

Raising awareness about inorganic solid waste management: an experience in an educational institution

Creando con-ciencia sobre el manejo de residuos sólidos inorgánicos: una experiencia en una institución educativa

Conscientização sobre o gerenciamento de resíduos sólidos inorgânicos: uma experiência em uma instituição de ensino

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ABSTRACT

From an environmental care perspective, a problem regarding the management of inorganic solid waste in the Municipal Educational Institution Ciudad Eben Ezer in the municipality of Fusagasugá (Cundinamarca) became evident. Therefore, pedagogical strategies were sought to promote its reduction, reuse and recycling among elementary school students. The study was conducted under a sociocritical paradigm, qualitative approach and action-research design. For the collection of information, a documentary review, a research workshop and a focus group interview were used, techniques applied to a convenience sample of 15 elementary school students. The results, from the categorical analysis, showed that the institution has developed actions to promote the adequate management of solid waste, but these have remained in the formal curriculum. The conclusion is that it is possible to develop the environmental awareness and commitment of the students through the implementation of pedagogical strategies.

Keywords: environment; education; pedagogical strategies; solid waste; environmental awareness.

RESUMEN

Desde una perspectiva de cuidado del ambiente, se evidenció una problemática en torno al manejo de residuos sólidos inorgánicos en la Institución Educativa Municipal Ciudad Eben Ezer del municipio de Fusagasugá (Cundinamarca). Por ello, se buscaron estrategias pedagógicas para fomentar su reducción, reutilización y reciclaje entre los estudiantes de básica primaria. El estudio se planteó bajo un paradigma sociocrítico, enfoque cualitativo y diseño de investigación-acción. Para la recolección de la información se empleó la revisión documental, el taller investigativo y la entrevista en grupo focal, técnicas aplicadas a una muestra por conveniencia de 15 estudiantes de básica primaria. Los resultados, desde el análisis categorial, permitieron evidenciar que en la institución se han desarrollado acciones para promover el manejo adecuado de los residuos sólidos, pero estos se han quedado en el currículo formal. Se concluye, a partir de la implementación de estrategias pedagógicas, que es posible desarrollar la conciencia y el compromiso ambiental de los estudiantes.

Palabras clave: medioambiente; educación; estrategias pedagógicas; residuos sólidos; conciencia ambiental.

RESUMO

Do ponto de vista do cuidado ambiental, foi identificado um problema relacionado ao gerenciamento de resíduos sólidos inorgânicos na Instituição Educacional Municipal Ciudad Eben Ezer, no município de Fusagasugá (Cundinamarca). Por esse motivo, buscaram-se estratégias pedagógicas para promover sua redução, reutilização e reciclagem entre os alunos do ensino fundamental. O estudo foi baseado em um paradigma sociocrítico, uma abordagem qualitativa e um projeto de pesquisa-ação. Para a coleta de informações, foram utilizadas uma revisão documental, um workshop de pesquisa e uma entrevista de grupo focal, técnicas aplicadas a uma amostra de conveniência de 15 alunos do ensino fundamental. Os resultados, a partir da análise categórica, mostraram que a instituição desenvolveu ações para promover o gerenciamento adequado dos resíduos sólidos, mas elas permaneceram no currículo formal. A conclusão é que, por meio da implementação de estratégias pedagógicas, é possível desenvolver a consciência ambiental e o comprometimento dos alunos.

Palavras-chave: meio ambiente; educação; estratégias pedagógicas; resíduos sólidos; conscientização ambiental.

Background

The amount of solid waste deposited in the world's large landfills reflects what humans have done during their time on the planet and its consequences. Along with population growth, consumption needs have also risen, generating a significant global economic, social, and environmental impact due to the excessive amounts of inorganic waste. “[This] creates a chain where an unnecessary need is generated, as a result of strategies that drive the purchase of products, without considering their manufacturing process and end-of-life” (Escobar and Fontalvo, 2020, p. 6). This indicates that the environmental issue caused by the amount of solid waste generated and its inadequate management requires urgent attention.

At the national level, “in 2021, an average of 33,938.58 tons/day of solid waste were disposed of by the public sanitation service in the national territory, which represents an increase of 4.16% compared to 2020” (Superintendence of Public Utilities [Superservicios, for the Spanish original], 2021, p. 15). This indicates that the production of waste has been increasing, which is concerning due to the impact it can have on ecosystems and the policies that need to be implemented for its proper treatment.

In the same vein, in the municipality of Fusagasugá (Cundinamarca), cases of improper solid waste management, particularly inorganic waste, have been reported. This is one of the most concerning environmental issues due to its high volume, its impact on the city's cultural landscape, and the contamination of water sources (Guerrero et al., 2021). This is also evident in public spaces, such as educational institutions. In these scenarios, educational processes such as the School Environmental Project (PRAE, for the Spanish original) are expected to foster the students' environmental awareness and commitment towards their surroundings (Valencia and García-Noguera, 2024).

In particular, at the Municipal Educational Institution (IEM, for the Spanish original) Ciudad Eben Ezer, the Institutional Educational Project (PEI, for the Spanish original) has diagnosed that students “do not have training regarding solid waste management, revealing the lack of shared responsibility between municipal environmental policies and the school's role concerning the issue” (IEM Ciudad Eben Ezer, 2022, p. 33).

Given the above and in order to provide solutions to the environmental issues caused by improper management of inorganic solid waste, pedagogical actions are proposed to raise the environmental awareness of students. This study seeks to establish strategies to promote the reduction, reuse, and recycling of inorganic solid waste among elementary school students at the Municipal Educational Institution Ciudad Eben Ezer.

Background

To begin with, it is important to consider the paper *Influence of the Management of Inorganic Solid Waste on the Level of Environmental Perception of Families in the Cementos Lima Camp* by Hurtado and Vásquez (2022). They conclude that the application of the strategy of segregation, collection, transportation, storage, and recovery of waste contributes to the environmental recovery of the environment.

The research study *Application of the Three Rs Rule for Raising Environmental Awareness Regarding the Problem of Inorganic Solid Waste in the Daily Activities of Sixth Grade Students at the Libertador Mariscal Castilla Educational Institution in the District of Oxapampa*, by Espinoza (2022), concludes that it is important to stimulate students environmentally through the Three Rs training workshop because it is a practical teaching-learning tool.

And the project *The management of solid waste in the school environment* carried out by Ballinas and Flores (2019) concludes that understanding the current state of waste management is essential in order to suggest management strategies and search for models that ensure that the entire educational community is committed to environmental care. Additionally, it allows documenting the operationalization of the categories indicated in the study.

For conceptualization purposes, the definition of *solid waste* is taken from Article 1 of Decree 838 of 2005, issued by the Ministry of Economic Development, which states:

Solid waste or refuse. It is any object, material, substance, or solid element resulting from the consumption or use of a good in domestic, industrial, commercial, institutional, or service activities, which the generator abandons, rejects, or delivers, and that is capable of being utilized or transformed into a new good with economic value, or sent to final disposal. (Ministry of Economic Development, 2005, p. 1).

This definition applies to the provision of public sanitation services. Solid waste also includes the waste produced from mowing the lawn, trimming trees, sweeping, and cleaning public spaces and roads. The waste that can be used and the waste that is not separated based on their harmfulness (Rivas, 2013).

In the modern world, proper solid waste management has gained increasing importance on a global scale. This is primarily because there is a constant search for sustainable environments that provide fair, viable, and manageable socioeconomic development, taking into account both the environment and society. "The exponential increase in the population also increases waste generation, which in turn reproduces greenhouse gases that contribute to global warming and climate change" (Serna & Serna, 2022, p. 397).

For the above reasons, numerous environmental initiatives have been undertaken to create a more habitable planet for current and future generations. In the same way, the different states have established local-level policies that greatly contribute to achieving the necessary change.

“The exponential increase in the population also increases waste generation, which in turn reproduces greenhouse gases that contribute to global warming and climate change” (Serna & Serna, 2022, p. 397). ”

In relation to the term “environment,” despite the fact that most people continue to use the term (in Spanish) *medio ambiente*, the Panhispanic Dictionary of Doubts of the Royal Spanish Academy (2023) advises against its use and recommends instead (the single word) *medioambiente*, defined as the “set of circumstances or external conditions to a living being that influences its development and activities”. For this case study, this meaning will be used in order to give sense to all the conceptual content of the topic.

Finally, environmental pedagogy (EP) is an initiative that, within the school setting, can contribute to the study of the environment and the proper management of solid waste (Campos et al., 2024). It is part of the educational process and ideally should have an interdisciplinary approach, focusing on specific topics according to the needs of the school context. “The ultimate reason for Environmental Pedagogy, since its origins, is to promote a shift in the model of the human relationship with the environment” (Suárez-López et al, 2019, p. 100). Therefore, it can be concluded that education is fundamental for raising awareness about environmental issues.

Methodology

The study is framed within the socio-critical paradigm, which is defined as emancipatory as it invites the subject to undertake a process of introspection and analysis about the society they are part of and the potential for change they can foster (Orozco, 2016). It also employs the qualitative approach through the use of non-standard techniques, allowing the inclusion of participants' viewpoints and perspectives in the collected data (Hernández et al., 2014). And in relation to the design, it is framed within action research, which motivates reflection processes that, in a critical manner, allow understanding the problem and designing intervention actions (García-Noguera, 2020).

In relation to the study participants, the project was conducted at the IEM Ciudad de Eben Ezer. The chosen population were third, fourth, and fifth grade students of primary education (a total of 105: 58 girls and 47 boys) and as a convenience sample, 15 students (8 girls and 7 boys) were considered, with five from each of the mentioned grades. Literature reviews, research workshops, and focus group interviews were used to gather the information. Each of the techniques was operationalized through instruments designed and validated within the study, via expert opinion (Hernández et al., 2014).

The collected information was analyzed considering the analysis category “Environmental pedagogical strategies to promote the reuse of inorganic solid waste” and the subcategories “Proposed pedagogical strategies for the reuse of inorganic solid waste,” “Knowledge of inorganic solid waste,” and “Lessons learned about the reuse of inorganic solid waste.” The data were recorded, coded, and presented using categorical analysis, and interpreted based on a methodological triangulation (Hernández et al., 2014).

Results

Proposed Pedagogical Strategies for the Reuse of Inorganic Solid Waste

This subcategory was developed through an analysis of the literature, for which a documentary analysis guide was used as instrument, allowing the collection of the information described in Table 1.

Table 1. Information collected in the subcategory
“Proposed Pedagogical Strategies for the Reuse of Inorganic Solid Waste”

Category	Subcategory	Unit of analysis	Findings
Environmental pedagogical strategies to promote the reuse of inorganic solid waste	Proposed Pedagogical Strategies for the Reuse of Inorganic Solid Waste	PEI	<p>EPPRDPI1: The IEM Ciudad Eben Ezer seeks to consolidate healthy and safe spaces for the educational, labor, and social activities of the community, and aims to establish sustainable relationships and strategies for the care of and harmonious interaction with the environment.</p> <p>EPPRDPI2: institutional principles.</p> <ol style="list-style-type: none"> 1. The guarantee of safety, health care, and disease prevention for students, administrative staff, teachers, and directors of the institution. 2. The order and cleanliness of institutional spaces and the care for the environment. <p>EPPRDPI3: institutional objectives.</p> <p>Adopt the educational approach established in the institutional pedagogical model as a mechanism for improving quality, as well as the sense of institutional belonging.</p>
Environmental pedagogical strategies to promote the reuse of inorganic solid waste	Proposed Pedagogical Strategies for the Reuse of Inorganic Solid Waste	PRAE	<p>EPPRDPR1: campaign for the development of critical thinking habits and responsible consumption in the community “May your consumption reduce the footprint on our planet.”</p> <p>EPPRDPR2: general objective.</p> <p>Generate strategies that allow the educational community to understand the interdependent relationships it maintains with its environment, in a reflective and critical manner, in order to promote appreciation and respect for the environment, especially from the perspectives of values, human rights, peace, democracy, and cultural, scientific, and technological improvement, with local and global projection.</p> <p>EPPRDPR3: specific objective.</p> <p>Encourage waste separation at the source in accordance with the new national regulations (Resolution 2184 of 2019).</p> <p>EPPRDPR4: scheduled activities for the year 2023.</p> <ol style="list-style-type: none"> 1. Awareness event through a cinema-forum concerning consumerism as a widespread issue due to the excessive use of natural resources and the uncontrolled generation of waste. 2. Sessions on the collection and separation of solid waste at all locations.

Category	Subcategory	Unit of analysis	Findings
Environmental pedagogical strategies to promote the reuse of inorganic solid waste	Proposed Pedagogical Strategies for the Reuse of Inorganic Solid Waste	Area Plan for Natural Sciences	<p>EPPRDPA1: Basic Standards by Competencies.</p> <p>Living environment: I identify structures of living beings that allow them to develop in an environment and that I can use as classification criteria.</p> <p>Physical environment: I place myself in the universe and on Earth and identify characteristics of matter, physical phenomena, and manifestations of energy in the surroundings.</p> <p>EPPRDPA2: Basic Learning Rights.</p> <p>DBA 6, 7: I identify adaptations of living beings, taking into account the characteristics of the ecosystems in which they live.</p> <p>DBA 3, 4, 6, 7: I explain the dynamics of an ecosystem, taking into account the energy and nutrient needs of living beings. EPPRDPA3: Basic Learning Rights.</p> <p>DBA 3: I identify and describe the flora, fauna, water, and soil of my environment.</p>

Source: Prepared by the authors, 2024.

Knowledge of inorganic solid waste

This subcategory was developed through a research workshop, for which the workshop protocol was used as an instrument, allowing the collection of the information detailed in Table 2.

Table 2. Knowledge of inorganic solid waste

Category	Subcategory	Unit of analysis	Findings
Environmental pedagogical strategies to promote the reuse of inorganic solid waste	Knowledge of inorganic solid waste	Classification of waste	<p>CRTEE008: "I want to recycle because there are many items in the trash that we can reuse."</p> <p>CRTEE009: "It is necessary for us to be able to reuse everything again because in this way we help the planet."</p> <p>CRTEE0010: "We are not aware of the harm we are causing to the planet." CRTEE0012: "The students have a lot of responsibility for what happens in the school with the garbage, excuse me, the solid waste."</p>
		Characteristics of Waste	<p>CRTEE005: "It is the waste that we throw into the trash."</p> <p>CRTEE0012: "It is all waste that is left on the ground."</p> <p>CRTEE0010: "What we find in the garbage chutes."</p>
		Reuse of waste	<p>CRTEE009: "Reuse; for example, bottles to fill them with something else." CRTEE0011: "Use them to make other objects; for example, cardboard boxes to make trash bins."</p> <p>CRTEE001: "Wash those items and reuse them, such as plastic cutlery."</p>
		Waste that is generated	<p>CRTEE001: "They are the waste materials we find in the trash."</p> <p>CRTEE002: "Waste is everything that people generate. It can be related to food or the materials they use."</p> <p>CRTEE003: "Solid waste encompasses all refuse from human activities." CRTEE004: "Reusing is to use again the things we discard."</p>

Source: Prepared by the authors, 2024.

Lessons learned on the reuse of inorganic solid waste

For the exploration of this subcategory, it is important to consider the educational proposal “*Creando con-ciencia*,” which aims to implement pedagogical strategies that enable the reuse of inorganic solid waste among students in the 3rd, 4th, and 5th grades of primary education at IEM Ciudad Eben Ezer. The implementation of this proposal (see Table 3) was based on the diagnosis constructed from the results obtained in the subcategories “Pedagogical strategies for the reuse of inorganic solid waste” and “Knowledge of inorganic solid waste.”

Table 3. Educational Proposal “*Creando con-ciencia*”

Category	Subcategory	Unit of analysis	Findings
Introductory workshop on managing inorganic solid waste	The students watch videos about the management of inorganic solid waste and, through questions, raise concerns about the topic.	Teacher Students	Create expectations regarding the topic of inorganic solid waste management in order to initiate contextualization.
Workshop “Characterizing the issue of inorganic solid waste management in the institution”	The Problem-Based Learning method is applied as follows: Exploration of deposits and tour of the facilities. Classification and separation of waste into the corresponding bins. Preparation (cleaning) of inorganic waste, which involves drying the waste and placing it in the white container.	Teacher Students	Recognize and characterize the issues related to the management of inorganic solid waste through its classification and separation.
Workshop “Proposal of Solutions for the Reuse and Recycling of Inorganic Solid Waste”	The students watch videos about creating toys and other objects using recycled or reused materials and propose actions to replicate this within the institution.	Teacher Students Interviewed	Develop competencies in the appropriate use of inorganic solid waste to create toys and use them in the classroom.
Workshop “Evaluation and Dissemination of the Results of the Implementation of the Educational Proposal”	1. Presentation of the work done to other grades, emphasizing the importance of proper inorganic solid waste management. 2. Interview to evaluate the learning of concepts and practices.	Teacher Students	Evaluate the management of inorganic solid waste and the impact of the proposal on both the students involved and the educational community.

Source: Prepared by the authors, 2024.

After the implementation of the educational proposal, a focus group interview was conducted using an interview guide as instrument, which allowed for the collection of the information detailed in Table 4.

Table 4. Lessons learned on the reuse of inorganic solid waste

Category	Subcategory	Unit of analysis	Findings
Environmental pedagogical strategies to promote the reuse of inorganic solid waste	Lessons learned on the reuse of inorganic solid waste	Inorganic solid waste	AREGFE0011: "Because this way, less waste is generated."
			AREGFE002: "Because we do not dispose of so much waste in trash containers."
			AREGFE0013: "Because this way we do not discard so many useful things."
			AREGFE003: "They are very important because, in this way, everyone learns to reuse and there is less waste."
			AREGFE0014: "This way, we all continue with the collection and classification of inorganic solid waste."
			AREGFE001: "Activities with solid waste can become crafts."
			AREGFE0015: "The more we reuse, the better the environment will be."
			AREGFE006: "When we reuse these inorganic solid wastes, we improve the waste conditions in schools, and that is good for the environment."
			AREGFE007: "The environment is protected when there is not so much solid waste on the ground or in the trash bins."
AREGFE009: "When we practice effective solid waste management, we become more convinced that we must help the planet."			

Source: Prepared by the authors, 2024.

Discussion

Once the analysis of results was completed, triangulation was carried out to view the findings in a cross-sectional manner, as detailed in Table 5.

Table 5. Triangulation of the results

Category	Subcategory	Information collected			Conclusion
		Literature Review	Workshop for students	Final interview	
Environmental pedagogical strategies to promote the reuse of inorganic solid waste	Proposed Pedagogical Strategies for the Reuse of Inorganic Solid Waste	EPPRDPI1: The IEM Ciudad Eben Ezer seeks to consolidate healthy and safe spaces for the educational, labor, and social activities of the community, and aims to establish sustainable relationships and strategies for the care of and harmonious interaction with the environment.	CRTEE0012: "The students have a lot of responsibility for what happens in the school with the garbage, excuse me, the solid waste."	AREGFE001: "Yes, ma'am, now the floor looks cleaner." "There is no paper or waste on the floor." The classmates use the bins, although they still get confused about where to dispose of organic and inorganic waste."	Considering the category "Environmental Pedagogical Strategies to Promote the Reuse of Inorganic Solid Waste" and the subcategory "Proposed Pedagogical Strategies for the Reuse of Inorganic Solid Waste",
			CRTEE0013: "There is no awareness in the school. We can help with that."		

Category	Subcategory	Information collected			Conclusion
		Literature Review	Workshop for students	Final interview	
Environmental pedagogical strategies to promote the reuse of inorganic solid waste	Proposed Pedagogical Strategies for the Reuse of Inorganic Solid Waste	<p>EPPRDPI2: institutional principles.</p> <p>1. The guarantee of safety, health care, and disease prevention for students, administrative staff, teachers, and directors of the institution.</p> <p>2. The order and cleanliness of institutional spaces and the care for the environment.</p> <p>EPPRDPI3: institutional objectives.</p> <p>Adopt the educational approach established in the institutional pedagogical model as a mechanism for improving quality, as well as the sense of institutional belonging.</p>	<p>CRTEE001: "There are trash cans, but we do not use them, and there is a lot of garbage outside of them."</p>	<p>AREGF003: "We now use the terms better: instead of trash, we say solid waste."</p> <p>AREGF005: "The three types of bins are already being used, and in some grades they are making objects with inorganic solid waste, such as vases, flowers, ornaments, and other items."</p>	<p>There is very little consistency between the PEI, the PRAE, and the institution's curriculum grid. This is demonstrated by the students' limited appropriation of both the conceptualization and the practices, as well as their low environmental awareness..</p>
	Knowledge of inorganic solid waste	<p>EPPRD3: In the pedagogical proposal, the curriculum design is based on two fundamental elements: Basic Quality Standards (EBC) and Basic Learning Rights (DBA). They involve themes or content, and we find cross-cutting topics.</p>	<p>CRTEE001: They are the waste materials that we find in the trash;</p> <p>CRTEE002: Waste includes everything generated by people, which can be food-related or come from items they use.</p> <p>CRTEE003: Solid waste encompasses all refuse from human activities</p>	<p>AREGF005: "The more we reuse, the better the environment will be."</p> <p>AREGF006: "When we reuse these inorganic solid wastes, we improve the waste conditions in schools, and that is good for the environment."</p> <p>AREGF007: "When we practice effective solid waste management, we become more convinced that we must help the planet."</p>	<p>Taking into account the category "Environmental Pedagogical Strategies to Promote the Reuse of Inorganic Solid Waste" and the subcategory "Knowledge of Inorganic Solid Waste," it was found that, from institutional documents and the perceptions of the students, the initial knowledge was very superficial and there was considerable confusion. However, when the initial workshop was conducted and the proposal was subsequently implemented, the students were able to appropriate it to the point of managing it in context and transmitting it to their peers in other grades.</p>

Category	Subcategory	Information collected			Conclusion
		Literature Review	Workshop for students	Final interview	
	Lessons learned on the reuse of inorganic solid waste	<p>EPPRDPA1: Basic Standards by Competencies.</p> <p>Living environment: I identify structures of living beings that allow them to develop in an environment and that I can use as classification criteria.</p> <p>Physical environment: I place myself in the universe and on Earth and identify characteristics of matter, physical phenomena, and manifestations of energy in the surroundings.</p> <p>EPPRDPA2: Basic Learning Rights.</p> <p>DBA 6, 7: I identify adaptations of living beings, taking into account the characteristics of the ecosystems in which they live.</p> <p>DBA 3, 4, 6, 7: I explain the dynamics of an ecosystem, taking into account the energy and nutrient needs of living organisms.</p> <p>EPPRDPA3: Basic Learning Rights.</p> <p>DBA 3: I identify and describe the flora, fauna, water, and soil of my environment.</p>	<p>CRTEE001: "They are the waste materials we find in the trash."</p> <p>CRTEE002: "Waste refers to everything generated by people and can include food or items they use."</p> <p>CRTEE003: "Solid waste encompasses all refuse from human activities."</p>	<p>AREGFE007: "First of all, we didn't know very well how to say each thing, we didn't know how to classify the waste, or what we could use it for, but with the help of the teacher, the videos, and the activities we did, we learned a lot, and now we want to form our environmental group."</p> <p>AREGFE009: "Just as we did when we went to the classrooms and told the students not to throw everything into the same trash can and especially not on the ground, to use the appropriate trash cans, and that some of the objects they were going to discard could be reused to make better use of them, thereby helping to take care of the school and the environment."</p>	Regarding the category "Environmental pedagogical strategies that promote the reuse of inorganic solid waste" and the subcategory "Learnings about the reuse of inorganic solid waste," the achievement of the objective is demonstrated at IEM Ciudad Eben Ezer. The students learned and relearned in the process, managing to appropriate concepts and practices and transferring them.

Source: Prepared by the authors, 2024.

Regarding the first subcategory ("Proposed Pedagogical Strategies for the Reuse of Inorganic Solid Waste"), once the results were analyzed, it was found that the PEI document (which condenses the PRAE and the curricular framework) is disconnected from solid waste management (specifically, inorganic), as there is no defined pedagogical strategy concerning the environmental topic and, therefore, waste management:

El Proyecto Educativo Institucional (PEI) funge como herramienta de gestión educativa y planeación del currículo oficial de las instituciones en respuesta a sus prospecciones, representaciones e ideales de ciudadanos, en este caso, vinculados a lo eminentemente humano. (Orozco, 2021, p. 295).

While there are objectives and activities within the PRAE that address the issue, it is not sufficient for it to become an institutional policy that sets out guidelines to follow. In this regard, Navarro and Villafañe (2022) state:

The PRAE is an improvement opportunity for the institution, in addition to recognizing it as a pedagogical tool that promotes environmental care and seeks the participation of the entire educational community for its design. It takes into account pedagogical tools and strategies that socialize and integrate the different social actors, each with a role and responsibility that ensures participation in the program. (p. 13).

The lack of a clear horizon prevents the materialization of necessary competencies in students within both pedagogical practices and the teaching-learning process to achieve environmental awareness (López and García-Noguera, 2024). In this regard, Pulido (2020, p. 258) states that “the Environmental Pedagogy Program (PRAE) must have a direct relationship with the context in which it is developed to promote the analysis, understanding of problems, and local environmental potentialities. It must create spaces for citizen participation.”

In this way, the students themselves prefer to involve other groups and grades in the proposal. From this perspective, it is possible that the study participants (third, fourth, and fifth grades) will project future goals that could well serve as a foundation for the mainstreaming of solid waste management within the institution, especially given that the school's emphasis is on health promotion and prevention.

The proposal initiated by the children is fundamental. The Ministry of National Education states that students should propose learning alternatives and build knowledge in a cross-sectional manner, thus generating autonomous knowledge. However, the educational community is also encouraged to participate.

Every educational institution must develop and implement an institutional educational project with the participation of all stakeholders. This project should outline how the educational goals determined by the Law will be achieved, taking into account the social, economic, and cultural conditions of its environment. (Decree 1860 of 1994, Chapter III, Article 14, p. 7).

The regulation is clear on this subject, and in this paper it is demonstrated that, with a pedagogical proposal, students can be involved in such a way that they come to realize the importance of the subject for the entire institution, which suggests a re-signification of the document. As Manrique (2021) says:

The importance of updating curricular frameworks in educational institutions lies in determining the context of the institution and addressing the gaps in the quality of education provided that need to be remedied. (p. 86).

Regarding the second subcategory (“Knowledge of inorganic solid waste”), substantial changes were evidenced throughout the project. At the beginning, students were not at all knowledgeable; one could say that they were not interested. It was important to generate a “reflection on the relationship that humans should establish with the environment, the appropriation of concepts related to the object of study and their application” (Lozano, 2023, p. 3). Thus, when applying the inquiry workshop, general notions about the topic were evidenced in the preconceptions, but there was no coherence in them.

Once the videos were watched, the children displayed greater interest, because they could better relate to the topic and take it more seriously than before. Additionally, they connected it with experiences and aspects of their own environment, starting from meaningful learning. In this regard, Baque and Portilla (2021) state:

Meaningful learning is a teaching strategy that emerges today as a solution to innovation problems in teaching, in which teachers have opted to implement tools as teaching strategies to guide the study to the knowledge of the students. (p. 85).

Upon engaging in the activities, the students identified key concepts and began to handle them comfortably and appropriately, as evidenced in the presentations they enthusiastically prepared. In this regard, Casas (2022) states:

In order for the individual to keep in mind the knowledge, experiences, and encounters related to the environment and develop an environmental consciousness that enables them to act and think in favor of the environment, all dimensions of environmental consciousness must work together (active, cognitive, affective, and conative). (p. 34).

Next, during the sharing session, there were some agreements and disagreements that raised concerns regarding the importance of inorganic solid waste management. This subcategory was possibly the one where the most progress was made, because when the proposal was implemented, the students managed to maintain a conversation using technical terms. In one of the conclusions of Ríos (2021), the author states that “with these strategies, they were also able to delve into and appropriate real situations occurring in their contexts regarding the care and preservation of the environment” (p. 59).

In this regard, in practical activities, the students managed to do a very good job as a team, dividing tasks, delegating functions, and organizing themselves almost independently, despite being elementary school children. In general, collaborative work requires participants to have communication skills, reciprocal relationships, as well as a desire to share in problem-solving (Pascagaza and Bohórquez, 2019). In this way, fundamental competencies are developed for the comprehensive development of the students, especially for building knowledge.

It is worth noting that the students investigated beyond the knowledge they were taught, and transferred it to others, adding value to the entire learning process. The starting point was the problem situation that arose within the institution. In this regard, Mendieta (2021, p. 85) states that Project-Based Learning “improves academic performance, enhances social attitudes, and improves the critical thinking of students.”

Finally, regarding the third subcategory (“Lessons learned about the reuse of inorganic solid waste”), students grasped the concepts, used them in their daily language, and corrected others. The activities were to their liking, as they participated with high levels of motivation, even when things that were not planned were carried out. Regarding the school, there is no longer any solid waste on the ground. The children use the bins, although they still find it challenging to determine which bin is appropriate; therefore, it is necessary to separate and classify the waste. To replicate what they have learned, they have created their environmental group.

Conclusion

In relation to the pedagogical strategies proposed for the reutilization of inorganic solid waste, on one hand, it is evident that the institutional documents interpret and propose strategies, but there is no connecting thread between them. It is proposed to review them and, in light of clear policies, to redefine them and assess the students’ appropriation of the curriculum framework. Regarding knowledge about inorganic solid waste, a review is necessary as students continue to be confused by the terminology. In this regard, it is proposed that the teaching-learning process be more practical than theoretical, an observation that came from the students themselves. When children internalize knowledge in context, their participation becomes much more effective, and there is a greater generation of awareness.

Finally, concerning what was learned about the reuse of inorganic solid waste, the implemented pedagogical strategy was motivating for the children: they embraced it and went beyond its execution, so much so that expectations were surpassed. The educators only led the process. In the implementation phase, significant results were achieved in reducing inorganic solid waste. The satisfaction rate was high, as evidenced by the observations made by the public during the presentations. The students learned the concepts related to inorganic solid waste management, put them into practice, raised awareness about their environment, and projected this to their peers and participants. It is expected that the proposal will become an institutional project and later turn into a significant experience for other institutions in the municipality of Fusagasugá.

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