimensions and interrelationships), and to discuss their alignment with conceptions of weak or strong sustainability,
2. Paulo Freire’s perspective, to classify the pedagogical orientation of the experiences (banking, liberating, or mixed) and recognize their critical-transformative potential; and
3. Lucie Sauvé’s cartography of AE trends, to map dominant and emerging approaches and their relationship to how problems and educational action are conceived.

2.8. Data extraction and analysis matrix

For the systematization, a digital matrix was developed that included, among other variables: authors, year, type of document, stakeholders involved, modality (formal/non-formal/community-based), target population, sociocultural and territorial context, topics addressed, reported results, lessons learned, and limitations; as well as analytical variables linked to Leff (dimensions of sustainability), Freire (type of education), and Sauvé (trends in AE), in addition to the potential contribution to the State AE Model.

3. RESULTS

The results are derived from a critical-interpretive qualitative analysis of 53 documents selected using the PRISMA protocol. This section is organized to first provide an understanding of the methodological and thematic patterns that shape the field’s output and, subsequently, the prevailing pedagogical orientations and rationales of sustainability, with the aim of discussing their contribution to transitions toward weak or strong sustainability within the socio-territorial context of Chihuahua.

3.1. Trends and Types of Documentation in Environmental Education in the State of Chihuahua

A review of contributions over the past 35 years

reveals a decline in output between 1997 and 2005, marking the early stages of this shift; there was moderate growth from 2006 to 2010, which can be interpreted as the beginning of thematic consolidation, along with increased scientific visibility. Furthermore, although there was a significant increase in 2013—which may coincide with the rise and proposal of the Decade of Education for Sustainable Development and the development and implementation of international agendas—there has been a critical decline in recent years (Figure 2).

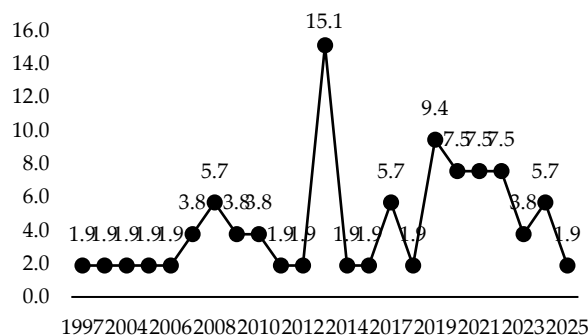


Figure 1. Percentage change in the number of environmental education publications in the state of Chihuahua, Mexico.

With regard to the distribution of the documents analyzed, Figure 3 shows that scientific articles predominate (41.5%), which suggests that academic output in the field of environmental assessment and natural resources is primarily concentrated in specialized journals. Next come conference abstracts, followed by book chapters and master’s theses, reflecting the presence of work presented at conferences and in graduate research. Posters, doctoral theses, and guides account for a smaller share of the output, suggesting less systematic use of these formats.

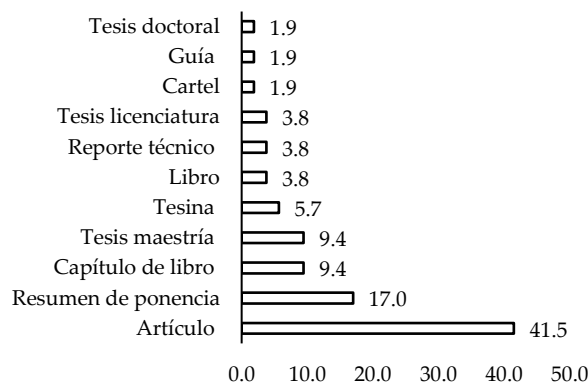


Figure 2. Percentage distribution of the documents analyzed by type (n=53).

The production of documentary films on environmental education (EE) in Chihuahua has

followed an uneven trajectory over the past 35 years: there was low production between 1997 and 2005, moderate growth between 2006 and 2010, and a sharp peak around 2013, followed by a decline in recent years.

Most publications on EE in Chihuahua have appeared in Mexico (89%), followed by the United States (6%), Brazil (4%), and Portugal (2%); while the institutions with the highest output in this field of study are the Autonomous University of Chihuahua, the Autonomous University of Ciudad Juárez, El Colegio de Chihuahua, the University of Guadalajara, and the School of Anthropology and History of Northern Mexico.

In terms of publication types, scientific articles predominate (41.5%), followed by conference abstracts, book chapters, and master's theses, reflecting a field that is active in both scientific circles and academic settings such as graduate programs and conferences.

Overall, this trend suggests that the field's visibility has increased intermittently, likely in tandem with institutional cycles and educational-environmental agenda.

3.2. Methodological approaches and intervention modalities in the studies analyzed

3.2.1. Methodological Approaches

The methodological approach used to analyze the 53 documents made it possible to identify different research approaches, educational intervention strategies, target audiences, and levels of evaluation.

It was found that 34% of the publications consisted of quantitative and descriptive studies aimed at investigating perceptions, attitudes, and levels of knowledge regarding environmental issues, using structured questionnaires and measurement scales, which reflects an interest in characterizing cognitive and attitudinal variables.

A significant number of studies (35.8%) employ a qualitative approach—whether interpretive, ethnographic, or documentary—focusing primarily on environmental knowledge, community norms, and practices, thereby providing a detailed and contextualized overview of the educational and sociocultural processes related to and/or associated with environmental education.

In addition, mixed-methods studies were identified (30.2%), with a predominance of those involving an educational intervention paired with an analysis of matched samples (before and after the intervention), as well as participant evaluations and records of training processes. These studies are more robust and comprehensive because they include a

diagnostic assessment, implementation, and evaluation of results.

A relevant finding for the discussion on sustainability is that these methodological approaches directly influence the topics addressed, favoring general approaches over specific environmental issues. From this perspective, EE appears to be oriented toward methodological approaches that, while allowing for a broad characterization of environmental problems, leave their structural causes and the socio-territorial dynamics that shape socio-environmental problems less explored.

3.2.2. Data collection techniques and tools

Surveys were the most commonly used method (40%), particularly in studies aimed at generating findings that would allow for the assessment of environmental perceptions, attitudes, levels of awareness, and specific knowledge.

Semi-structured interviews, participant observation, field notes, and document analysis were methods and tools used in qualitative and mixed-methods research.

3.2.3. Research strategies

With regard to methodological designs, the majority of the documents (75%) correspond to descriptive cross-sectional studies, focused on characterizing variables at a specific point in time; a smaller proportion (25%) consists of participatory action research, case studies, or experimental designs.

This pattern indicates a field with a strong diagnostic focus and limited temporal continuity, which limits the assessment of sustained impacts and the understanding of long-term changes linked to transitions toward sustainability.

3.2.4. Types of Educational Interventions

A significant proportion of the research (58%) is limited to the development of assessments without educational intervention or to the presentation of theoretical proposals that have not been implemented, thereby highlighting a gap between program design and implementation.

On the other hand, experiences were also identified where an educational intervention had indeed been implemented (42%), particularly in school, community, and non-formal education settings. These interventions include training programs, educational workshops, the use of educational technologies, educational games, ecotourism tours, and project-based learning

strategies. Here, the issue of long-term evaluation arises, as assessments are limited to immediate evaluations or process descriptions.

In terms of modality, 60% are oriented toward formal settings and 40% toward non-formal education practices.

3.2.5. Classification of variables and target audience

Environmental knowledge, attitudes, perceptions of the environment, and levels of ecological awareness are the variables most frequently (62%) assessed in the studies analyzed. Likewise, variables associated with environmental practices, competencies, biocultural knowledge, and processes of territorial appropriation are also present, though to a lesser extent (38%). This bias toward cognitive/attitudinal dimensions suggests that the field has prioritized outcomes related to awareness and training, with less attention paid to transformations in sustainable practices and socioterritorial components.

3.2.6. Evaluation and reported impact

In terms of evaluation, assessments without impact analysis and ex post evaluations predominate (53%). There is a scarcity of longitudinal studies or measurements of medium- and long-term impact (47%), suggesting that in the state of Chihuahua, there is little continuity in environmental education (EE) projects and limited monitoring of their educational impacts. Consequently, there is a need to strengthen intervention designs and indicator systems that allow for the systematic evaluation of EE's contribution to territorial sustainability.

The methodological approaches, research strategies, and types of intervention identified in the analyzed publications allow us to understand not only how EA is researched in the state of Chihuahua but also how they shape the environmental themes and issues addressed. In this regard, the predominance of descriptive, diagnostic, and short-term designs directly influences the level of thematic specificity in the research. Based on this, the following section analyzes the environmental themes addressed in the reviewed studies, with the aim of identifying trends, concentrations, and thematic gaps in the academic literature on EE in the state.

3.3. Analysis of the topics covered

This analysis identified 10 thematic areas that structure academic research in environmental education (EE) in the state of Chihuahua. Given the interdisciplinary nature of the field, these areas are not mutually exclusive; consequently, some studies

address more than one theme. The central objective of this classification is to identify general trends, the degree of thematic specificity (general approaches vs. situated issues), and underrepresented areas that limit a comprehensive understanding of the region's socio-environmental challenges.

3.3.1. Overview of Environmental Issues in the State of Chihuahua

Publications on environmental education (EE) in Chihuahua show a high concentration of studies in the general EE category, accounting for 50.9% of the total documents analyzed. These works take the form of diagnostic studies, educational proposals, intervention experiences, or conceptual analyses, without specifying a particular environmental issue. This trend is consistent with what was observed in section 3.2, where descriptive and cross-sectional studies aimed at characterizing cognitive and attitudinal variables prevail.

Second place is occupied by studies focusing on environmental perception, attitudes, and awareness, accounting for approximately 17% of the publications. Although some of these studies are linked to specific environmental contexts (urban biodiversity, deserts, ecotourism, water, climate change, or school gardens), a significant portion addresses these variables at a descriptive level, focusing on identifying general opinions or dispositions without explicitly linking them to a specific socio-environmental issue.

Less frequently cited themes include community and social participation (15.1%); water and water resources, as well as sustainability and sustainable development, and educational technologies and resources (7.5% each); and flora, fauna, and biodiversity (5.7%). Finally, topics such as climate change, pollution, and gardens or agroecology have a marginal presence, with percentages equal to or less than 4% each.

3.3.2. Level of thematic specificity: general approaches and context-specific issues

In addition to the frequency of topics, the analysis reveals differences in the level of specificity in addressing environmental issues. A significant proportion of the studies focus on environmental education and ecological awareness from broad, cross-cutting perspectives, without identifying specific environmental problems. This pattern is associated with the predominance of the diagnostic approach, as evidenced in section 3.2.

On the other hand, a smaller group of studies addresses educational processes related to specific

environmental issues concerning the Chihuahuan Desert, biodiversity, ecotourism, school gardens, water scarcity, or climate change. These contributions provide a territorial and sociocultural context that links EE to the environmental challenges specific to the state of Chihuahua.

The coexistence of both levels of approach suggests that EE in the state is undergoing a transition, in which general approaches focused on raising awareness coexist with nascent efforts to link educational processes to specific environmental issues.

3.3.3. Emerging themes and underrepresented areas

The thematic analysis also highlights the underrepresentation of strategic issues in agroecology research. Particularly notable is the scarcity of studies focusing on pollution, climate change, and food production from agroecological perspectives, despite the significance of these issues within the state's environmental, social, and productive contexts.

Likewise, the use of educational technologies and media appears only in its infancy and, in most cases, as an isolated teaching resource, lacking a critical examination of its potential to strengthen processes of community participation, territorial advocacy, or long-term impact assessment.

3.3.4. Implications of thematic diversity

The diversity of identified topics reflects a broad and expanding field of research, although it is still characterized by a focus on general and diagnostic approaches. Even in studies that address specific environmental issues, the analysis tends to remain at the descriptive level, with little connection to processes of collective action, longitudinal monitoring, or the transformation of socio-environmental practices.

In this regard, the thematic heterogeneity constitutes a significant finding, as it highlights both the growing interest in EE in Chihuahua and the need to strengthen research that more systematically integrates the social, cultural, and territorial dimensions of the environmental problems addressed.

3.4. An Analysis from the Perspective of Paulo Freire's Critical Pedagogy and Liberating Education

For Paulo Freire, education was an act of love and courage, as well as a practice of freedom grounded in reality. In this review, analysis from this Freirean perspective allowed for the classification of the

publications into three pedagogical orientations: banking (a transmissive pedagogical approach), liberating (oriented toward critical and participatory reflection), and mixed (studies that simultaneously presented both banking and liberating features).

3.4.1. Distribution of teaching guidelines

The results show that, within the territorial and sociocultural context of the state of Chihuahua, the blended approach predominates (71.7%), followed by the liberating approach (17.0%) and the banking approach (11.3%). This pattern suggests that environmental education (EE) does not operate as a dichotomy between transmission and emancipation, but rather as a combined field where teaching methods focused on content, training, or informational awareness coexist alongside discursive or methodological elements oriented toward participation, praxis, and critical reflection (Figure 4).

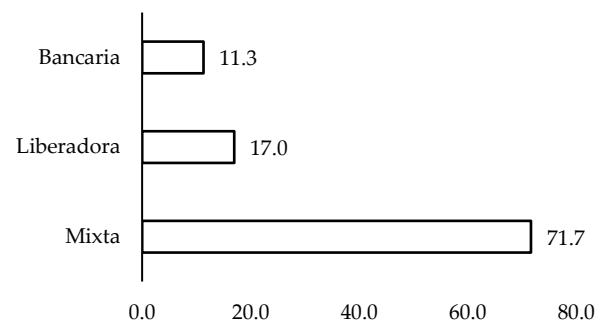


Figure 3. Percentage of publications aligned with Paulo Freire's perspective.

3.4.2. Tensions between the drive for emancipation and institutional inertia

The documents classified as "liberating" demonstrate a dialogical and territorial orientation, in which knowledge is constructed together with the participants and based on specific socio-environmental issues, creating space for praxis (action-reflection-action) and the recognition of community-based knowledge.

In terms of education for sustainability, these experiences represent pathways with greater potential for integrating learning, participation, territorial ownership, and the development of alternatives within specific sociocultural contexts.

3.4.3. Characteristics of liberating experiences: dialogue, territory, and praxis

The prevalence of mixed-method studies and the low proportion of fully liberatory approaches point to a process of pedagogical evolution, in which critical education brings together critical references

but faces structural limitations in translating them into methods rather than merely intentions. From the perspective of sustainability, this result suggests that a significant portion of the field still focuses on short-term educational achievements (awareness-raising, training, content delivery), while experiences with problematizing pedagogies and effective participation (closer to transformative approaches) remain in the minority.

These pedagogical orientations allow for a better understanding of what kind of sustainability the analyzed experiences promote: the coexistence of banking mechanisms and liberating elements helps explain why, even with critical discourses, many experiences tend to remain at the level of individual or educational changes (compatible with weak sustainability), while dialogical, territorial, and praxis-based experiences open up possibilities for moving toward strong sustainability approaches. The following section analyzes this issue through the dimensions of sustainability and environmental rationality proposed by Enrique Leff.

3.5. Analysis of the Approach to Environmental Rationality and Sustainability: Perspectives from Enrique Leff

The studies included in this review were classified based on the six dimensions of sustainability proposed by Enrique Leff (ecological, economic, social, cultural, political, and ethical). For each study, a dominant dimension was identified, which articulates the central problem, the general objective, and the analytical approach of the document; furthermore, one or more complementary dimensions were noted when the content revealed an explicit connection between two distinct levels of environmental rationality.

This analysis allows for the recognition of the multidimensional and integrated nature of sustainability, reducing the likelihood of rigid classifications and prioritizing an interpretation grounded in the theoretical, methodological, and empirical framework of each study.

3.5.1. Weak and strong sustainability in the production analyzed

An analysis of the publications allows for a reinterpretation of the results based on the classic distinction between weak sustainability and strong sustainability. It is observed that most of the studies (81%) fall within a conception of weak sustainability, characterized by an emphasis on EA as a strategy for individual and educational change, centered on pro-environmental values, attitudes, and behaviors,

without deep critical thinking about development models.

This orientation shows an absence of economic analysis and transformation of production systems, as well as limited examination of territorial conflicts, socio-environmental inequalities, and power relations; consequently, sustainability appears as an improvement in behavior and an educational adjustment compatible with existing structures.

In contrast, a small—but valuable—number of studies (19%) more clearly align with a conception of strong sustainability. This is identified by: integrating cultural diversity, territory, and ecosystem conservation; recognizing irreplaceable ecological limits and the centrality of nature's intrinsic value; and articulating traditional knowledge, worldviews, and ethics as the foundations of the society-nature relationship, questioning instrumental and productivist rationality.

3.5.2. Distribution of the dominant dimension

Figure 5 shows that research on ESD in the state of Chihuahua is more heavily concentrated on the social dimension of sustainability, with a strong emphasis on educational processes, stakeholder training, attitude change, teaching practices, and community participation. Likewise, the cultural and political dimensions appear less frequently in the background, particularly in studies related to indigenous communities, curriculum analysis, regulatory frameworks, and the institutionalization of EE. Next is the economic dimension, with very few studies that treat it as a central focus. Finally, the ecological and ethical dimensions appear, generally presented as complementary dimensions.

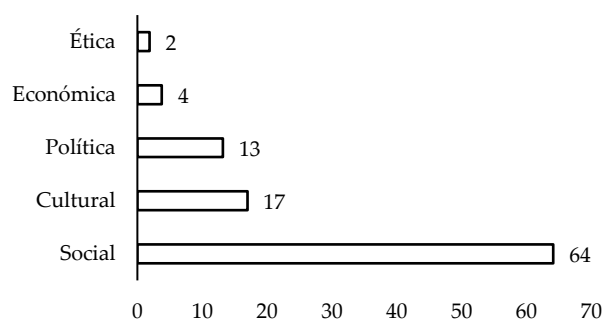


Figure 4. Percentage of publication rankings based on Enrique Leff's sustainability dimensions

3.5.3. Interrelationships among the dimensions of sustainability

Recurring patterns of interconnection between dimensions were identified:

Social-ecological: the most common combination, linking educational processes with content on biodiversity, conservation, water, the desert, pollution, and climate change; this suggests a pedagogical approach that views EE as a means to examine and reshape the relationship between society and nature within the school and community contexts.

Social-ethical: emphasis on values, attitudes, responsibility, care, and environmental awareness, presenting EE as an axiological space aimed at transforming behaviors rather than productive/institutional structures.

Social-political: frequently in curricular, normative, or institutional analyses, the social-political dimension is accompanied by the ethical dimension, which presupposes that educational governance, legal frameworks, and the institutionalization of EE hold central relevance; however, it simultaneously reveals limitations in explicitly incorporating the deep ecological dimension or alternative productive approaches.

In this regard, it is noteworthy that more than 96% of the publications are interrelated with at least three of the six dimensions of sustainability.

3.5.4. Areas requiring attention in environmental education in the region

Despite the frequency of interrelationships, the economic dimension rarely emerges as a dominant theme (less than 4%), with few or no studies proposing productive alternatives, environmental economic rationality, community-based ecotourism, or the integration of environmental and social costs. Something similar occurs with the political dimension, as it appears infrequently (13%) and is generally linked to regulatory and educational management aspects, with limited reference to processes of environmental democratization, territorial disputes, and environmental conflicts.

Both situations suggest that EA in Chihuahua has been conceived outside the debates related to development models, environmental political economy, and the transformation of productive systems. Likewise, there is little critical examination of the power relations that underpin the use and control of natural resources, which fosters public disinterest and limits its transformative potential in structural terms.

3.6. A Survey of Environmental Education in the Studies Analyzed by Lucy Sauvé

3.6.1. Distribution of Major Trends in Environmental Education Programs in the State of

Chihuahua

Based on the Taxonomy of Environmental Education proposed by L. Sauvé, the documented experiences were analyzed, and a significant body of work was identified around a set of dominant trends. Figure 6 shows that the problem-solving trend is present in 22.6% of the studies; the conservationist/resource-oriented trend, in 20.8%; and the practical trend, in 17%. This set constitutes a hegemonic core focused on addressing environmental issues, natural resource management, and applied educational intervention.

The relevance of this finding, from a sustainability perspective, lies in the fact that these approaches tend to prioritize educational responses focused on problem management and the conservation and care of resources, with an operational emphasis on training and intervention activities.

Although such orientations can be valuable for promoting care practices, their predominance may also be associated with structural limitations when they are not explicitly articulated with economic and political dimensions, with approaches to socio-environmental justice, or with processes of territorial governance.

3.6.2. The Presence of Critical Currents and Their Significance for Transformative Sustainability

The critical strand accounts for 13.2% of the studies, indicating a still-minority but significant presence of approaches focused on social dimensions, socio-environmental conflicts, environmental justice, and reflexivity.

This component suggests that the field is in a transitional phase where, alongside the technical-operational predominance, approaches are emerging that potentially strengthen strong sustainability by incorporating questions about power, inequality, territory, and structural conditions that lead to environmental degradation.

3.6.3. Intermediate Trends: Educational Focus and the Relationship with Values and Nature

The humanist and naturalist approaches fall into an intermediate category, each accounting for 7.5%. The former emphasizes values education, while the latter focuses on knowledge of and appreciation for nature.

In the analyzed materials, these approaches do not emerge as dominant themes in the field, but rather as supporting pedagogical frameworks and educational approaches that are often integrated into conservation-oriented or problem-solving initiatives.

3.6.4. Underrepresented fields: local knowledge, scientific literacy, and complexity

Trends with a low presence were identified: ethnographic (5.7%), scientific (3.8%), and holistic (1.9%). The ethnographic trend is associated with few studies grounded in local knowledge, worldviews, and community narratives, while the scientific trend is linked only to a limited extent with scientific literacy and a systemic understanding of ecological processes. The low presence of the holistic approach suggests that the complexity perspective does not yet structure the field; instead, fragmented approaches focused on problems, resources, and actions predominate, rather than an integrated ecosystemic and sociocultural vision (Figure 6).

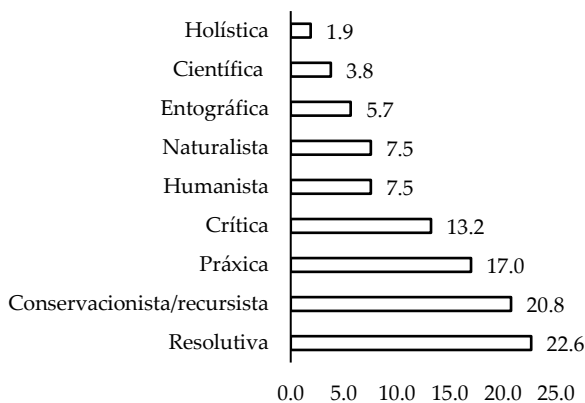


Figure 5. Percentage distribution of main streams of environmental education.

3.6.5. An integrative reading: implications for weak/strong sustainability and environmental governance

Overall, the observed distribution indicates that environmental studies in Chihuahua have developed primarily from approaches focused on the management of problems and resources, with a lesser presence of critical, holistic, and ethnographic approaches. This configuration is consistent with the previously identified predominance of diagnostic methodological approaches and with the hegemony of weak sustainability in the analyzed body of work, insofar as educational action tends to focus on raising awareness, care, and behavioral improvement, without a systematic problematization of development models, power relations, or economic and political structures, consistent with the reality of the state of Chihuahua.

Nevertheless, the presence of the critical approach and, to a lesser extent, the ethnographic approach, suggests emerging pathways to strengthen strong sustainability approaches, especially when they are

linked to sociocultural diversity, territory, and environmental governance processes in community and indigenous contexts, as is the case with the Rarámuri, Guarijío, Pimas, Ódame, and Tepehuanos, or other groups such as the Mennonite community.

3.7. Analysis of Theoretical and Methodological Trends in Environmental Education in Chihuahua

An integrated analysis of methodological approaches, theoretical trends in environmental education, pedagogical orientations, and conceptions of sustainability allows us to identify a set of structural trends that shape the field of environmental education in the state of Chihuahua.

First, from a methodological perspective, diagnostic and cross-cutting research predominates, with a high prevalence of descriptive studies and instruments focused on cognitive and attitudinal variables (knowledge, perception, ecological awareness), as well as educational interventions with primarily immediate or short-term evaluation.

This methodological configuration tends to favor results related to awareness-raising and characterization, but limits the possibility of documenting sustained changes in practices, collective capacities, and territorial impact.

Second, the thematic analysis shows a high concentration on “general EE” approaches and a lesser presence of strategic themes such as climate change, pollution, and agroecology/community gardens, suggesting that a significant portion of the research is not systematically linked to specific socio-environmental issues in the region.

This thematic breadth is consistent with the predominance of cross-sectional and diagnostic studies, and reflects a field still under development, with nascent efforts to move toward situated approaches.

Third, the pedagogical analysis based on Paulo Freire reveals that the predominant orientation is blended (71.7%), followed by liberating approaches (17.0%) and banking approaches (11.3%).

This predominance suggests a recurring tension: in several cases, language of participation and critical thinking is observed, but in practice, training methods centered on content transmission, skill-building, and awareness-raising persist. In terms of education for sustainability, this implies that the transformative potential of ES is expressed unevenly and is frequently constrained by institutional inertia, limitations on continuity, and the absence of longitudinal evaluations.

Fourth, analysis from the perspective of

environmental rationality and the dimensions of sustainability (Leff) allows us to consolidate a central finding: most of the output is oriented toward a weak conception of sustainability (81%), while a smaller proportion (19%) aligns with criteria of strong sustainability.

Weak sustainability is characterized by an emphasis on individual and educational changes, with little critical examination of development models and limited incorporation of economic and political dimensions; in contrast, studies associated with strong sustainability tend to integrate territory, sociocultural diversity, ecosystem conservation, and, in some cases, community knowledge and worldviews.

Finally, the mapping of EE currents (Sauvé) reveals a hegemonic core composed of the resolute (22.6%), conservationist/resource-oriented (20.8%), and praxic (17%) currents, with a smaller presence of critical currents (13.2%) and scant representation of holistic, scientific, and ethnographic approaches.

This profile reinforces the previous interpretation: EE in Chihuahua has developed primarily from orientations focused on problem-solving, resource care/management, and applied intervention, while critical and biocultural approaches (more consistent with strong sustainability and with the analysis of governance and socio-environmental justice) appear as emerging pathways.

4. DISCUSSION

The results of this systematic review show that environmental education (EE) in Chihuahua is in a transitional phase, characterized by the coexistence of diagnostic and general approaches alongside emerging initiatives with critical, territorial, and biocultural orientations. This configuration is not an isolated exception but aligns with trends documented in international reviews: there remains a bias toward cross-sectional designs and measurements of knowledge, attitudes, and perceptions, to the detriment of longitudinal evaluations and impact analyses (Ardoin et al., 2020; Tilbury, 2011).

At the state level, this methodological orientation is associated with low implementation of specific interventions and weaknesses in coordination between research, action, monitoring, and evaluation, which limits the EE's capacity to sustain processes of change in the medium and long term (Tilbury, 2011; UNESCO, 2020).

4.1. The predominance of the diagnostic approach and limitations on the transition to sustainability

The prevalence of diagnostic and cross-sectional

studies observed in Chihuahua tends to yield evidence focused on the characterization of individual variables (knowledge, attitudes, perceptions), with less attention paid to changes in practices, collective capacities, or territorial impact. This pattern, in addition to being consistent with the global trend reported in the international literature, is linked in the state context to a discontinuity of projects and the limited institutionalization of monitoring mechanisms (Ardoin et al., 2020). In terms of sustainability, the consequence is significant: when EE is evaluated over short time frames and using primarily cognitive-attitudinal indicators, its contribution to socio-ecological transitions becomes difficult to demonstrate and, in many cases, is reduced to immediate educational achievements (Tilbury, 2011).

From a sustainability perspective, this limitation is significant: transitions toward sustainability require educational processes characterized by continuity, social learning, and institutional coordination (Tilbury, 2011; UNESCO, 2020). Therefore, a key implication is to strengthen methodological designs that integrate the actual implementation of strategies, indicators that go beyond attitudes, and medium- and long-term evaluations (for example, changes in community practices, territorial ownership, organizational and participatory capacities, or impact on environmental governance) (Tilbury, 2011; UNESCO, 2020).

4.2. General thematic approach versus specific socio-environmental issues

The thematic analysis confirms that the majority of studies address environmental assessment in general terms, without delving into conflicts or issues specific to the region. This contrasts with the trend that various authors have highlighted at the international level, where EE with the greatest transformative potential is linked to controversial and context-specific issues—such as climate change, environmental justice, or resource governance—through problematizing and territorially grounded approaches (Wals & Corcoran, 2023). In Chihuahua, the persistence of general approaches suggests that part of the field remains anchored in stages of awareness-raising and basic training, even as the territory faces complex challenges related to water, ecosystems, inequality, and sociocultural diversity (UNESCO, 2020).

This gap—between the international shift toward localization and problematization and the regional persistence of general approaches—constitutes a concrete contribution of this work: it allows for a discussion of EE from a socio-territorial perspective and

highlights the need to link it to the state's socio-environmental challenges. Furthermore, the underrepresentation of strategic issues such as climate change, pollution, and agroecology/food production reinforces the idea of a field that needs to broaden its research and practice agenda to align with contemporary sustainability priorities (UNESCO, 2020).

4.3. Hybrid Pedagogies: The Tension Between Critical Discourse and Transmissive Practice

Paulo Freire's analysis offers a key insight into understanding the transformative limits of early childhood education in Chihuahua: mixed approaches predominate, where participatory and critical discourses coexist with pedagogical practices of a transmissive nature. This finding aligns with what has been documented in various contexts, where discourses of participation and transformation can coexist with more transmissive school practices, creating gaps between what is proposed at the curricular/theoretical level and what actually occurs in the classroom (Cotton, 2006; González Gaudiano & Arias Ortega, 2009).

From a sustainability-oriented perspective, this tension suggests that the adoption of emancipatory discursive frameworks does not automatically translate into transformative praxis. Consequently, strengthening problematizing pedagogies does not merely involve "incorporating participation" as a teaching strategy, but rather ensuring institutional and methodological conditions that enable situated dialogue, collective construction of meaning, and articulation with territorial processes (for example, community organization, collective action, and environmental governance). In other words, the challenge is to move from an ES focused on individual training to an education for sustainability that builds social capacities to influence the processes that cause environmental degradation (Sterling, 2010b)

4.4. Weak sustainability hegemony and gaps in the economic and political dimensions

A key finding of this study is that a narrow conception of sustainability predominates in the set of documents analyzed.

This pattern aligns with international critiques that have noted that EE has frequently been subsumed by the sustainable development paradigm, prioritizing efficient resource management and changes in individual behavior without questioning economic and political structures (Gudynas, 2009; Sterling, 2001, 2010b). In the case of Chihuahua, this hegemony is expressed through an educational-axiological emphasis and the limited incorporation of economic and political

dimensions, which restricts the potential of environmental education to address development models, territorial conflicts, socio-environmental inequalities, or disputes over resource control (Gudynas, 2009).

This finding is linked to a particularly significant gap: the economic dimension rarely appears as a dominant theme (less than 4%), and the political dimension occurs infrequently (13%) and is typically limited to educational policy and management, with little connection to environmental democratization, territorial disputes, or environmental conflicts. This absence reduces the likelihood that EE will contribute to strong sustainability, as it leaves out key elements for socio-ecological transitions: political economy, governance, power, and justice.

4.5. Main Trends in EE: Problem- and Resource-Based Management vs. Critical and Holistic Approaches

Sauvé's mapping reinforces the previous interpretation: the regional field is structured around three main currents – resolute, conservationist/resource-oriented, and practical – with a lesser presence of the critical current and low representation of holistic or ethnographic approaches (Sauvé, 2004). In practical terms, this means that much of EE in Chihuahua is oriented toward addressing environmental problems and promoting resource stewardship/management through educational initiatives and applied interventions. These orientations can yield significant benefits (learning, pro-environmental attitudes, care initiatives), but they tend to be limited when they are not connected to processes of governance, socio-environmental justice, and structural transformation (Sterling, 2010; Wals & Corcoran, 2023).

However, the (minority) presence of critical and ethnographic currents suggests emerging pathways to strengthen strong sustainability: approaches more closely connected to territory, sociocultural diversity, local knowledge, and challenges to the dominant instrumental rationality (Gudynas, 2009; Sauvé, 2004). These pathways are consistent with the findings on strong sustainability identified in a smaller portion of the corpus and constitute a foundation for guiding a contextualized state model.

4.6. Implications for strengthening education for sustainability in Chihuahua

1. Taken together, the findings suggest that strengthening the contribution of environmental education to sustainability requires action on at least four fronts:

2. Strengthen continuity and longitudinal evaluation, prioritizing intervention designs with medium- and long-term follow-up and indicators that include changes in practices, collective capacities, and territorial impact (not just knowledge/attitudes) (Tilbury, 2011; UNESCO, 2020).
3. Increase thematic specificity and problematization, linking EE to strategic socio-environmental challenges in the region (e.g., water, climate, pollution, agroecology, and environmental justice), moving beyond the predominance of general approaches (UNESCO, 2020; Wals & Corcoran, 2023).
4. Consolidate critical pedagogies in practice, reducing the tension between liberatory discourse and lecture-style formats through dialogic, participatory, and situated methodologies that foster praxis and social learning (Sterling, 2010).
5. Integrate economic and political dimensions, connecting AE with environmental governance, power, production models, territorial conflicts, and institutions—a necessary condition (Gudynas, 2009; Sterling, 2010).

These implications are particularly relevant given the regulatory and institutional context in Mexico and Chihuahua, where instruments for mainstreaming and institutionalizing EE have been strengthened (UNESCO, 2020). In this regard, the evidence synthesized here can serve as a foundation for guiding the design of state-level strategies for education for sustainability that are culturally relevant, geographically grounded, and equipped with mechanisms for monitoring and inter-institutional coordination (Tilbury, 2011).

4.7. Limitations of the review

This review incorporates both scientific and gray literature, which broadens the scope of the field but also implies heterogeneity in the type of evidence reported and variability in the level of methodological detail (Ardoin et al., 2020). Likewise, the predominance of diagnostic and cross-sectional studies in the corpus limits the ability to compare longitudinal impacts across interventions (Tilbury, 2011). However, these limitations also constitute a substantive finding: they highlight the need to strengthen research and intervention designs with greater temporal continuity and evaluative robustness in the state of Chihuahua.

5. CONCLUSIONS

This PRISMA-based systematic review synthesized 53 documents (1990–2025) on environmental education (EE) initiatives in the state

of Chihuahua, Mexico, and identified methodological, thematic, and pedagogical trends, as well as discussed their contribution to sustainability within the frameworks of Freire, Leff, and Sauv . The results reveal a growing field, but one with discontinuous development and a predominance of diagnostic and cross-sectional studies, focused primarily on cognitive and attitudinal variables and with limited short-term evaluation.

This configuration restricts the ability to document sustained changes and to assess educational impacts on socio-environmental practices and territorial processes.

Thematically, a high concentration on “general EE” approaches was identified, along with a lesser presence of contemporary strategic issues such as climate change, pollution, and agroecology/food production, suggesting the need to strengthen research and educational experiences that are more situated and linked to specific socio-environmental issues within the territory.

From an educational perspective, the predominance of blended approaches (71.7%) reveals a recurring tension: discourses of participation and critical thinking coexist with transmission-oriented teaching practices, which limits the emancipatory potential of environmental education when it is not established as a dialogical, territorial, and participatory practice.

The most relevant finding for Sustainability is the identification of a hegemony of weak sustainability (81%) in the analyzed body of work, compared to a lesser presence of approaches associated with strong sustainability (19%).

Weak sustainability is expressed in an EE focused on awareness-raising and individual change, with little problematization of development models and limited integration of economic and political dimensions. In contrast, experiences that approach strong sustainability tend to incorporate territory, sociocultural diversity, and ecosystem conservation, and open up the possibility of articulating local knowledge, worldviews, and environmental ethics. Sauv ’s mapping reinforces this interpretation by showing a dominant core of resolute, conservationist/resource-oriented, and praxic currents, with a lesser presence of critical, holistic, and ethnographic currents.

Taken together, the results suggest that environmental education in Chihuahua is in a transitional phase and that strengthening it as education for sustainability requires: (i) moving toward methodological designs that include longitudinal tracking and indicators reflecting

changes in practices, collective capacities, and territorial impact; (ii) broadening and refining the thematic agenda to address key socio-environmental challenges in the state; (iii) consolidating problematizing and dialogic pedagogies that overcome the tension between critical discourse and rote learning; and (iv) explicitly integrating economic and political dimensions through approaches to environmental governance, socio-environmental justice, and analysis of production models. These pathways would enable a transition from an EE predominantly oriented toward weak sustainability toward situated, culturally relevant, and territorially anchored approaches with greater transformative potential.

5.1 Implications for public policy and educational-environmental governance

The synthesized evidence provides insights to guide the design and strengthening of state strategies

for education for sustainability. In particular, the findings suggest the need to:

- Promote inter-institutional coordination mechanisms among the education and environmental sectors and local stakeholders;
- Establish monitoring and evaluation guidelines to support the implementation of projects and programs, thereby avoiding discontinuity;
- Promote teacher and community training in critical pedagogies and participatory methodologies; and
- Prioritize context-specific approaches (rural, urban, indigenous) that recognize the state's sociocultural diversity and link education with territorial governance and the management of strategic resources, such as water.

These actions would help align EE with transitions toward robust sustainability and build territorial capacities for collective action in the state of Chihuahua.

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Appendix A

Table A1. Documents included in the systematic review for the state of Chihuahua.

Author	Title	Document type	Source	Country
Adame, C., 2020	La Educación ambiental y las Competencias en estudiantes de Educación Media Superior en Ciudad Juárez (Environmental Education and Competencies in Upper Secondary School Students in Ciudad Juárez)	Resumen ponencia	-	México
Alcalá, J., Soto, R., Lebgue, T. & Sosa, M. 2007	Percepción comunitaria de la flora y fauna urbana en la ciudad de Chihuahua, México (Community perception of urban flora and fauna in the city of Chihuahua, Mexico)	Artículo	Revista Latinoamericana de Recursos Naturales, 3 (1): 58-64, 2007	México
Alcalá, J., Soto, R., Lebgue, T. & Sosa, M. 2015	Análisis para el fomento de la educación ambiental en el sector educativo: ciudad de Chihuahua (Analysis for the promotion of environmental education in the education sector: city of Chihuahua)	Artículo	Revista Iberoamericana de Producción Académica y Gestión Educativa, 2(3), 1-18	México
Aldama, J. & Manjarrez, G. 2013	El uso del video en internet como medio didáctico para estudiantes de licenciatura en asignaturas medioambientales: experiencia docente de aprendizaje significativo y valores (The use of online videos as a teaching tool for undergraduate students in environmental subjects: teaching experience of meaningful learning and values)	Resumen ponencia	Revista Internacional de Contaminación Ambiental. (2013). <i>Memorias del Congreso Internacional de Ciencias Ambientales 2013</i> . Vol. 29, Suplemento 1. Universidad Autónoma de Ciudad Juárez	México
Andrino, L., Rascón, L. & Salazar. A. 2020	Conciencia ambiental con ecoturismo (Environmental awareness through ecotourism)	Capítulo de libro	Factores críticos y estratégicos en la interacción territorial: desafíos actuales y escenarios futuros, Volumen IV, UNAM, Asociación Mexicana de Ciencias para el Desarrollo Regional (AMCDR)	México
Balderrama, S., Lebgue, T., Viramontes, O., Soto, R., Cortés, L., Quintana, M. & Durán, A. 2012	Environmental Perception of the Housewives in the Communities of the Alta Sierra Tarahumara, Chihuahua, Mexico	Resumen ponencia	Revista Internacional de Contaminación Ambiental Volumen 29 Suplemento 1, 2013. XII Congreso Internacional y XVIII Congreso Nacional de Ciencias Ambientales	Estados Unidos
Castañón, A., Avelar, L. & García, J. 2022	Efectos del nivel de conocimiento y educación ambiental sobre el comportamiento, intenciones y actitudes de futuros egresados (Effects of environmental knowledge and education levels on the behavior, intentions, and attitudes of future graduates)	Artículo	Journal of Education and Practice, Vol 3, No.8, 2012, International Institute of Science and Technology Education (IISTE)	México
Cen, M. 2006	Okó Bawírame. Percepciones del deterioro ambiental en San José del Pinal, Ocoviachi y Cuiteco, Sierra Tarahumara (Okó Bawírame. Perceptions of environmental degradation in San José del Pinal, Ocoviachi, and Cuiteco, Sierra Tarahumara)	Tesis maestría	Repositorio CIESAS	México
Chavira, S., Rodríguez, S. & Santellano, E. 2017	Medición de la actitud ambiental en dos programas de ingeniería (Measuring environmental attitudes in two engineering programs)	Capítulo de libro	Educación Ambiental en las Instituciones de Educación Superior	México
Escobar, M., 2002	Saberes ambientales de la comunidad Rarámuri Ba'Winokachi a partir de la recolección de plantas silvestres comestibles (Environmental knowledge of the Rarámuri Ba'Winokachi community based on the collection of edible wild plants)	Tesis licenciatura	CUCBA	México

Escobedo, R. & Cordero, T. 2023	Propuesta de proyecto transversal e interdisciplinario para educación media superior: "El calentamiento Global" (Proposal for a cross-curricular and interdisciplinary project for upper secondary education: "Global Warming")	Artículo	Educación Química, 34(2(¿), 139-150	México
Fujigaki, A., 2020	Caminos rarámuri para sostener o acabar el mundo. Teoría etnográfica, cambio climático y antropoceno (Rarámuri paths to sustain or end the world. Ethnographic theory, climate change, and the Anthropocene)	Artículo	MANA 26(1): 001 - 035	México
García, S. 2005	Educación Ecológica: reflexión y praxis en torno a la sequía en Chihuahua (Ecological Education: Reflection and Practice Regarding the Drought in Chihuahua)	Libro	Libro	México
García, S., Reyes, V. & Tovar, P. 2007	Un Proyecto de Educación Ambiental en Torno a la Sequía en Chihuahua: Proceso, Resultados y Aplicaciones Ulteriores (An Environmental Education Project on Drought in Chihuahua: Process, Results, and Further Applications)	Resumen ponencia	Memorias en Extenso del VI Congreso Internacional y XII Nacional de Ciencias Ambientales, Ciudad de Chihuahua, México	México
Gracia, J. & Rivero, E., 2013	Albergue escolar indígena sustentable en recursos naturales. Resultados de un proyecto piloto en Chihuahua (Sustainable indigenous school hostel using natural resources. Results of a pilot project in Chihuahua)	Resumen ponencia	XII Congreso Internacional y XVIII Congreso Nacional de Ciencias Ambientales. Revista Internacional de Contaminación Ambiental, 29 (Supl. 1), 2013	México
García, S. 2019	Imaginación Global del Lugar y la Educación Ambiental (Global Imagination of Place and Environmental Education)	Libro	Faculty Gallery. 475	Estados Unidos
Garduño, M. 2019	Representaciones sociales de cultura ambiental en estudiantes universitarios. El impacto de la educación ambiental del Nuevo Modelo Ecológico acordado por la ONU. 1970-2015 (Social representations of environmental culture among university students. The impact of environmental education under the New Ecological Model agreed by the UN. 1970-2015)	Tesis doctoral	El Colegio de Chihuahua	México
Garza, V. 2008	Tráfico ilegal de vida silvestre y educación ambiental (Illegal wildlife trafficking and environmental education)	Artículo	CULCYT, Cultura Científica y Tecnológica, año 6, no. 33-34, julio-octubre 2009, UACJ, ISSN: 2007-0411	México
Garza, V. & Cervantes, E. 2009	Plinius: Centro de documentación digital sobre tráfico ilegal de especies (Plinius: Digital documentation center on illegal trafficking of species)	Artículo	CULCYT, Cultura Científica y Tecnológica, año 6, no. 33-34, julio-octubre 2009, UACJ, ISSN: 2007-0411	México
Garza, V., Cervantes, E., Figueroa, I. & Garza, B. 2010	Rutas de tráfico ilegal de vida silvestre en Chihuahua (Illegal wildlife trafficking routes in Chihuahua)	Artículo	CULCYT, Cultura Científica y Tecnológica, año 7, no. 36-37, enero-abril 2010, UACJ	México
Garza, B. 2011	La Educación Ambiental en los libros de Texto Gratuito de México (Environmental Education in Mexico's Free Textbooks)	Tesis maestría	El Colegio de Chihuahua	México
Gómez, H. 2018	Programa de Educación no Formal para el Cambio Climático en el Municipio de Chihuahua (Non-Formal Education Program on Climate Change in the Municipality of Chihuahua)	Tesina maestría	Tesina maestría	México
González, M. 2022	Educación ambiental sustentable para jóvenes con necesidades educativas especiales. Ciudad Juárez (México) (Sustainable environmental education for young people with special educational needs. Ciudad Juárez (Mexico))	Artículo	Academic Journal of Studies in Society and Technologies-Geplat Paper, volumen 3, número 1, 2022 (ISSN: 2675-4967) http://geplat.com/papers/index.php/home	Brasil

González, M., Carrera, L. 2024	Senderismo ecoturístico en sitios naturales con petrograbados para la Educación e Interpretación Ambiental. Samalayuca, México (Ecotourism hiking in natural sites with petroglyphs for environmental education and interpretation. Samalayuca, Mexico)	Artículo	RISTI, no. E71, 07/2024 Revista Ibérica de Sistemas e Tecnologias de Informação Iberian Journal of Information Systems and Technologies	Portugal
Gutiérrez, M. & Gutiérrez, L. 2008	Educación ambiental en el desierto: un esfuerzo proactivo (Environmental education in the desert: a proactive effort)	Artículo	Tecnociencia Chihuahua, volumen II, No. 3, septiembre-diciembre 2008	México
Herrera, V. 2013	Manual de prácticas ambientales para la educación no formal de niños de 4o a 6o grado de primaria (Environmental practices manual for non-formal education of children in grades 4 to 6 of elementary school)	Resumen ponencia	XII Congreso Internacional y XVIII Congreso Nacional de Ciencias Ambientales. Revista Internacional de Contaminación Ambiental, 29 (Supl. 1), 2013	México
Herrera, B., 2013	Proyectos de ecología enfocados a niños con aptitudes sobresalientes (Ecology projects focused on children with outstanding abilities)	Resumen ponencia	XII Congreso Internacional y XVIII Congreso Nacional de Ciencias Ambientales. Revista Internacional de Contaminación Ambiental, 29 (Supl. 1), 2013	México
Herrera, R., Posada, J. & Mendoza, D., 2017	La ambientalización curricular en el Instituto Tecnológico de Chihuahua (Environmental awareness in the curriculum at the Chihuahua Institute of Technology)	Capítulo de libro	Libro: Educación Ambiental en las Instituciones de Educación Superior	México
Herrera, R., Santa-Anna, A., Rivera, A., Zárate, E. & Rodríguez, R. 2019	Caracterización de las prácticas de educación para la sustentabilidad en la modalidad de educación ambiental no formal. Estudio de caso (Characterization of education practices for sustainability in non-formal environmental education. Case study)	Artículo	Revista Brasileira de Gestão Ambiental e Sustentabilidade (2019): vol. 6, n. 13, p. 459-468.	Brasil
Islas, P., Sandoval, F., Domínguez, C. 2019	Visión integral de la educación medio ambiental en la comunidad menonita (Comprehensive view of environmental education in the Mennonite community)	Reporte Técnico	Coordinación General de Investigación y Posgrado UACJ-Investigación	México
Laffont, C. 2017	Diagnóstico sobre el abordaje ambiental en el currículo de la licenciatura en educación de la universidad Autónoma de Ciudad Juárez (Diagnosis of the environmental approach in the curriculum of the bachelor's degree in education at the Autonomous University of Ciudad Juárez)	Tesis maestría	CUCBA	México
Loredo, J. & Arán, A., 2023	Uso de Naturalista como refuerzo del programa de estudios de la materia Ecología de bachillerato (Use of Naturalista as a supplement to the high school Ecology curriculum)	Artículo	Revista Latinoamericana Ogmios, 3(7), 62-79	México
Mancera, F. 2009	Pedagogía de la complejidad ambiental del desierto y las sequías: un acercamiento a los aprendizajes colectivos en el desierto chihuahuense (Teaching about the environmental complexity of the desert and droughts: an approach to collective learning in the Chihuahuan Desert)	Capítulo de libro	UNAM-Instituto de Investigaciones Antropológicas, Colegio de la Frontera Norte, El Colegio de Chihuahua, Universidad Autónoma de Ciudad Juárez	México
Mancera, F., Herrera, A. & Sahagún, M 2019	Educación indígena y el desarrollo sustentable en el contexto de la Sierra Tarahumara: legislación sin transversalidad (Indigenous education and sustainable development in the context of the Sierra Tarahumara: legislation without mainstreaming)	Artículo	Caleidoscopio 41, julio-diciembre 2019	México

Martínez, M., Parra, H. & Porras, D. 2021	Biodiversidad desde la bioética y sustentabilidad (Biodiversity from the perspective of bioethics and sustainability)	Artículo	RULLEc Repositorio Universitario, UNAM	México
Martínez, M., Ruiz, T., & Ojeda, D. 2022	Ley educativa para fortalecer la bioética y sustentabilidad en el estado de Chihuahua, México (Education law to strengthen bioethics and sustainability in the state of Chihuahua, Mexico)	Artículo		México
Meissner, D., 2000	Border Environmental Education Resource Guide: Southern New Mexico, South Texas, Northern Chihuahua, Northern Coahuila, Northern Nuevo Leon, Northern Tamaulipas	Guía	Environmental Protection Agency, Washington, DC. Office of Environmental Education.; World Wildlife Fund, Washington, DC.	Estados Unidos
Miranda, C. 2021	Conocimientos infantiles del desierto chihuahuense: desarrollo de la conciencia ambiental (Children's knowledge of the Chihuahuan Desert: developing environmental awareness)	Tesis maestría	IPEC Instituto de Pedagogía Crítica	México
Nava, M. & Galvez, F. 2024	Proyecto Educativo Ambiental Sobre los Riesgos a la Salud por Contaminación Atmosférica: Caso Centro Comunitario Oratorio Don Bosco, Ciudad Juárez, Chihuahua, México (Environmental Education Project on Health Risks from Air Pollution: Case Study of the Don Bosco Community Center, Ciudad Juárez, Chihuahua, Mexico)	Resumen ponencia	Memorias Científicas y Tecnológicas Vol. 3 N.º 2 Junio 2024 7.º Coloquio de Posgrados del IIT	México
Navarro, E. 1997	Estrategias didácticas para propiciar el interés del niño de tercer grado de educación preescolar por el área de la naturaleza (Teaching strategies to stimulate third-grade preschoolers' interest in nature)	Tesis licenciatura	Universidad Pedagógica Nacional Unidad 08-A	México
Pérez, 2004	Incorporación de los hombres en procesos de educación ambiental con perspectiva de género, reto para el desarrollo sustentable (Incorporating men into environmental education processes with a gender perspective: a challenge for sustainable development)	Tesis maestría	Universidad de Guadalajara	México
Quintana, R., Espinoza, J. & Gutiérrez, A. 2013	Granja didáctica universitaria Educación ambiental y producción animal sustentable para toda la vida (University educational farm Environmental education and sustainable animal production for life)	Artículo	Revista Iberoamericana para la Investigación y el Desarrollo Educativo, vo. 4, núm 7, julio-diciembre 2013	México
Ramírez, M. 2020	Percepción de la problemática ambiental en Delicias, Chihuahua, México (Perception of environmental issues in Delicias, Chihuahua, Mexico)	Capítulo de libro	Sociedad, Ambiente y Cultura. Diversas Miradas desde el Gran Desierto Chihuahuense	México
Ramírez, L. 2021	Las percepciones sociales del desierto chihuahuense en la educación formal primaria (Social perceptions of the Chihuahuan desert in formal primary education)	Artículo	Sociedad y ambiente, 24, 2021, ISSN: 2007-6576, pp. 1-32	México
Reyes, A., Sandoval, D. & Suárez, R. 2021	Organizaciones rurales en el cuidado ambiental: caso de Áreas Naturales Protegidas del Estado de Chihuahua, México (Rural organizations in environmental care: the case of Protected Natural Areas in the State of Chihuahua, Mexico)	Artículo	Topofilia. Revista de Arquitectura, Urbanismo y Territorios, 14(22), 157-173. Instituto de Ciencias Sociales y Humanidades "Alfonso Vélaz Pliego", BUAP	México

Rivera, M. 2022	Retos de los activistas ambientales del estado de Chihuahua en materia de educación para el desarrollo sostenible (Challenges faced by environmental activists in the state of Chihuahua in the area of education for sustainable development)	Tesina maestría	Repositorio Universidad Autónoma de Chihuahua	México
Rivero, M. & Maldonado, G. 2013	Programa educativo ambiental para la conservación de tecnologías apropiadas en un albergue escolar indígena, en Chihuahua (Environmental education program for the conservation of appropriate technologies at an indigenous school hostel in Chihuahua)	Resumen ponencia	Revista Internacional de Contaminación Ambiental Volumen 29 Suplemento 1, 2013. XII Congreso Internacional y XVIII Congreso Nacional de Ciencias Ambientales	México
Ruiz, Y. 2024	Diseño y evaluación de juegos de mesa con temas ambientales (Design and evaluation of board games with environmental themes)	Tesina maestría	Repositorio Universidad Autónoma de Chihuahua	México
Salazar, M., Valles, M. & Rangel, Y., 2025	Percepción de docentes sobre su capacitación en construcción de huertos con un modelo <i>blended learning</i> (Teachers' perceptions of their training in garden construction using a blended learning model)	Artículo	Revista de Investigación Educativa de la Rediech, Volumen 16, e2483, ISSN: 2448-8550	México
Sosa, M., Alcalá, J., Soto, R., Lebgue, T. & Quintana, C. 2008	Percepción ambiental de estudiantes universitarios a través de variables medioambientales (Environmental perception of university students through environmental variables)	Artículo	Revista Latinoamericana de Recursos Naturales, 4 (2):178 -184, 2008	México
Soto, R., Corona, M., Prado, D., De la Fuente, M., Camarillo, F. & Lebgue, K. 2013	Evaluación y capacitación en educación ambiental de alumnos del CECyTECH en el municipio de Satevó, Chihuahua (Assessment and training in environmental education for students at CECyTECH in the municipality of Satevó, Chihuahua)	Cartel	Revista Internacional de Contaminación Ambiental, Volúmen 29 (Supl. 1) 2013, XII Congreso Internacional y XVIII Congreso Nacional de Ciencias Ambientales, ISSN: 01884999	México
Soto, R., Lebgue, T., Balderrama, S., Vélez, C., Aguilar, N. Viramontes, O & Durán, A. 2014	Environmental Awareness of the Young in a Rural Community in the Sierra Tarahumara, Chihuahua, Mexico/onciencia ambiental de los jóvenes en una comunidad rural de la Sierra Tarahumara, Chihuahua, México	Artículo	Journal of Education and Practice, Vol 3, No.8, 2012, International Institute of Science and Technology Education (IISTE)	México
Vega, S. s.f.	Biocultural and Environmental Education and Training as a Strategy for Adaptation to Climate Change in Response to Limited Water Resources in Communities/Educación y capacitación biocultural y ambiental como estrategia de adaptación al cambio climático frente a la limitada disponibilidad de recursos hídricos en las comunidades	Reporte Técnico	Consejo Ecoregional Sierra Tarahumara, A.C. (CESTAC)	México