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School gardens and environmental education: a systematic review of their pedagogical effectiveness

Huertos escolares y educación ambiental: revisión sistemática de su efectividad pedagógica

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Abstract

Given the growing concern about climate change and increasing urban pollution, this study seeks to evaluate the effectiveness of school gardens in environmental education through a systematic review. Using a qualitative approach and a documentary design, the PRISMA protocols were applied for literature selection; 16 studies published between 2022 and 2026 were included. The findings show that school gardens strengthen environmental education by promoting sustainability practices, recycling, resource conservation, and ecological commitment among students at various educational levels. Furthermore, they foster hands-on learning, critical awareness of environmental issues, and a sense of belonging to local contexts. The study concludes that school gardens constitute a transformative pedagogical strategy that goes beyond traditional teaching and contributes to contextualized and participatory environmental education.

Keywords: school gardens, environmental education, effectiveness.

Resumen

Ante la creciente preocupación por el cambio climático y el aumento de la contaminación urbana, este estudio busca evaluar la efectividad de los huertos escolares en la educación ambiental mediante una revisión sistemática. Con un enfoque cualitativo y diseño documental, se aplicaron los protocolos PRISMA para la selección de literatura; se incluyeron 16 estudios publicados entre 2022 y 2026. Los hallazgos muestran que los huertos escolares fortalecen la educación ambiental al promover prácticas de sostenibilidad, reciclaje, conservación de recursos y el compromiso ecológico de estudiantes en diversos niveles educativos. Además, favorecen el aprendizaje práctico, la conciencia crítica sobre problemas ambientales y la apropiación de contextos locales. Se concluye que los huertos escolares constituyen una estrategia pedagógica transformadora que supera la enseñanza tradicional y contribuye a una educación ambiental contextualizada y participativa.

Palabras clave: huertos escolares, educación ambiental, efectividad.

Introduction

Climate change has become a matter of global concern, as average annual temperatures are reaching levels never before recorded. Across many countries, dry and rainy seasons are intensifying, giving rise to a new form of migration, so-called climate displacement, in which people are forced to relocate, whether temporarily or permanently, because of shifts tied to the climate crisis. The Grupo Banco Mundial (2018) estimates that by 2050 roughly 143 million people could be forced to migrate, with environmental pollution, changing climate patterns, and the loss of biodiversity standing out as the factors that most threaten the survival of our species (Vallejos & Callao, 2022).

Faced with this alarming situation, nations around the world have signed protocols and treaties committing themselves to reducing greenhouse gas emissions. Even so, according to the Intergovernmental Panel on Climate Change (IPCC), the vulnerability and threats tied to its impacts play out unevenly across the globe and within Latin American countries, shaped by their geographic, climatic, socioeconomic, and demographic conditions (Cambridge

University Press, 2023); droughts, floods, and rising temperatures, in turn, are contributing to food insecurity across the region (Cediel-Becerra & Sánchez-Arévalo, 2025).

In countries such as Peru, the effects of climate change are already driving air and water pollution (Blanco-Villafuerte & Hartinger, 2023), harming not only crops but public health as well, since climate change is also significantly altering the flow of the Lurín River basin in Peru (Osorio et al., 2022). Compounding the problem is pollution from open-air dumps, which release a substantial share of Peru's greenhouse gas emissions (Cristóbal et al., 2022). Addressing this reality calls for action that is not only governmental but also social, institutional, and educational. Although awareness campaigns have long targeted communities, a certain indifference toward the planet persists, rooted partly in the belief that individual action makes no real difference, overlooking the fact that the sum of small actions can, in fact, reshape reality.

Given the accelerating pace of climate deterioration, education must take on an active role in social transformation. Environmental education is essential in this regard, as it helps learners grasp environmental realities and their decline (Blanco et al., 2022). Environmental education, coupled with education on climate change, should therefore be treated as a priority across Latin America (Medina & Páramo, 2024). Curricula need to move decisively in this direction, since Cruz et al. (2023) found that students themselves regard current approaches to environmental education and related practices as inadequate. Such perceptions point to weaknesses in institutional teaching, which makes initiatives like school gardens all the more necessary for fostering environmentally responsible attitudes and practices (Condori et al., 2025).

Research conducted in Ibero-American settings (Spain and Portugal) shows that the effectiveness of school gardens hinges on their deliberate integration into the formal curriculum, with such spaces reported to substantially improve school satisfaction and classroom climate (Pozuelos et al., 2026). School gardens thus emerge as both pedagogical and agroproductive strategies capable of promoting food sovereignty, environmental education, and sustainable endogenous development in Europe and Latin America alike (Cadenas, 2025). But what exactly are school gardens? The Food and Agriculture Organization of the United Nations (2009) defines them as a method of growing food that draws on the land's natural resources, such as soil, sunlight, air, rainfall, plants, animals, and people. For Puentes-Luna et al. (2025), school gardens are an easily implemented, high-impact pedagogical tool for developing environmental projects within educational institutions. With this in mind, the present study aims to determine the effectiveness of school gardens in environmental education through a systematic review.

School gardens were chosen as the focus of this study because of their cross-cutting contributions to education. Salas et al. (2026) describe them as pedagogical instruments and spaces that strengthen collective work, encourage children's participation and sense of agency, and promote adequate and sustainable nutrition. Vences et al. (2024) likewise report that gardens foster meaningful learning and reinforce environmental awareness through hands-on experiences tied to caring for one's surroundings, collaborative work, and sustainability, a point Caro et al. (2026) echo as well. Other identified benefits include a strengthened socio-environmental identity, as students connect with agricultural practices, the conservation of natural resources, and a renewed recognition of their rural context (Holguín & Cotes, 2025).

Additional Andean research shows that collective work in the school garden fosters spontaneous leadership, empathy, and emotional self-regulation among primary school students (Lalama-Franco et al., 2025). Experiential learning, implementing a garden, for instance, likewise supports the development of ecological awareness and the adoption of sustainable practices (Añazco et al., 2025). These contributions raise the question that guides the present study: how effective are school gardens in environmental education, as revealed through a systematic review?

Methodology

This study follows a qualitative approach and a documentary design grounded in a systematic review. According to Aromataris et al. (2024), a systematic review relies on explicit, systematic, and reproducible procedures to identify, select, critically appraise, and synthesize the relevant evidence. To ensure transparency and rigor, the PRISMA protocols (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), first published in 2009 and later updated with methodological guidance (Page et al., 2021), were applied; these guidelines shape how the review's purpose, procedures, and results are reported. Building on this methodological framework, the research was carried out in the following phases:

Identification and search phase (input)

Potentially relevant literature was initially gathered without applying strict filters. The database search covered the 2022–2026 period and yielded 250 records through academic search engines. At this stage, 32 duplicates were removed, leaving 218 records for the next phase.

Screening phase

From the 218 records, a preliminary selection was carried out by reading titles and abstracts. During this process, 110 records were excluded for being irrelevant or failing to align with the review's objectives, leaving 108 studies for full-text evaluation.

Eligibility phase

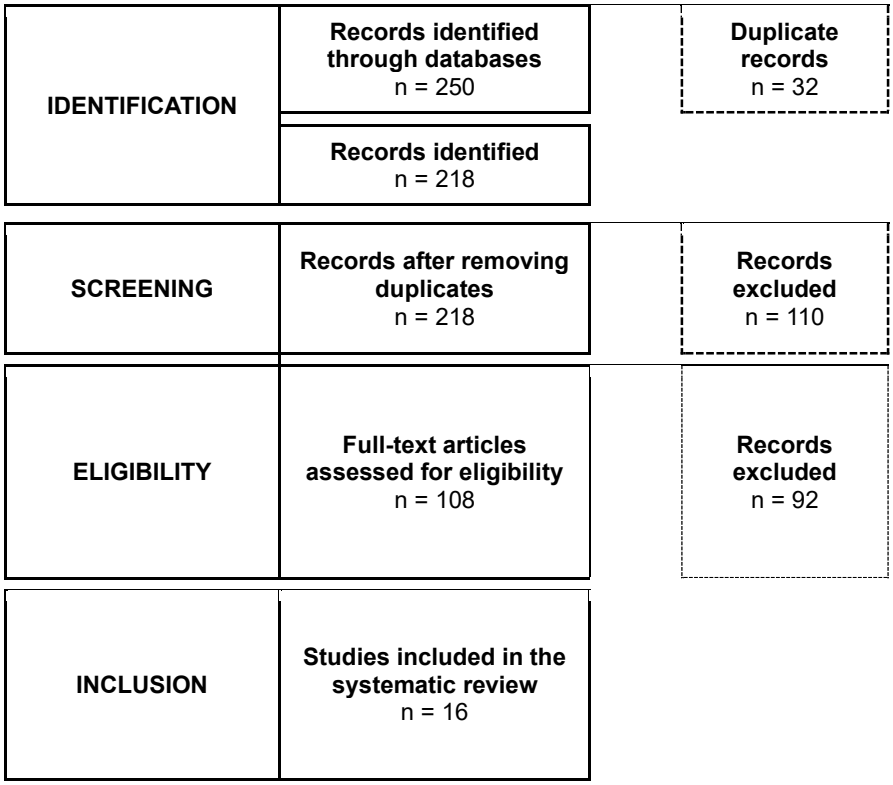
The 108 full-text articles were assessed to verify compliance with the inclusion criteria. After careful reading, 92 articles were excluded for methodological reasons or lack of relevance, leaving a subset suitable for inclusion.

Inclusion phase

In the end, 16 studies met the criteria and were included in the systematic review, forming the final sample for the qualitative analysis.

Figure 1

PRISMA flow diagram - Systematic review



Note. Author's own elaboration

Results

This section presents the findings drawn from the systematic review of the selected scientific literature. To offer a clear picture of recent academic output (2022–2026), the documents have been organized by author, title, and methodological type. Table 1 condenses this basic information, serving as a starting point for identifying the

pedagogical trends, the benefits for environmental education, and the operational challenges that characterize the implementation of school gardens across a range of geographic contexts.

Table 1
Findings drawn from the selected sample based on the PRISMA protocols

No.	Author(s)	Title	Type of study	Findings
1	Pozuelos et al., (2026)	School gardens: A multiple case study on pedagogical innovation and community engagement in Spain and Portugal	Article	The study confirms that the school garden is a pedagogical resource with strong transformative potential. Its effectiveness hinges on deliberate curricular integration, teacher commitment, and the involvement of the educational community, in keeping with the principles of an active, sustainable, and contextualized pedagogy.
2	Ríos et al., (2025)	Effects of urban school gardens on environmental education and child nutrition: A study in public institutions in Metropolitan Lima	Article	The study concludes that school gardens represent a comprehensive educational strategy capable of fostering environmentally responsible citizenship and healthier lifestyles, provided their implementation is participatory, well planned, and context-sensitive.
3	Nastacuas et al., (2024)	Strengthening environmental stewardship through the school garden among third-grade children in the Indigenous reservation of Nariño	Article	The results show that the entire sample, in terms of participation and environmental knowledge, was able to shift its behavior toward more sustainable practices. However, challenges such as resource scarcity and initial disinterest highlight a pressing need for further education on the topic.
4	Jaramillo & Guerra (2024)	Urban and school gardens: Social innovation for sustainability and environmental education	Thesis	Through hands-on practice, students learn not only about sustainable agriculture but also about the importance of teamwork and caring for the resources the environment provides them, gaining transformative experiences and developing their skills.
5	Espejero (2024)	Fostering environmental education through the development of school gardens in first grade at the Consuelo Araujo Noguera educational institution, Jesús Sierra Uribe campus, in the city of Valledupar-Cesar	Thesis	The results reveal a strong impact on students' eating habits, with increased fruit consumption, along with a higher rate of meaningful student actions toward the environment—for example, waste sorting and the reuse of solid materials to build planters and beautify the school's green areas.

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6	Ariza (2024)	The school garden as a teaching strategy for strengthening environmental education and food security at the Nobel Juan Manuel Santos educational institution (municipality of Soledad, Colombia).	Thesis	The school garden was found to be an effective pedagogical strategy for improving environmental education and food security. Setting up school gardens has enabled students to improve both their actions and their knowledge regarding the environment.
7	Taicus (2024)	Cultivating learning: Pedagogical strategies in the school garden to foster environmental culture and agroecological education	Article	The most significant finding of this study is that implementing school gardens in Indigenous communities, such as the Awá, is an effective pedagogical strategy for strengthening environmental culture and agroecological education. The study further highlights that school gardens play a crucial role in preserving ancestral knowledge.
8	Yllas et al., (2022)	Chromatic traps in the school garden: Ecopedagogy, agroecology, and critical environmental education	Article	Throughout the process, it was possible to link ecopedagogical practices with critical environmental education, an approach that began in the school garden and spread to several other spaces within the school. Rather than simply learning about integrated pest management (IPM) in the garden, students developed knowledge in a genuinely integrated way.
9	Villalba (2026)	Teaching natural sciences and environmental education through a school garden at I.E.T.A. El Salado, Villa Amalia campus	Thesis	Implementing the school garden as a pedagogical strategy allowed students to develop key scientific competencies such as observation, question formulation, classification, inference, argumentation, and the application of knowledge.
10	Torres (2024)	Implementing school gardens within the Spanish education system	Article	The study identified the limitations and difficulties schools face when implementing a school garden and provided tools to facilitate its implementation and ensure its success over the medium and long term.
11	González et al., (2025)	Cultivating knowledge: A successful school garden case study in Tomatlán, Jalisco, Mexico	Article	Continuously strengthening environmental education is essential, recognizing that society's active engagement with science and innovation is a fundamental pillar for driving initiatives that promote sustainability and a deep environmental awareness.
12	Quizhpi et al., (2022)	Strengthening environmental education through a teaching guide based on the school garden at Sub-level 2 of the Manuel J. Calle Educational Unit	Article	Creating opportunities for children to interact with the school garden is essential, since such experiences enrich their learning and support meaningful understanding. By taking part in garden activities, children engage directly with the soil and other natural materials, while also developing practical skills, reinforcing attitudes of responsibility and care, and consolidating their knowledge of natural cycles, nutrition, and sustainability.

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13	Moreno (2024)	Designing a sustainable pilot garden to promote environmental education at Carlos Albán Holguín school in Bogotá, Colombia	Thesis	Students took part in activities that helped address the challenges that arise when implementing school gardens. Participants showed genuine interest in the environment and in environmental challenges, expressing concern about the effects of food insecurity and sustainability.
14	García (2025)	School gardens in secondary education as a means of transforming learning and cultivating student motivation	Article	Implementing an ecological school garden becomes a resource that enables students to adopt a responsible stance toward their surroundings and to understand how human actions affect them. The project likewise highlights the value of diversity in educational development through inclusion and shared learning.
15	Holguin & Cotes (2025)	School gardens and the socio-environmental identity of primary school students at a rural educational institution in the municipality of Samaná, Caldas	Article	School gardens promote environmental literacy, hands-on learning, cooperation, and collective responsibility. They also foster family involvement, a strengthened cultural identity, and community resilience in the face of challenges such as climate change.
16	Márquez & Vargaz (2022)	The school garden as a teaching strategy that facilitates learning about ecological and environmental foundations for sustainable development	Article	Sharing the research project and its activities with the community revealed certain limitations, including a lack of knowledge about ecological and sustainable-development fundamentals and the absence of adequate environmental policies at both the institutional and municipal levels.

Note. Author's own elaboration

Taken together, the studies included in this review point to a broad consensus regarding the pedagogical and transformative value of school gardens. Drawing on a range of geographic and educational contexts, the reviewed works agree that school gardens are not merely a patch of green within the school, but an educational tool with real potential to generate meaningful learning, encourage sustainable behavior, and strengthen students' relationship with their surroundings.

One finding that recurs across the studies is the school garden's capacity to integrate knowledge from multiple subject areas. Villalba (2026) notes that implementing a garden allows students to develop key scientific competencies such as observation, question formulation, classification, inference, and argumentation. This suggests that the garden is not an isolated space but a living classroom where natural science, mathematics, language, and even social studies can converge naturally. Pozuelos et al. (2026) reinforce this idea, noting that a garden's effectiveness depends on deliberate curricular integration, meaning that a physical space alone is not enough; a pedagogical plan is needed to connect it with academic content.

Another important dimension is the impact on environmental awareness and healthy living habits. Espejero (2024) documents a strong impact on students' eating habits, with greater fruit consumption and an increase in meaningful actions such as waste sorting and the beautification of green spaces. Ríos et al. (2025) conclude that gardens represent a comprehensive strategy for shaping environmentally responsible citizenship and promoting healthier lifestyles, provided they are implemented in a participatory and context-sensitive manner. Nastacuas et al. (2024) add that students managed to shift their behavior toward more sustainable practices, although they note that resource scarcity and initial disinterest remain obstacles that need to be overcome.

The community and cultural dimension likewise stands out as a key element. Taicus (2024) highlights that in Indigenous communities such as the Awá, school gardens play a crucial role in preserving ancestral knowledge

while strengthening environmental culture and agroecological education. Holguín and Cotes (2025) note that these spaces encourage family involvement, reinforce cultural identity, and build community resilience against challenges such as climate change. This suggests that the school garden reaches well beyond the classroom, becoming a bridge between school and community that recovers traditional knowledge often lost within conventional education systems.

Not all the studies, however, are equally optimistic. Several identify limitations and difficulties that can jeopardize the success of these initiatives. Torres (2024) documents the barriers schools encounter when setting up a garden and offers tools to support its sustainability over the medium and long term. Márquez and Vargas (2022) point to limitations such as a lack of knowledge about ecological foundations and sustainable development, along with the absence of adequate environmental policies at both the institutional and municipal levels. These difficulties matter, because they show that initial enthusiasm is not enough; teacher training, material resources, and institutional support are all needed if school gardens are to avoid becoming short-lived projects.

Teacher participation and commitment emerge as a decisive factor. Pozuelos et al. (2026) insist that success hinges on teacher commitment and the involvement of the educational community. González et al. (2025) argue that continuously strengthening environmental education is essential, recognizing that society's active engagement with science and innovation is a fundamental pillar. This raises an important point: the school garden does not run on its own; it needs people who believe in it and are willing to devote time and effort to its upkeep and pedagogical development.

Another interesting finding concerns the garden's value as a space for inclusion and shared learning. García (2025) shows that the school project highlights the value of diversity in educational development through inclusion and collaborative learning. Jaramillo and Guerra (2024) add that hands-on practice teaches students not only about sustainable agriculture but also about the importance of teamwork and resource stewardship. This suggests that the garden builds not just knowledge, but also values and social skills that are difficult to cultivate in a traditional classroom.

The garden's experiential, hands-on nature is perhaps its greatest strength. Quizhpi et al. (2022) argue that creating spaces for interaction with the garden is essential, since these experiences enrich children's learning and pave the way for meaningful understanding. As active participants, children engage directly with the soil and other materials, forging an emotional and practical connection to what they learn. Yllas et al. (2022) link ecopedagogical practices to critical environmental education, showing that the garden can serve as a starting point for broader reflection on the relationship between human beings and their environment.

Discussion

One of the more interesting tensions to emerge from these studies is the gap between enthusiasm for the garden's possibilities and the real difficulties involved in sustaining it over time. On one hand, the positive findings are numerous and consistent: improved environmental knowledge, changed eating habits, the development of scientific competencies, a strengthened cultural identity, and community participation. On the other hand, the limitations are just as significant: lack of resources, initial disinterest, absence of supportive policies, limited teacher training, and difficulty maintaining projects over time. This tension suggests that the success of school gardens depends not only on their intrinsic value but also on the conditions under which they are implemented. A well-planned garden, backed by institutional support and committed teachers, can have deep and lasting effects; an improvised garden left to fend for itself risks becoming a failure that discourages future attempts.

It is also worth noting that most of the studies come from Latin American and European contexts, each with very different educational and cultural realities. This diversity enriches the overall picture, showing that the school garden is an adaptable strategy across settings, while also raising questions about how successful experiences can be transferred from one context to another. What works in an Indigenous community in Nariño may not translate directly to an urban school in Bogotá or an institute in Spain. Contextualization, as Ríos et al. (2025) point out, is key to the strategy's effectiveness.

Overall, the studies reviewed paint a hopeful yet realistic picture. The school garden is a powerful tool for environmental education, values formation, competency development, and community connection. Its transformative potential is undeniable, and the documented success stories offer valuable models to replicate. At the same time, its implementation clearly faces obstacles that should not be understated. Lack of resources, limited teacher training, and the absence of supportive policies are real barriers that need attention if school gardens are to move from isolated initiatives to sustainable educational policy.

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Perhaps the most important contribution of this review is the recognition that the school garden is not an end in itself, but a means. Its real value lies not in the plants it grows, but in the experiences it generates, the knowledge it builds, and the values it promotes. To fulfill that role, it needs to be more than an extracurricular project; it must be woven into the curriculum, supported by the educational community, and backed by policies that guarantee its continuity. Without those conditions, the garden risks becoming a fleeting experience; with them, it can become an engine of educational and social transformation that reaches well beyond the school walls.

Finally, in order to look more closely at the nature of the findings and identify common patterns across the studies analyzed, an analytical coding and grouping of the literature was carried out. This procedure makes it possible to move beyond a purely chronological or individual description toward a more structural understanding of the lines of research on school gardens. Table 2 below sets out the thematic classification built from the systematic review, linking the studies that address each dimension (identified by the numbering used earlier) and making it easier to pinpoint the areas of greatest scientific consensus as well as those that still represent challenges or gaps in knowledge.

Table 2

Thematic classification of studies on school gardens and environmental education

No.	Thematic category	Studies addressing it	Description
1	School garden as a pedagogical strategy	1, 2, 4, 6, 7, 9, 12, 14, 16	The studies highlight the school garden as an innovative teaching strategy that fosters active, meaningful, and context-sensitive learning through hands-on experiences connected to the natural and social environment.
2	Environmental education and sustainability	1, 2, 3, 5, 6, 7, 8, 10, 11, 13, 14, 15, 16	The evidence shows that school gardens strengthen environmental education, sustainability, recycling, resource conservation, and ecological commitment among students across different educational levels.
3	Competency development and meaningful learning	3, 4, 6, 8, 9, 12, 15	The research shows that garden-based activities foster scientific, cognitive, social, and attitudinal competencies, supporting meaningful learning and critical thinking.
4	Community participation and socio-environmental identity	1, 2, 4, 10, 14, 15	The studies emphasize the importance of teacher, family, and community involvement in strengthening cultural identity, cooperation, and collective responsibility in the face of environmental challenges.
5	Agroecology and ancestral knowledge	7, 8, 15	The research emphasizes that school gardens help recover agroecological practices and ancestral knowledge, particularly in Indigenous and rural communities, strengthening a harmonious relationship with nature.
6	Food security and healthy habits	2, 5, 6, 13	The studies find that school gardens help improve eating habits, promote healthy consumption, and raise awareness of food security and nutritional sustainability.
7	Limitations and implementation challenges	3, 10, 16	Difficulties are identified relating to a lack of resources, limited environmental policies, insufficient teacher training, and institutional obstacles to sustaining school garden projects over time.

Note. Authors' own elaboration

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Conclusions

Based on the full body of evidence reviewed, it can be said that school gardens are far more than a patch of green within educational institutions. They represent a pedagogical strategy with remarkable transformative potential, capable of shaping multiple dimensions of student development: cognitive, social, environmental, and even emotional. Their effectiveness, however, is neither automatic nor guaranteed; it depends on a set of conditions that schools must carefully consider.

First, the findings agree that the school garden facilitates meaningful learning that is difficult to achieve through traditional methods; through direct experience with soil and plants, students do develop scientific competencies such as observation, classification, and argumentation, while integrating knowledge from different curricular areas. This suggests that the garden is not a mere ornamental addition but a pedagogical resource capable of bringing the curriculum to life in a contextualized way. When children watch a plant grow, they are not only learning biology; they are also practicing mathematics as they measure, language as they describe, and social studies as they come to understand where food comes from.

Another relevant finding is the positive impact on eating habits and environmental awareness: participants showed higher consumption of fruits and vegetables and a more responsible attitude toward the environment, shifting their behavior toward more sustainable practices. That said, resource scarcity and initial disinterest were flagged as obstacles requiring attention. This suggests that the garden can act as a catalyst for habit change, but that its success depends on a planned, sustained intervention over time.

The community and cultural dimension likewise emerges as an essential component, particularly in Indigenous and rural contexts where ancestral knowledge about the land and food still holds relevance. This challenges the notion that environmental education is merely academic content, turning it instead into an experience that connects the school with its social and cultural surroundings. The garden thus becomes a bridge between generations and between the community and the educational institution.

At the same time, it is important to acknowledge the limitations and challenges these initiatives face: insufficient teacher training, a lack of supportive institutional policies, and scarce material resources. These are not minor obstacles, since they contribute to many school gardens being neglected or abandoned over time.

Another aspect worth noting is the tension between the garden's potential and the real difficulties involved in implementing it. On one hand, the studies agree that its benefits are numerous and significant, improving learning, developing competencies, fostering healthy habits, strengthening cultural identity, and encouraging community participation. On the other hand, they also agree that implementation runs up against structural barriers; the success of the school garden, therefore, depends not solely on its own merits but on the conditions under which it takes shape.

In sum, the conclusions of this review indicate that school gardens are an educational tool of considerable value, but one whose implementation calls for a comprehensive and realistic approach. Creating a physical space is not enough; what is needed is a clear pedagogical project, teacher training, adequate resources, community involvement, and institutional policies that ensure its long-term sustainability.

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