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Seeding the Future: Environmental Education and Sustainability in Favelas and Urban Communities

Priscilla Pereira da Silva
Mestranda, UNINOVE, Brasil
priscilla.ps@uni9. edu.br
ORCID 0009-0002-0408-0397

Sidnei Aranha
Mestre, UNINOVE, Brasil
Doutor, UNIFESP, Brasil
sidneiaranhagja@gmail.com
ORCID 0000-0003-0931-229X

Andreza Portella Ribeiro
Professora Doutora, UNINOVE, Brasil
andrezp@uni9.pro.br
ORCID 0000-0002-1763-4558

Jorge L Gallego
Professor Doutor, Universidad de Medellín, Colômbia.
jlgallego@udemedellin.edu.co
ORCiD 0000-0002-8462-1124

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Semeando o Futuro: Educação Ambiental e Sustentabilidade em Favelas e Comunidades Urbanas

RESUMO

Objetivo – Desenvolver um instrumento de pesquisa com perguntas destinadas a profissionais e educadores experientes na área, com a finalidade de oferecer um material orientativo para o planejamento de projetos e ações de educação ambiental, enfatizando o tema de gerenciamento de resíduos sólidos.

Metodologia – Pesquisa bibliográfica descritiva e exploratória, seguida da análise de conteúdo de seis artigos alinhados ao objetivo proposto. Esses artigos serviram como base para identificar os principais desafios enfrentados em projetos de educação ambiental, realizados em favelas e comunidades urbanas, além das abordagens metodológicas adotadas, com o intuito de mitigar tais desafios.

Originalidade/relevância – As favelas enfrentam diariamente a ausência de infraestrutura básica e altos níveis de vulnerabilidade social. Em tal contexto, a educação ambiental torna-se essencial à promoção da saúde pública, dada sua relação direta com o ambiente. Por outro lado, entende-se que há ainda um longo caminho a percorrer para tornar esse processo efetivo, para que mudanças reais e duradouras sejam percebidas no comportamento da população, tanto em relação aos resíduos sólidos urbanos, quanto ao meio ambiente de forma mais ampla.

Resultados – As iniciativas só alcançam impacto significativo com a participação ativa dos moradores nas discussões e decisões sobre o gerenciamento de resíduos, o que evidencia a importância de se fortalecer o senso de pertencimento e responsabilidade compartilhada.

Contribuições teóricas/metodológicas – O instrumento desenvolvido pode ser útil ao planejamento de ações informais ou em grupos focais, compostos por profissionais ou educadores ambientais que atuam em comunidades vulneráveis.

Contribuições sociais e ambientais – Evidencia-se a importância de fortalecer o senso de pertencimento e responsabilidade compartilhada para que mudanças reais e duradouras sejam percebidas no comportamento da população em relação aos resíduos sólidos e ao meio ambiente de forma mais ampla.

PALAVRAS-CHAVE: Educação Ambiental; Resíduos Sólidos Urbanos; Favelas e Comunidades Urbanas.

Seeding the Future: Environmental Education and Sustainability in Favelas and Urban Communities

ABSTRACT

Objective – To develop a research instrument with questions aimed at professionals and experienced educators in the field, with the purpose of providing a guiding material for planning environmental education projects and actions, emphasizing the theme of solid waste management.

Methodology – Descriptive and exploratory bibliographic research, followed by content analysis of six articles aligned with the proposed objective. These articles served as the basis for identifying the main challenges faced in environmental education projects carried out in favelas and urban communities, as well as the methodological approaches adopted in order to mitigate such challenges.

Originality/relevance – Favelas face daily lack of basic infrastructure and high levels of social vulnerability. In this context, environmental education becomes essential to promote public health, given its direct relationship with the environment. On the other hand, it is understood that there is still a long way to go to make this process effective so that real and lasting changes are perceived in the population's behavior, both regarding urban solid waste and the environment more broadly.

Results – Initiatives only achieve significant impact with the active participation of residents in discussions and decisions on waste management, which highlights the importance of strengthening the sense of belonging and shared responsibility.

Theoretical/methodological contributions – The developed instrument can be useful for planning informal actions

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or focus groups composed of professionals or environmental educators working in vulnerable communities. **Social and environmental contributions** – The importance of strengthening the sense of belonging and shared responsibility is highlighted so that real and lasting changes are perceived in the population's behavior regarding solid waste and the environment more broadly.

KEYWORDS: Environmental Education; Urban Solid Waste; Favelas and Urban Communities.

Sembrando el Futuro: Educación Ambiental y Sostenibilidad en Favelas y Comunidades Urbanas

RESUMEN

Objetivo – Desarrollar un instrumento de investigación con preguntas dirigidas a profesionales y educadores experimentados en el área, con el propósito de ofrecer un material orientativo para la planificación de proyectos y acciones de educación ambiental, enfatizando el tema de la gestión de residuos sólidos.

Metodología – Investigación bibliográfica descriptiva y exploratoria, seguida del análisis de contenido de seis artículos alineados con el objetivo propuesto. Estos artículos sirvieron como base para identificar los principales desafíos enfrentados en proyectos de educación ambiental realizados en favelas y comunidades urbanas, además de los enfoques metodológicos adoptados con el fin de mitigar dichos desafíos.

Originalidad/relevancia – Las favelas enfrentan diariamente la ausencia de infraestructura básica y altos niveles de vulnerabilidad social. En este contexto, la educación ambiental se vuelve esencial para la promoción de la salud pública, dada su relación directa con el ambiente. Por otro lado, se entiende que aún queda un largo camino por recorrer para hacer efectivo este proceso, de modo que se perciban cambios reales y duraderos en el comportamiento de la población, tanto en relación con los residuos sólidos urbanos como con el medio ambiente en un sentido más amplio.

Resultados – Las iniciativas solo logran un impacto significativo con la participación activa de los residentes en las discusiones y decisiones sobre la gestión de residuos, lo que evidencia la importancia de fortalecer el sentido de pertenencia y la responsabilidad compartida.

Contribuciones teóricas/metodológicas – El instrumento desarrollado puede ser útil para la planificación de acciones informales o en grupos focales compuestos por profesionales o educadores ambientales que actúan en comunidades vulnerables.

Contribuciones sociales y ambientales – Se evidencia la importancia de fortalecer el sentido de pertenencia y responsabilidad compartida para que se perciban cambios reales y duraderos en el comportamiento de la población en relación con los residuos sólidos y el medio ambiente de forma más amplia.

PALABRAS CLAVE: Educación Ambiental; Residuos Sólidos Urbanos; Favelas y Comunidades Urbanas.

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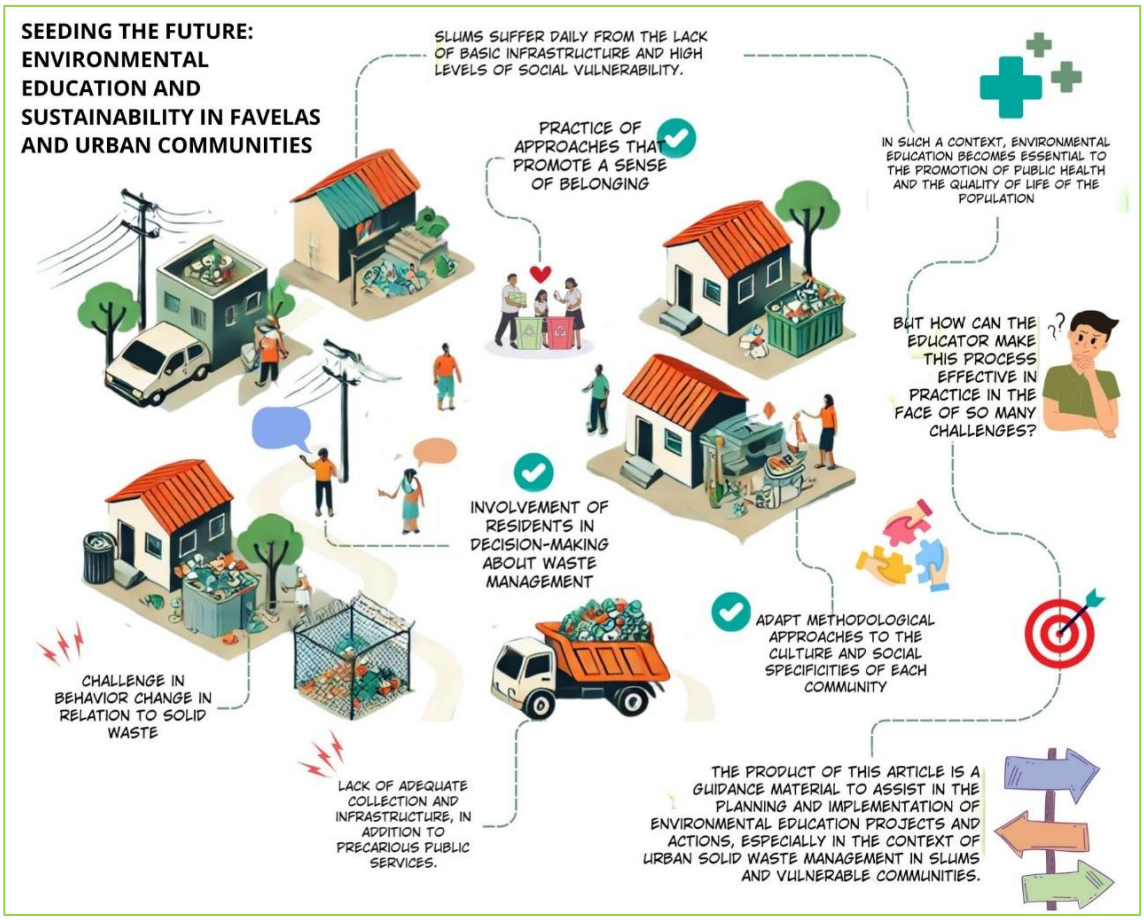
GRAPHICAL ABSTRACT



Source: Authors (2025).

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1 INTRODUCTION

Rapid urbanization, population growth, combined with purchasing power and uncontrolled consumerism have led to an unprecedented increase in urban solid waste (USW), exacerbating environmental degradation and public health challenges. In developing countries, the challenges of urban solid waste management (USWM) are aggravated by unplanned urbanization, social inequalities, economic growth, and cultural and social factors (Lima et al., 2018).

Dias (2012) emphasizes the urgency of real changes in citizens' habits and attitudes to reduce and prevent waste generation. Therefore, Environmental Education (EE) plays a crucial role, as it is a powerful tool for transforming human perceptions and relationships with the environment, and consequently, behavior. Sorrentino (1998) and da Silva (2019) state that EE's primary goal is to "contribute to biodiversity conservation, individual and community self-realization, and political and economic self-management, through educational processes that promote the improvement of the environment and quality of life" (Sorrentino, 1998, p. 193).

Carvalho (2012) considers that the role of critical EE is to train individuals to critically analyse their environments and interpret the socio-environmental relationships, conflicts, and problems present within them, making a critical diagnosis of environmental issues and developing an understanding of the place occupied in these relationships, which are the starting point for the exercise of environmental citizenship. It is understood that an educational intervention that truly contributes to lasting transformation requires that interaction with the environment take on the character of an interrelation, in which human beings participate, becoming involved in the surrounding environmental conditions, producing vision and constructing perceptions, interpretations, and interpretations of the environment that surrounds them, as Carvalho (2012) points out.

EE is a political-educational process that empowers society with knowledge and skills, promoting values and attitudes that translate into civic practices. These practices aim to build and sustain a society where natural resources are used responsibly, ensuring their preservation for current and future generations. Although guaranteeing rights is fundamental, it is not sufficient to consolidate effective participation. To this end, it is essential to implement educational processes that promote active learning through participation (Costa Pinto, 2003; da Silva, 2019). Educational processes that foster community organization, aiming to solve local problems and contribute to improving the population's quality of life and environmental conservation, can strengthen and promote popular participation and the development of collective actions that strive for the well-being of all (Sorrentino, 1998; Jacobi, 2004; Moreira, Ramos, and Gallego, 2025).

The scientific literature presents several studies focusing on the importance of environmental education involving and having the concrete participation of society (De Souza and Gomes, 2020; Gomes, Brasileiro, and Caeiro, 2020; Timóteo, 2019). However, there is a long way to go in any methodological approach focused on environmental issues for the educational process to have a practical impact and promote behavioral change that becomes a habit. This challenge applies especially to the topic of USW, requiring the population to adopt sustainable practices continuously and effectively.

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This shift is even more complex when it comes to applying such approaches to marginalized communities, such as favelas and urban communities (IBGE, 2024), which often suffer from a lack of basic infrastructure and high levels of social vulnerability (Polaz and Teixeira, 2007).

It is essential to highlight, question, criticize, and reframe the role of the environmental educator, warning of "the risk of reducing the educational act to a simple transmission of information from the natural sciences, without connecting this knowledge to the complexity of the social and environmental issues that surround and constitute it" (Carvalho, p. 81, 2012).

In contrast, environmental educators face significant challenges within formal education, lacking quality time for their application within a mandatory and dense curriculum that still considers EE as a form of knowledge separate from other subjects. An even more challenging scenario is the issue of non-formal education in favelas, where environmental educators must overcome additional obstacles, such as vulnerability, lack of resources, tools, infrastructure, and basic services (Oliveira, 2011).

Given this reality, the main objective of this study was to develop a research instrument for collecting data from environmental educators to be applied to environmental education projects, with an emphasis on USWM in favelas.

The developed instrument can serve as a guiding tool for planning environmental education activities aimed at USWM in favelas, helping to maximize results in the medium and long term. In other words, actions should not be limited to simply sharing information on environmental awareness, but rather contribute to redefining residents' relationship with the environment, promoting a behavioral transformation that integrates sustainable practices into daily life, strengthening citizenship and commitment to the community.

2 METODOLOGY

This research is characterized as descriptive and exploratory, as it aims to identify and record information regarding the characteristics of the problem addressed. A qualitative approach with bibliographic research was used to identify the types of approaches, challenges, and results of applying EE to USWM in favelas and urban communities in the scientific literature. The bibliographic research was conducted on the main scientific platforms — Capes Journals and Google Scholar — using the following keywords: Environmental Education and Urban Solid Waste Management and Favelas and Urban Communities.

Given the specificity of the approach, the survey considered only six scientific articles published between 2018 and 2023, whose information aligned with the main objective of this research. The aim was to identify and understand the relationships between the proposed approaches, the challenges faced, and the results obtained by educators in the selected articles, in order to collect relevant data for formulating the instrument's questions. Figure 01 presents the methodological steps for constructing the research instrument, while Tables 1 and 2 present the data obtained through content analysis, as recommended by Bardin (2011).

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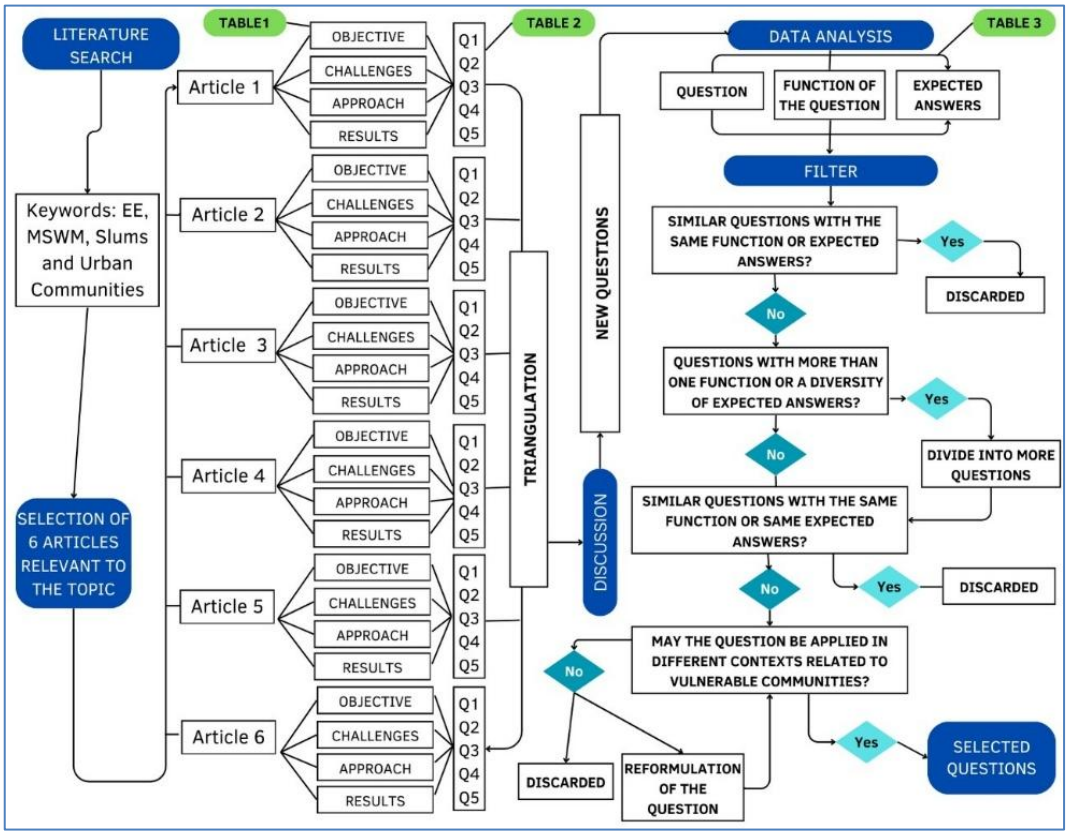
Figure 01 – Flowchart of the methodology applied in the construction, analysis, and selection of the questionnaire.



Source: Authors (2025).

Table 1: Analysis and systematization of the information gathered from the selected scientific articles.

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Source	Objetive	Challenges	Approaches	Results
(1) Nascimento et al. (2019)	Develop a photography tool to raise awareness among young people about the impacts of improper waste disposal in mangroves.	Improper waste disposal in mangroves; lack of effective public conservation policies; need for greater community engagement.	Use of photography as an environmental awareness tool; participatory workshops; an interdisciplinary approach integrating science, art, and local knowledge.	Increase young people's awareness of environmental impacts; diagnose the local ecosystem's status; mobilize for conservation; and change behaviors regarding waste disposal.
(2) Ornelas (2018)	Analyze the workshop methodology and reflect on the role of gardens in education and in the agroecological debate with vulnerable youth.	Lack of selective waste collection in the region; resistance to composting; limited access to adequate water for garden maintenance; prevalence of unhealthy foods.	Methodology guided by the collective construction of knowledge, articulation between theory and practice, and critical and reflective participation; use of playful dynamics and sensory activities; inspiration from Paulo Freire's pedagogy.	Transformation of idle spaces into productive gardens; encouragement of healthy food consumption; promotion of sustainable attitudes; replication of knowledge in home gardens; building a culture of socially and environmentally responsible citizenship.
(3) De Melo e Magalhães (2022)	Present the population's actions in waste management in vulnerable communities, highlighting merits, opportunities for improvement, and possible inspirations for the reality of São Paulo.	Difficult access in favelas, inadequate waste collection, lack of infrastructure and urban planning, socio-spatial segregation, absence of efficient public policies.	Participatory management and community engagement; DE as a basis; popular mobilization and social inclusion.	Positive results in terms of community awareness and engagement; inclusion of residents in waste management; increased recycling and selective collection; income generation and improvement of local conditions.
(4) Gomes e Pedroso (2022)	Present teaching methodologies in Environmental Education developed in research in the context of	Lack of uniformity in EE practices; predominance of the behaviorist approach; methodologies aimed at behavior	Systematic review with analysis of 30 articles using Minayo's proposal (2014) and Mizukami's approaches (1986).	Behaviorist and Cognitivist approaches predominate, with aspects from various categories (humanist, traditional). Observation of hybrid methodological combinations, expanding the understanding of EE in

	elementary education,	change, limiting the critical approach.		the context of elementary education.
(5) De Lima et al. (2022)	Addressing the challenges of EE and the construction of social technologies in Nova Holanda, Maré favela, with a focus on the school environment	Environmental racism, necropolitics, political disinterest, violence in favelas, lack of sanitation, inadequate school infrastructure (noise, smell), lack of post-pandemic engagement.	Popular and dialogical education, inspired by Paulo Freire; Polytechnic; Praxis; Theater of the Oppressed; Composting, vermicomposting and biodigester workshops for ecological sanitation.	Student engagement, critical awareness development regarding sanitation, construction of biodigester prototypes, implementation of practical actions to transform the local reality, strengthening cooperation between students and the school community.
(6) Sousa (2022)	Report the experience of an extension project in the classroom, linking waste disposal to nature conservation and appropriate forms of disposal.	Difficulty raising awareness in peripheral contexts; lack of access to information and technology; cultural resistance.	Extension project at school, practical and playful activities, use of interactive platforms (Kahoot), socio-interactionist approach.	Increased awareness of proper waste disposal; greater interaction and absorption of content through dynamics; integration of environmental and social issues.

Source: Authors (2025).

The next step involved formulating questions aligned with the study's main objective. For each article, five questions were developed, correlating them with the identified objectives, challenges, approaches, and results, taking into account the thematic context of each article (Table 2).

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Table 2: Initial set of questions designed to propose an instrument to be applied to environmental educators.

Source	1st) Question	2nd) Question	3rd) Question	4th) Question	5th) Question
(1) Nascimento et al. (2019)	How can the use of photography contribute to environmental awareness in traditional communities?	What were the main challenges faced in promoting behavioral changes regarding waste disposal?	How did young people's participation in environmental workshops influence their perception of the mangrove ecosystem?	What strategies were used to promote community engagement in mangrove conservation?	How can environmental workshops be replicated in other contexts to maximize the impact of EE?
(2) Ornelas (2018)	What are the main challenges faced in implementing composting practices in communities with little infrastructure?	How did the participation of children and adolescents influence the effectiveness of socio-environmental education actions?	What strategies were adopted to overcome initial resistance to composting?	How were agroecological activities integrated into the formal school curriculum of the participating children?	What changes in community behavior have been observed regarding the consumption of healthy foods?
(3) De Melo e Magalhães (2022)	How can selective collection programs adapt to the specific characteristics of favelas?	How has EE been effective in community mobilization?	What are the main challenges faced in implementing selective collection systems in areas with difficult access?	How can EE actions be expanded to strengthen social inclusion?	What impact can solid waste management have on improving the quality of life in favelas?
(4) Gomes e Pedroso (2022)	Which teaching methodologies in EE are most effective in bringing about long-term behavior change?	How can interdisciplinarity enrich EE in schools?	What are the main obstacles to the use of active methodologies in EE?	How could the action research methodology be applied in elementary education for EE?	How does the integration of methodological approaches impact the results of EE actions?
(5) De Lima et al. (2022)	How can popular education contribute to participant engagement in sanitation actions?	What were the main difficulties encountered in implementing the project?	How does the Theater of the Oppressed methodology help raise participants' awareness?	Which technological solutions were best accepted by participants and why?	How can the critical training of participants influence the transformation of local reality?

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(6) Sousa (2022)	How can the socio-interactionist approach increase the effectiveness of EE in school contexts?	How does the inclusion of interactive dynamics contribute to changing students' behavior regarding waste management?	What are the biggest barriers encountered in applying EE practices in areas with limited access to technology?	How can the integration of extension projects be used to bring environmental issues closer to students' daily lives?	What strategies can be adopted to ensure that EE has impacts beyond the school environment?

Source: Authors (2025).

The questions were analyzed as a whole, providing a holistic view of the identified challenges and approaches. Data triangulation was used for this analysis, allowing for comparison and contrast between different approaches, challenges, and perspectives of the authors of the selected articles, which informed the discussion. This process highlighted the need to formulate new questions, which were incorporated into the initial set. Subsequently, a final analysis was performed to filter the questions based on their functionality (Table 3).

3 RESULTS AND DISCUSSIONS

This chapter demonstrates the systematization carried out in reading the selected articles (Table 01), prioritizing their methodological approaches and challenges, which served as a basis for the preliminary development of the research instrument to guide the planning of EE actions in favelas and urban communities.

3.1 Challenges faced by Environmental Educators in the favelas

Based on the information in Table 1, it was possible to verify that precarious basic sanitation does not guarantee residents' access to essential services. According to De Lima et al. (2022), this reality can be understood as environmental racism and necropolitics, which are consequences of the political disinterest in guaranteeing human rights and dignity in these territories, where people with a lack of opportunities and low income predominate. Therefore, favela residents are more vulnerable and susceptible to exposure, as their rightful quality of life and environment are not provided. These places and their organizations are constantly neglected and ignored. However, EE is even more important in these territories for the stability of public health (Ornelas, 2018; De Lima et al., 2022).

Improper solid waste disposal in favelas and urban communities is a complex and delicate issue, involving a lack of information, a lack of discussion spaces on the topic, and a lack of infrastructure, such as the unavailability of appropriate compartments and containers for different types of waste. According to Sousa (2022), the collection truck typically passes a maximum of three times a week in these areas, which are densely populated, with frequent disposal in small spaces. The scarcity of collection services encourages improper disposal, resulting in overflowing dumpsters, the exposure and accumulation of waste in the open air, which ultimately contributes to the stigma of the gloomy landscapes of favelas (Sousa, 2022).

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The situation becomes even more critical when homeless people and waste pickers sift through accumulated waste in search of recyclable materials to generate income and survive. These people typically lack protective equipment, exposing themselves to various health risks. Competition for space and housing is intense, exacerbated by the lack of suitable areas and effective logistics for recycling points and USWM (Schueler et al, 2018).

Collection in favelas also faces other obstacles, such as difficult-to-access alleys that stretch into labyrinthine structures, stilt houses, and other dwellings that make proper waste disposal more challenging (Sousa, 2022). It is worth noting that residents also face various adverse conditions, such as hunger, unhealthy conditions, lack of basic sanitation, and unemployment.

Environmental urgency and sustainability practices are topics of growing importance, but their implementation faces complex challenges in contexts of extreme social inequality. For many families in vulnerable situations, issues such as recycling, conscious consumption, and waste separation are secondary to a more immediate reality: survival. In environments of poverty and precariousness, where the daily struggle includes dealing with hunger, inadequate housing conditions, and the scarcity of basic resources, sustainability can seem distant, if not a privilege (De Lima et al., 2022).

Considering the environmental impact on the daily lives of people living in one- or two-room shacks, sharing a small space with several others, requires a deep reflection on environmental justice and inclusion. Recycling and consumption reduction practices, often promoted as individual responsibilities, can become an additional burden in a context of deprivation. For those already facing extreme hardship, the concept of "conscious consumption" loses meaning, since consumption itself is minimal and limited to the essentials. Given the extreme hardships faced by these populations, promoting environmental awareness becomes a significant challenge. Encouraging concern for the environment and recycling comes up against the reality of unmet basic needs, such as food, and consumption conditions restricted to the essential (De Lima et al., 2022).

The proposal for sustainable consumption practices therefore needs to be rethought for these highly vulnerable contexts, where even waste separation faces limitations in cramped housing that accommodates multiple people. This situation demands sustainable consumption strategies that not only consider the realities of these communities but also integrate sustainability into meeting urgent needs, creating viable solutions that are sensitive to these contexts (De Melo and Magalhães, 2022; Schueler et al, 2018).

3.2 Possibilities of methodological approaches used by Environmental Educators

Aderaldo, Lima, Aderaldo, and Gondim (2024) state that environmental education is essential to raise public awareness and guide practices that ensure proper solid waste management, promoting a positive impact on the environment. However, Environmental Educators face the challenge of promoting proper USWM, often with limited resources and infrastructure (Table 1). Therefore, it is essential to assess available support and utilize different methodological approaches to ensure these actions are effective and sustainable. According to Frascara (2000), design methodology can be an effective tool for addressing social problems and

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significantly alleviating them, as long as communication is grounded in the reality with which individuals are intended to interact. Frascara (2000) states that, to achieve this, careful study of the public is necessary when attempting to generate changes in their attitudes and behaviors.

To better understand the public, interdisciplinarity must be used to understand their deficiencies (Frascara, 2000). In Sociology, contextualize the designer's activity within the social environment. In Psychology, understand the studies of perception. In Anthropology, understand the concepts of culture and cultural diversity. In Educational Sciences, understand aspects related to learning. In Marketing, specifically Social Marketing, understand the collective behavior of the public. Finally, in the field of Social Sciences, the author states that a multidisciplinary approach can be found to address the diverse areas and the different potentials of distinct individuals (Frascara, 2000).

According to Frascara (2000), by understanding their audience, the designer can immerse themselves in their user's reality and create effective communication. Thus, they will be able to establish experiences and evoke feelings through graphic production or products. As previously noted, few professionals develop projects with a focus on the user and the feelings they evoke.

According to Mizukami (1986), the educational phenomenon is not a ready-made formula and cannot be defined in a single way, as it is a multidimensional phenomenon. Therefore, there are several ways to conceive it.

Gomes and Pedroso (2022) present a systematic analysis of articles based on the application of EE methodologies, classifying the approaches as: (i) traditional: in which the focus is on the transmission of content, with the teacher as the holder of knowledge and the students as the audience; (ii) behaviorist: based on instruction, promoting skills and competencies; (iii) cognitivist: emphasizing the individual's action in their environment through teamwork, problem-solving, inquiry-based learning, games, and research; (iv) humanist: which understands the student as the subject of their own knowledge and learning, with the teacher as a mediator in this process; (v) sociocultural: based on the initial codification of a situation from the student's daily life. The aim is to develop a theme that generates critical reflection on reality itself, in a dialogical manner and imbued with praxis, leading students to act and reflect on their actions.

The authors also found a predominance of behaviorist and cognitive approaches, with aspects of various categories: humanist and traditional (Gomes and Pedroso, 2022). However, the articles analyzed that apply approaches focused on the vulnerable territories of students base their results on predominantly humanist and sociocultural approaches with traits of the cognitive and behaviorist approaches.

Humanist and sociocultural approaches to EE are effective in favelas because they value local experiences and knowledge, promoting environmental engagement aligned with the residents' realities. These methodologies respect the cultural identity of communities and reinforce the role of individuals, integrating sustainability into everyday needs and the struggle for better living conditions (Ornelas, 2018; De Melo and Magalhães, 2022).

While humanistic EE focuses on strengthening values and belonging, the sociocultural approach adapts environmental practices to local social and economic dynamics. Together, these approaches promote initiatives such as selective waste collection and community gardens, transforming environmental issues into a collaborative effort adapted to the specific conditions

of favelas, generating an inclusive environmental education relevant to these contexts (Ornelas, 2018; De Melo and Magalhães, 2022).

Analyzing the approaches used in the six articles and their results, we note a departure from traditional methodologies and approaches (Gomes and Pedroso, 2022). The predominant use is methodologies focused on the participation and protagonism of students in the knowledge construction process, through the stimulation of reflection and critical thinking, opening up important spaces for proposing solutions to environmental issues in their territories. Highlighting the articles by Nascimento et al. (2019), Ornelas (2018), De Melo and Magalhães (2022), and De Lima et al. (2022) in Table 1, which used these approaches as a central focus, combined with social inclusion, participation, community involvement, and real practices with students, resulting in engagement, increased environmental awareness, and real transformations in physical spaces in the territory, as reported in the articles by Ornelas (2018), De Melo and Magalhães (2022), and De Lima et al. (2022) (Table 1). At least three articles cite the Freirean approach based on dialogue, reflection and problematization of issues directly related to the participants' reality.

3.3 Elaborated Instrumental and Reflections

The reflection carried out during the development of the initial set of questions allowed new ideas to emerge, leading to the formulation of additional questions based on the author's experience in EE. During the data analysis process, duplicate or inappropriate questions were discarded, while similar or complementary questions were unified.

The development of the questions revealed the need for a practical EE guide to promote sustainable and participatory practices in USWM in favelas. Thus, relevant questions were incorporated into the analysis. The refinement resulted in a new set of questions (Table 3), in which each question was detailed regarding its function, expected responses, practical examples, and application strategies, making them more targeted and effective.

Table 3 – Sets of questions and their functionality and applicability.

	Question	Function	Expected response
1	What are the main challenges faced in promoting behavioral changes regarding waste disposal?	Identify obstacles to environmental awareness and waste management.	Challenges include: lack of awareness, ingrained behaviors, convenience of improper disposal, lack of recycling incentives, lack of proper disposal infrastructure, and difficulties in influencing long-term habits.
2	What strategies can be adopted to overcome initial resistance to EE?	Understand and explore ways to overcome initial barriers to engagement with EE.	Strategies such as: awareness-raising campaigns, community engagement, gamification, rewards for good practices, inclusion of community leaders, contextualized education, and practical demonstrations of positive impact.

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3	Strategies such as: awareness-raising campaigns, community engagement, gamification, rewards for good practices, inclusion of community leaders, contextualized education, and practical demonstrations of positive impact.	Explore educational methods that influence sustainable behavior change, with real-world examples demonstrating applicability.	Effective methodologies such as project-based learning, hands-on and experiential activities, environmental impact narratives, nature immersion activities, the use of local examples of positive environmental impact, and reflective discussions. Add practical examples, such as recycling projects in schools or awareness programs in local communities.
4	How can the participation of children and adolescents in EE contribute to transforming the reality of a territory?	Identify the impact of EE on young people and how this can influence changes in the territory.	Emphasizing that children and adolescents, by becoming aware and engaged, can influence their families and communities, promoting sustainable practices. This engagement contributes to the development of a more conscious generation, active in environmental protection and local transformation.
5	How has EE been effective in community mobilization?	Understand how EE promotes community engagement and mobilization.	Explaining that EE, by raising awareness about environmental issues, facilitates the unity and organization of residents around conservation practices. Examples include waste collection activities and environmental restoration projects organized within the community.
6	How can EE actions be expanded to strengthen social inclusion?	Explore ways to integrate and strengthen social inclusion into EE initiatives.	Strategies such as: engaging vulnerable communities in EE practices, creating training workshops for income generation in sustainable practices, involving local leaders, and strengthening community networks.
7	How can popular education contribute to participant engagement in EE in favelas?	Identify the role of popular education in community involvement in EE in areas of greater vulnerability.	Using accessible and participatory approaches, such as discussion groups, workshops, and practical activities that respect local reality and knowledge, facilitates understanding and engagement among favela residents.
8	How do you ensure that community participation in EE projects is sustained in the long term?	Explore mechanisms to ensure continued community engagement in EE projects.	Suggesting the creation of local leadership groups, offering ongoing incentives, training for autonomous project management, creating partnerships with NGOs and public agencies, and building a sense of belonging and collective responsibility.
9	What do you consider essential to start an EE process within a socially vulnerable territory?	Identify essential elements for implementing EE in socially vulnerable areas.	Points such as: understanding local reality and needs, creating links with community leaders, adapting activities to social and cultural reality, a participatory approach that respects local knowledge, and evaluating available resources.

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10	What strategies do you use or consider effective in attracting and engaging community residents to participate in the EE process?	Understand methods to attract and motivate residents to EE in vulnerable communities.	Strategies such as: offering practical and relevant activities, holding workshops and community events, ensuring local representation in activities, encouraging the participation of local leaders, offering incentives or benefits to participants, and using community communication networks to publicize the actions.
11	What strategies can be used to promote community engagement in EE participation in practical actions within the territory?	Explore tactics to foster active community engagement in environmental practices.	Ideas such as: organizing cleanup campaigns, community garden projects, recycling and material reuse workshops, creating environmental monitoring groups, and activities that value and strengthen a sense of belonging and responsibility for the territory.
12	How can environmental workshops be replicated in other contexts to maximize the impact of EE?	Explore how to expand the impact of EE workshops through replication in different contexts.	Suggestions include: adapting workshops to local circumstances, training multipliers in different communities, creating accessible and easy-to-use teaching materials, documenting and sharing best practices, and establishing partnerships to facilitate replication.
13	How can agroecological activities contribute to a community's EE?	Identify the contribution of agroecological practices in promoting environmental awareness.	Agroecological activities encourage sustainability, organic farming, and respect for the environment, in addition to promoting food security, engaging the community, and generating interest in sustainable farming practices and preserving natural resources.
14	How can interdisciplinarity enrich EE in communities regarding urban solid waste?	Explore the role of interdisciplinarity in understanding and solving urban solid waste problems.	By integrating different disciplines, such as biology, geography, and mathematics, to understand the impacts of waste and promote practical solutions, in addition to fostering a more comprehensive and applicable vision of the topic within the community context.
15	How can the socio-interactionist approach increase the effectiveness of EE in favela contexts?	Assess the effectiveness of the socio-interactionist model in EE in vulnerable areas.	Highlighting the importance of building collective knowledge, interaction and the exchange of experiences among residents, which facilitates the assimilation of content and promotes more contextualized learning that is applicable to the local reality.
16	How can the integration of methodological approaches impact the results of EE actions?	Explore how combining methodologies can improve EE actions.	Integrating theoretical and practical methods makes learning more comprehensive and effective. The combination of reflective, practical, and interactive activities facilitates engagement and fosters a deeper understanding that can be applied to participants' daily lives.
17	How does the inclusion of interactive dynamics contribute to changing	Assess the impact of interactive activities on	Interactive dynamics such as games, simulations, and practical activities make learning more engaging and concrete, helping

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	students' behavior regarding waste management?	changing behavior in relation to waste.	students internalize correct practices and facilitating behavior change regarding waste disposal and management.
18	How can the use of photography contribute to environmental awareness in traditional communities?	Explore the use of photography as a tool for environmental awareness in specific cultural contexts.	Photography can capture and highlight the beauty and fragility of local ecosystems, as well as document environmental impacts. Images visualize the importance of preservation, facilitating community recognition and appreciation of the environment.
19	Which technological solutions are generally most accepted by participants in EE processes and why?	Identify which technologies are best accepted in EE and why.	With solutions such as mobile apps, social media, and easily accessible digital communication platforms, these tools are practical and accessible, facilitating communication and the sharing of environmental information.
20	What are the biggest barriers encountered in applying EE practices in areas with limited access to technology?	Identify the challenges of implementing EE in regions with technological constraints.	Barriers such as lack of internet access, lack of familiarity with technological devices, lack of adequate infrastructure, and difficulties in implementing digital interactive methods can limit the diversification of EE approaches.
21	How can the critical training of participants influence the transformation of local reality?	Explore how participants' critical awareness can bring about local change.	Critical education empowers participants to question and act on environmental issues, fostering a proactive attitude and solutions to local problems. By understanding causes and effects, they become agents of change in their communities.
22	What strategies can be adopted to ensure that EE has lasting impacts?	Identify actions that promote the durability of the effects of EE in communities.	With strategies such as: training local leaders, ongoing training, developing public policies that support local initiatives, creating support networks, and encouraging community autonomy to maintain sustainable practices.
23	In your experience, what aspects should be considered within EE approaches for this process to be effective in EE in relation to urban solid waste in favelas?	Explore the key elements for an effective EE approach to solid waste in favelas.	With aspects such as: understanding the local context, including leaders, practical recycling and correct disposal activities, and promoting a positive impact on the health and well-being of the community.
24	What impact can solid waste management have on improving the quality of life in favelas?	Assess the benefits of solid waste management for the quality of life in favelas.	That effective management reduces pollution, prevents health problems related to waste, improves the aesthetics and safety of the community, in addition to generating economic opportunities and strengthening the sense of environmental responsibility.

25	In your experience, what are the biggest challenges in implementing EE in favelas and urban communities? Could you share practical examples of these experiences?	Explore practical difficulties and challenges in implementing EE in vulnerable communities.	Challenges include: lack of resources, initial resistance from residents, lack of adequate infrastructure, distrust of external initiatives, and low prioritization of environmental issues. Practical examples may include resistance to participating in workshops or difficulties organizing selective waste collection due to a lack of logistical support.
26	What are the main challenges faced in implementing composting practices in communities with little infrastructure and lack of available physical spaces?	Identify specific obstacles to implementing composting in areas with limited infrastructure.	Challenges such as: lack of physical space, difficulties in separating waste, lack of knowledge about composting, risks of pest proliferation and resistance from residents.
27	What are the main challenges faced in implementing selective collection systems in areas with difficult access?	Explore difficulties in implementing selective collection in hard-to-reach areas.	Challenges such as: narrow or poorly paved streets, difficult access for collection trucks, lack of suitable containers, low public awareness and absence of logistical support systems.
28	How can selective collection programs adapt to the specific characteristics of favelas?	Evaluate strategies to adapt selective collection to the reality of favelas.	Adaptations such as: use of small, accessible collection points, involvement of local collectors, use of educational campaigns to raise awareness among residents, and installation of specific containers for selective collection at strategic points.
29	In your opinion, why are waste problems in favelas so widespread? Could you share practical examples of such incidents from your experience?	Identify the reasons for the severity of waste problems in favelas and give practical examples.	Problems are exacerbated by a lack of regular collection, a lack of environmental awareness, insufficient infrastructure, and inadequate disposal practices. Examples include areas where accumulated waste causes health and safety problems.
30	In your opinion, how do community-specific cultural and social approaches influence the success or failure of EE projects focused on municipal solid waste?	Explore the influence of cultural and social factors on EE success.	Respect for local cultural practices and the involvement of community leaders favor acceptance and engagement in projects, while a lack of adaptation to cultural realities can lead to failure.
31	In your opinion, are urban solid waste problems within favelas different, similar, or the same as in neighborhoods considered "regular"? Explain your conclusion. Could you share practical examples of such occurrences from your experience?	Compare waste problems in favelas with those in regular neighborhoods, with examples.	The problems differ mainly due to the lack of infrastructure and regular collection in favelas, while in regular neighborhoods there is greater municipal support. Practical examples include lower collection frequency and the lack of adequate containers.
32	In your opinion, is the government or community members responsible for the current waste problems in favelas?	Assess responsibilities for inadequate waste management in favelas.	Responsibility is shared, but lack of government support and limited infrastructure are predominant factors. Community members have the additional responsibility of improving local organization.

33	What is your opinion on developing an EE guide for better solid waste management and behavior change in favelas and urban communities?	To evaluate the usefulness of an EE guide for waste management and behavioral change in favelas.	The guide can be an essential tool for standardizing good practices, educating the community, and offering practical solutions adapted to local realities.
34	In your opinion, what would be the challenges of developing this guide for application in favelas in general?	Identify challenges in creating an EE guide for application in favelas.	Challenges such as: adapting to the cultural and structural diversity of favelas, accessible language, including practical and applicable solutions, and the need for technical and logistical support for the distribution and application of the guide.
35	What recommendations would you give for building this guide?	Suggest best practices for developing an effective EE guide for favelas.	Recommendations include: use of simple language, inclusion of illustrations and practical examples, division into easy-to-follow steps, involvement of community leaders in construction and review, and suggestion of low-cost solutions that are viable in the local context.

Source: Authors (2025).

4 FINAL CONSIDERATIONS

This study demonstrates the essential role of EE in promoting sustainable USWM practices, especially in favelas and urban communities.

The results indicate that for EE initiatives to be truly impactful, it is essential to adapt methodological approaches aligned with the culture and social specificities of each community. Active resident participation in USWM discussions and decision-making processes not only enhances learning but also fosters a sense of belonging and shared responsibility, driving meaningful behavioral change.

Furthermore, the instrument developed in this study, with targeted questions for environmental educators, serves as a practical tool for planning EE initiatives. It supports educators and researchers in building collective knowledge and advancing sustainable USWM practices in vulnerable communities.

Finally, this study emphasizes the need for sustained investment in public policies that promote EE and sustainable waste management to foster a more equitable and environmentally just future. While empowering communities as agents of transformation is essential, it does not diminish the responsibility of public authorities to provide adequate infrastructure, services, and rights. Effective environmental justice in favelas and urban communities requires collaborative efforts among public authorities, private organizations, and civil society.

Further research is needed to deepen the understanding of local dynamics and identify best practices that can be adapted across diverse contexts, ensuring scalable and sustainable solutions for USWM.

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DECLARATIONS

AUTHOR CONTRIBUTIONS

- **Concepção e Design do Estudo**: APR e PPS.
- **Curadoria de Dados**: PPS e APR
- **Análise Formal**: PPS e APR
- **Aquisição de Financiamento**: APR.
- **Investigação**: PPS; SA.; CDS
- **Metodologia**: PPS; SA.; CDS e APR
- **Redação - Rascunho Inicial**: PPS e APR.
- **Redação - Revisão Crítica**: APR; SA e JLG
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- **Supervisão**: APR.

CONFLICTS OF INTEREST

We, the authors **Priscilla Pereira da Silva; Sidnei Aranha; Camila Dias Souza; Andreza Portella Ribeiro; and Jorge L. Gallego**, hereby declare that the manuscript entitled *"Seeding the Future: Environmental Education and Sustainability in Favelas and Urban Communities"*:

- Has no financial ties that could influence the results or interpretation of the study.
- Has no professional relationships that could affect the analysis, interpretation, or presentation of the results.
- The authors (APR and JLG) are employed by the respective institutions listed in their affiliations, while the authors PPS, SA, and CDS completed their pós-graduate studies at UNINOVE with full scholarships.

We declare that there are no conflicts of interest with other groups or academic and research institutions.