ASSESSING ENVIRONMENTAL PERCEPTION OF STUDENTS: PIAÇABUÇU PARK AND SCHOOL VICINITY (PRAIA GRANDE-SP)

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RESUMO: Este estudo analisou a percepção ambiental de estudantes do Ensino Médio sobre o Parque Piaçabuçu (Praia Grande – SP) e o entorno da escola. Identificaram-se problemáticas socioambientais e questões de preservação percebidas pelos alunos. Imagens de satélite foram utilizadas para avaliar a supressão da vegetação ao longo do tempo. Cerca de 90% dos estudantes desconhecem o Parque e menos de um terço participa de projetos de Educação Ambiental. Os principais problemas apontados foram lixo (95,5%), poluição do ar (77,3%), queimadas (40,9%) e desmatamento (31,8%). Observou-se expansão urbana desde a criação do Parque em 1996. O estudo destaca a importância de integrar a Educação Ambiental ao currículo escolar, especialmente em áreas próximas a Unidades de Conservação.

Palavras-chave: Educação Ambiental; Unidade de Conservação; Preservação.

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ABSTRACT: This study analyzed the environmental perception of high school students regarding the Piaçabuçu Park (Praia Grande – SP) and the area surrounding their school. Socio-environmental issues and conservation concerns perceived by the students identified, and Satellite images used to assess vegetation suppression over time. About 90% of the students were unaware of the Park, and less than one-third participated in environmental education projects. The main problems reported were litter (95.5%), air pollution (77.3%), wildfires (40.9%), and deforestation (31.8%). Urban expansion observed since the Park's creation in 1996. The study highlights the importance of integrating Environmental Education into school curricula, especially in regions near Conservation Units.

Keywords: Environmental Education; Conservation Unit; Preservation

Introduction

The environment has been undergoing rapid and unprecedented degradation due to an anthropocentric and exploitative approach focused on intensive extraction of natural resources. The environmental crisis has also led to pollution in marginalized communities; deforestation for city growth and rapid urbanization, which often leads to the loss of green spaces, affecting human health and promoting climate change. Urgent transformations in societal values towards responsibility, preservation, and sustainability needed to mitigate these damages.

Relationships between Environmental Perception, Environmental Education, Awareness, and Conservation

Building a society more committed to sustainability necessarily involves strengthening the relationships between environmental perception, environmental education, awareness, and conservation. These concepts complement and reinforce each other, forming a fundamental cycle to promote real changes in human attitudes towards the environment (Reis Fim et al., 2024).

Environmental perception refers to how individuals and social groups observe, interpret, and relate to the environment around them. Factors such as culture, personal experiences, level of knowledge, socioeconomic context, and ties to the territory shape this perception (Fraga et al., 2021). In this sense, environmental education acts as a transformative instrument, seeking to expand critical understanding of environmental issues, strengthening values, attitudes, and behaviors that favor balanced coexistence between humans and nature. When planned and contextualized, environmental education helps to broaden environmental perception, making it more conscious, critical, and action-oriented (Pacheco et al., 2024).

From this expanded perception and access to knowledge through environmental education, environmental awareness arises. This process is associated with the internalization of ecological values, fostering awareness and behavioral changes that support conservation practices and the formation of collective consciousness about the importance of preserving natural resources and adopting sustainable practices in daily life (Lima, 2024).

Global environmental conservation emerges as a practical result of these stages, and a more conscious and educated society tends to engage more responsibly in concrete actions for protection, recovery, and sustainable use of the environment, whether through public policies, community mobilizations, or individual practices (Mendes e Oliveira, 2022).

The dimensions of Environmental Education do not act in isolation: environmental perception influences how environmental education should be conducted (Almeida, 2021) Education, in turn, promotes awareness and awareness is the foundation for more effective, participatory, and lasting environmental conservation. Strengthening these connections is essential to face contemporary socio-environmental challenges and build a fairer and more sustainable future (Robinson, 2021).

Brazilian Environmental Legislation

Brazilian environmental legislation has evolved since the creation of the Forest Code in 1934 (Brasil, 1934), which aimed to regulate the use of forests. The Second Forest Code of 1965 (Brasil, 1965) declared forests as common interest assets, imposing limits on rural property use to ensure preservation. On the other hand, the National Environmental Policy (PNMA) established the National Environmental Council (CONAMA) to advise and propose guidelines for governmental environmental policies. Despite its complexity and comprehensiveness, Brazilian environmental legislation faces challenges in implementation due to inconsistencies and demands that are difficult to solve. The legislation incentivizes sustainable practices and provides benefits for those who conserve and recover environmental areas. However, the preservation of conservation units in urban areas is often neglected due to inefficiencies in applying legal norms. The issue of Permanent Preservation Areas (PPAs) in urban areas is particularly problematic, with municipalities facing difficulties in meeting legal requirements (Pereira, 2023; Moreira, 2021).

Environmental conservation laws in Brazil began effectively in 1981 with the National Environmental Policy (Brasil, 1981), which established principles for environmental preservation and improvement. Subsequent laws formed a comprehensive system of environmental protection, including the revised Forest Code in 2012 (Brasil, 2012), which regulates land use and forest activities, and the Environmental Crimes Law in 1998 (Brasil, 1998), which defines penalties for harmful activities.

The National System of Conservation Units - SNUC was established in 2000 (Brasil, 2000), defining categories and management norms for conservation units. The Solid Waste Law in 2010 (Brasil, 2010) regulates the integrated management of solid waste, involving shared responsibility among government, private sector, and society. Environmental licensing guidelines set by CONAMA Resolution in 1997 (CONAMA, 1997). The Convention on Biological Diversity and the Kyoto Protocol (Kyoto Protocol, 1998) further emphasize commitments to biodiversity conservation and greenhouse gas emission reductions.

Conservation Units (UC) and the Management Plan and Socio-environmental Characteristics around Conservation Units

Conservation Units (UC) are legally protected areas aimed at preserving biodiversity and essential natural resources (Brasil, 2000). These units seek ecological stability and protection from external negative influences such as nonplanned housing, grazing, and fires. They also aim to establish a planned connection between the protected area and the population using the natural resources, often precariously. Buffer Zones (BZ) around conservation units minimize negative impacts, regardless of management plans (Pereira, 2023; Souza et al., 2017).

Preservation areas in Brazil can include various land uses, from sustainable activities like ecotourism and environmental education to stricter restrictions such as prohibiting deforestation and unregulated occupation. Pollution control, waste disposal, industrial activity restrictions, urbanization limitations, and infrastructure regulation are essential to protect conservation units. The level of restriction depends on the type of conservation unit and the management plan guidelines. The specific legal instrument - CONAMA's Resolution No. 302/02 - sets criteria for creating UCs, including demographic density and urban infrastructure requirements. (Brasil-CONAMA, 2002),

The management plan is the main technical instrument for managing a UC, responsible for zoning, usage norms, conservation strategies, and permitted activities. It must include internal aspects and socio-environmental characteristics of the surroundings to be effective. The absence or poor implementation of the management plan weakens UC management, especially in surrounding areas, compromising ecological, social, and economic functions (Brasil, 2000).

Understanding environmental perception involves how individuals and communities build social values and relate to the environment. It includes knowledge, values, beliefs, experiences, and feelings influencing views on nature and environmental problems. This understanding is crucial for environmental education projects, participatory management, and nature conservation, revealing whether residents see the UC as a preservation space, a barrier, or a development opportunity (Marques et al., 2022).

Brief Characterization of the Piaçabuçu Conservation Unit in Praia Grande-SP and potential benefits of an Environmental Education Program for is Management Plan

The Piaçabuçu Conservation Unit located in the municipalty of Praia Grande covers 7.96 km² and it was established as Piaçabuçu Park through Complementary Law No. 152 in 1996 (PRAIA GRANDE, 1996). It is influenced by several rivers, including Acaraú-Mirim, Indaiatuba, Ameixa, Cruzes, and Guaramar. The most common Atlantic Forest vegetation types in the Piaçabuçu Park include restinga, dense submontane and montane ombrophilous forests, mangroves, and dense lowland ombrophilous forests. Urbanization has led to exposed soil areas and low vegetation patches, afecting the Permanent Preservation Areas (APP) of the Boturoca and Piaçabuçu Rivers. The Park was delimitated to protect these environments from urban growth. However, almost three decades after its creation, the absence of a Management Plan of this UC and the anthropogenic impacts on its surroundings, is a problem that must be addressed to local communities.

The absence of an effective management plan in UCs compromises environmental management and the protection of natural ecosystems. In the absence of a comprehensive management plan, anthropogenic activities lack adequate regulation, resulting in impacts that compromise the ecological integrity of the unit and destabilize the socio-environmental equilibrium of the territory. This absence also hinders community involvement in environmental education and decision-making. Developing and implementing a management plan is crucial for protecting the UC and ensuring sustainable local development (Souza-Filho, 2021; Araújo, 2022).

Developing and implementing a management plan is crucial for the efficient management of UCs and offers benefits beyond the physical boundaries of these protected areas. Environmentally, the plan sets clear norms for ecosystem use, protection, and recovery, controlling human activities, reducing negative impacts, and preserving ecosystem services like climate regulation, soil and water conservation, and local fauna and flora maintenance. This helps minimize land use conflicts and promotes sustainable practices in buffer zones (Seifert et al., 2022).

Socially, the plan encourages dialogue between UC managers and the surrounding community, fostering community participation in management decisions, strengthening the sense of belonging, and promoting social inclusion. It can stimulate sustainable economic activities such as ecological tourism, agroecological production, low-impact extraction, and local crafts, generating income and cultural appreciation for nearby populations. The plan also facilitates institutional partnerships, environmental education projects, and extension activities with schools and universities, expanding conservation efforts beyond formal environmental management.

Schools Around Protected Areas as Important Places for Environmental Awareness

Schools near protected areas play a central role in forming critical and participatory environmental awareness. Because they are located directly in territories facing environmental pressures, land use conflicts, or local biodiversity, these schools can act as bridges between knowledge, territorial appreciation, and environmental conservation (Freire et al., 2024). Integrating local socio-environmental reality into the school curriculum through contextualized environmental education can awaken new perceptions and relationships with the environment in students, their families, and communities (Santos, 2024).

Schools can also serve as spaces for community dialogue and articulation, promoting reflections on challenges and opportunities related to the UC's presence, such as biodiversity preservation, usage restrictions, sustainable income alternatives, and ecological tourism. This approach generates multipliers of awareness, with students becoming community protagonists, disseminating values of nature care, collective responsibility, and respect for natural heritage. Investing in environmental education projects in schools around protected areas strengthens environmental conservation, promotes citizenship, territorial identity, and sustainable development, recognizing these spaces as strategic parts of the community (Mendonça et al., 2024).

Thus, the development of Environmental Education Projects in schools near a Conservation Unit (UC) to achieve success, must be contextualized within the framework of environmental legislation, requiring a diagnosis of students regarding the environment around the school. This helps develop in students a sense of belonging to the adjacent space and fosters proactivity, ensuring that conservation of the environment is reached.

The aim of this study is to analyze the environmental perception of high school students from a public school in relation to the Piaçabuçu Park (Praia Grande – SP) and the area surrounding the school unit. Based on these perceptions, we sought to identify the main socio-environmental problems and issues related to the preservation of this Conservation Unit (UC) perceived by students as a way of supporting the development of future Environmental Education projects. The study also aimed to analyze the suppression of vegetation around the school over time, through the use of satellite imagery, which can be added and contrasted to the environmental perception diagnosis for future EA projects.

Materials and Methods

To analyze students' environmental perceptions of the Piaçabuçu Park and the school vicinity, a comprehensive diagnostic methodology was employed

to provide a comprehensive overview of the factors influencing the vegetation surrounding the Conservation Unit (UC).

This approach allowed us to identify the main socio-environmental issues perceived by students, as well as the challenges related to preserving the Piaçabuçu Park, contributing to the planning of future Environmental Education programs. The study conducted through several key steps:

(a) Bibliographic Research: Extensive literature review performed to gather existing knowledge and data related to the socio-environmental issues and conservation efforts in the Piaçabuçu Park and its surroundings.

(b) Student Surveys: Surveys administered to high school students to capture their perceptions and awareness of the environmental issues affecting the Park and the school area.

(c) Area Characterization: Detailed characterization of the area surrounding the school carried out, including mapping and documenting the vegetation and land use changes over time.

(d) Photographic Records: Personal photographic records of environmental damage collected, to visually document the changes and impacts on the local environment.

(e) Narratives from Local Residents: Narratives and testimonies from local residents gathered to provide insights into the historical and ongoing socio-environmental challenges faced by the community.

(f) Satellite Image Analysis: An analysis of satellite images conducted with the students to examine the suppression of vegetation around the school over time, providing a visual and temporal perspective on environmental changes.

Study Area

Piaçabuçu Park

The municipality of Praia Grande is located on the central-south coast of São Paulo, near the geographical coordinates 24.03°S, 46.50°W. To the west, it borders the municipality of Mongaguá, to the north and east with the municipality of São Vicente, and to the south with the Atlantic Ocean. Its territorial area is 145 km², corresponding to 6.1% of the total area of the Metropolitan Region of Baixada Santista (RMBS) (Praia Grande, 1996; Silva, 2022; Praia Grande, 2011) (Figure 1).

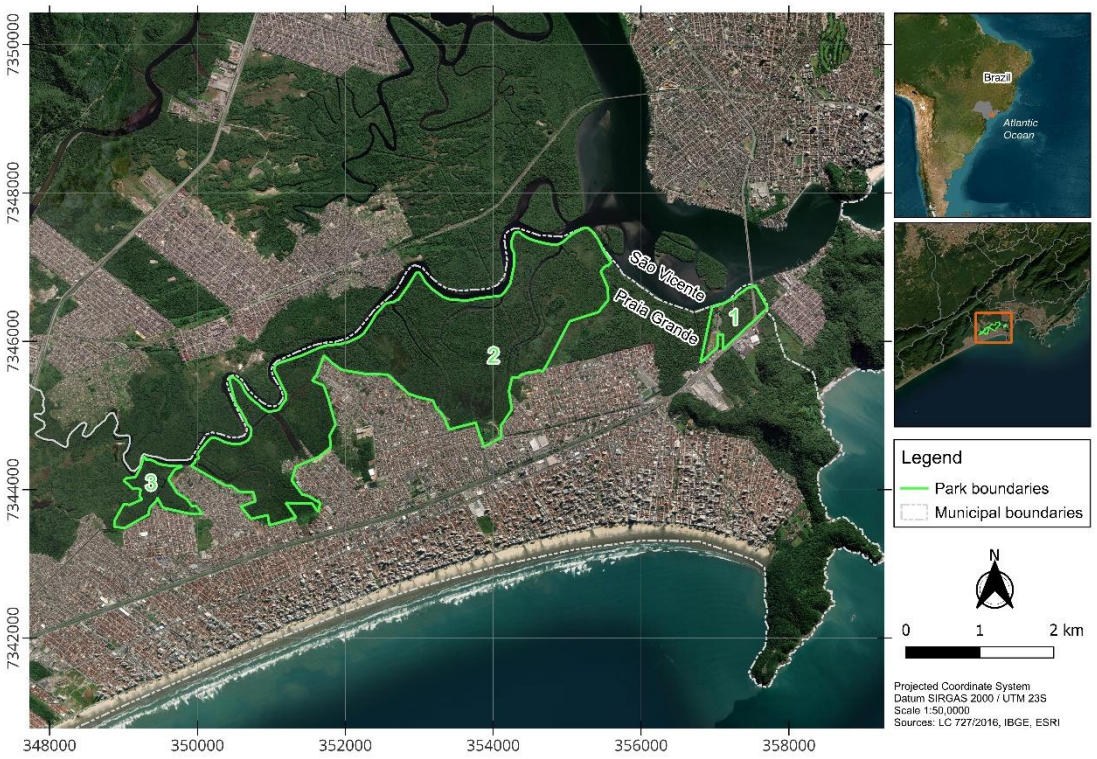

Figura 1: Delimitation of the Piaçabuçu Park/UC (in green color) established by Complementary Law No. 152 of December 26, 1996, and modified by Complementary Law No. 727 of December 16, 2016. Numbers indicate the park units.

Source: Prepared by the author (2025).

Climatic conditions, combined with geological and pedological aspects, influence the growth of three important and distinct vegetation formations in the municipality: the Atlantic Forest, present on the steep slopes of the Serra do Mar; the Restinga Forest on the sandy soil of the Quaternary plain; and the Mangroves on the muddy soil of the Fulvio-marine plain of the Piaçabuçu River. In the municipality, the Atlantic Forest is concentrated and protected in two integral protection conservation units: the Serra do Mar State Park and the Xixová-Japuí State Park (Silva et al, 2022; Praia Grande, 1996).

A brief Characterization of the Vegetation of the Conservation Unit

The vegetation of the municipality UC is composed of typical mangrove vegetation (*Rhizophora mangle*, *Laguncularia racemosa*, and *Avicennia schaueriana*), with the presence of *Hibiscus* sp. and Acrostichum sp. at the interface with more continental vegetation, along the Piaçabuçu River, also influenced by the rivers that cross it, namely: Acaraú-Mirim River, Indaiatuba River, Ameixa River, Cruzes River, and Guaramar River. The Restinga occurs in the sandier region of the coastal plain, characterized by trees up to 15 meters

high, accompanied by various ferns, orchids, and bromeliads. Much of the Atlantic Forest vegetation in the municipality is well preserved, mainly protected by the Serra do Mar State Park – Guariúma Nucleus and the Xixová-Japuí State Park, with most of the preserved area at the foot of the Serra do Mar, with the Atlantic Forest on the slope (Silva, 2022; Praia Grande, 1996; Praia Grande, 2011).

Anthropogenic activities exert negative impacts on the composition and structural dynamics of vegetation. compromising soil conservation, water resource quality, water flow regime, and biodiversity in all Permanent Preservation Areas (PPAs). This interference acts as a barrier to ecological succession, as the invasive potential hinders seed germination and impairs the growth of native species. Restoration and vegetation recomposition strategies vary according to the environmental characteristics of each analyzed APP, for slightly or highly disturbed areas (Brandão et al., 2021).

It is recommended to promote the natural regeneration of native species and enhance vegetation density to strengthen ecosystem resilience and biodiversity. "Environmental enrichment" also stands out as an additional strategy for the conservation and maintenance of these ecosystems. The isolation and treatment of the anthropic area are fundamental for the success of forest restoration. Another important factor is fencing the area, ideal for ensuring effective protection, preventing the access of animals and humans to preservation areas with high anthropic interference. Additionally, the construction of firebreaks is a positive measure in the restoration process, as it contributes to the maintenance of plantations and favors the advancement of natural regeneration in the area (Silva, 2022).

School unit where the research was carried out

Doctor Alfredo Reis Viegas is a Public School in Brazil (State Administrative Dependency). The Brazilian School Identifier Code is 35012063 (INEP). The Local School Code is 12063 (CIE). Located in Praia Grande-SP in a aperfirerical urban area at Olga de Almeida Machado Street carries on the High School Education Level in a Regular Education Modalities. It has a 9 hours Workload during the day. The school has 14 teachers. According to the school data evaluation questionnaire for this School, 10% of students' mothers have higher education; 34% of parents usually talk about what happens at school; 29% of students usually read books that are not part of the subjects. It has a good building infrastructure and food provided for the students.

Environmental perception of the students

The research conducted between December 2024, and March 2025, after approval by the Ethics Committee on the “Plataforma Brasil” under number CAAE 84194424.6.0000.5513. The perception survey with the students was presented to 311 students regularly enrolled in the 2024 school year, in the 1st,

2nd, and 3rd years of high school. Students of both sexes and aged between 16 and 18 years old.

The approach made using the email and/or phone number registered in the DSS (Digital School Secretariat). The students received the access link to the FICT (Free and Informed Consent Term), for reading and parental consent regarding the participation of their child in the research. After parental or legal guardian consent in the TCLE, the research participant instructed to access and read, the FIAT online (Free and Informed Assent Term). Being aware and in agreement with the FICT, a questionnaire was applied in an online electronic form, containing 14 (fourteen) multiple-choice items, with an estimated response time of 10 minutes. The questionnaire exclusively developed by the researchers for this study, due to the specific environmental situation in which the school is located in an urbanized core, paradoxically in an area adjacent to the UC buffer zone.

The methodological approach to data analysis according to Sampaio (2022) involved tabulating the responses of the questionnaire, organizing them into graphs and tables, and conducting descriptive analyses to interpret the results obtained.

Results and Discussion

Environmental Perception: Results of the Survey with Students

Of the 311 students invited to participate in the survey, 95.7% agreed to answer the questionnaire. The majority of students participating in the research were in the 3rd year of high school (66.30%) (Figure 3).

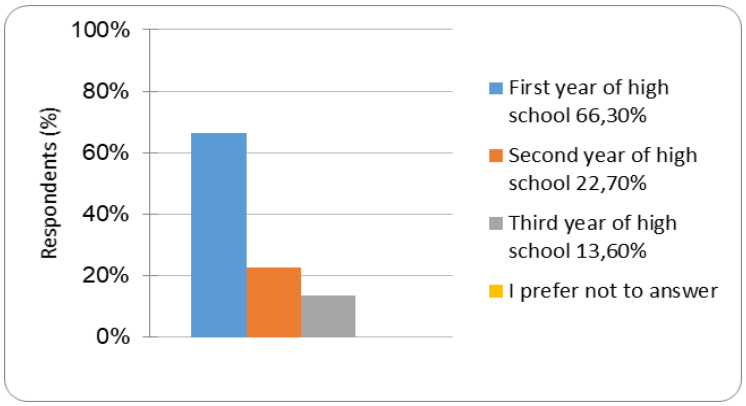

Figure 3. Distribution of respondents by grade level at the school unit surrounding Piaçabuçu Park, Praia Grande, SP.
Source: Prepared by the author.

Environmental responsibility in school goes beyond the inclusion of ecological themes in the curriculum. The school, as a social institution, constitutes a space where human relationships are forged and individuals

shaped as historical agents, with an emphasis on ethical principles in everyday school life. It is fundamental to teach humans to be human and to overcome the inequalities that reproduced there. This construction goes beyond age; it expressed in the daily experience of values, attitudes, and sustainable practices inside and outside the school environment. With programs and strengthening ideas, the student becomes a practical example of commitment to the planet. The school prepares students to be transformative agents in their communities (Gomes, 2024).

A recent study (Aguiar, 2023) demonstrates that the process of identity construction, whether among collective or individual actors, is not unique and can vary according to generational, gender, ethnic, territorial, etc., cleavages.

The age of the students surveyed shown in figure 4. Of the total number of students surveyed, 75% were 16 years old (Figure 4).

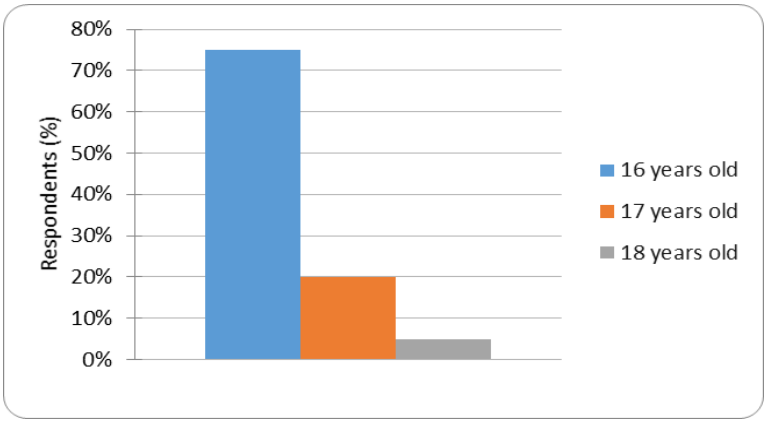

Figure 4. Distribution of respondents by age at the school unit surrounding Piaçabuçu Park, Praia Grande, SP.
Source: Prepared by the author

The logic of immersing mature students, like high school students, in the context of environmental education occurs progressively and continuously as they develop and gain the ability to understand certain interactions between society and nature. When they get involved, the awakening of values, attitudes, and responsible behaviors towards socio-environmental issues enhanced. This helps them recognize their responsibility as active subjects in the environment they live in and propose solutions to environmental challenges, strengthening their formation as conscious, ethical, and participative citizens capable of making informed and sustainable decisions both in their daily lives and in their collective actions (Lutif, 2023).

When asked if students knew the Piaçabuçu Park in the neighborhood, the majority of responding students (90.9%) indicated that they did not know it (Figure 5).

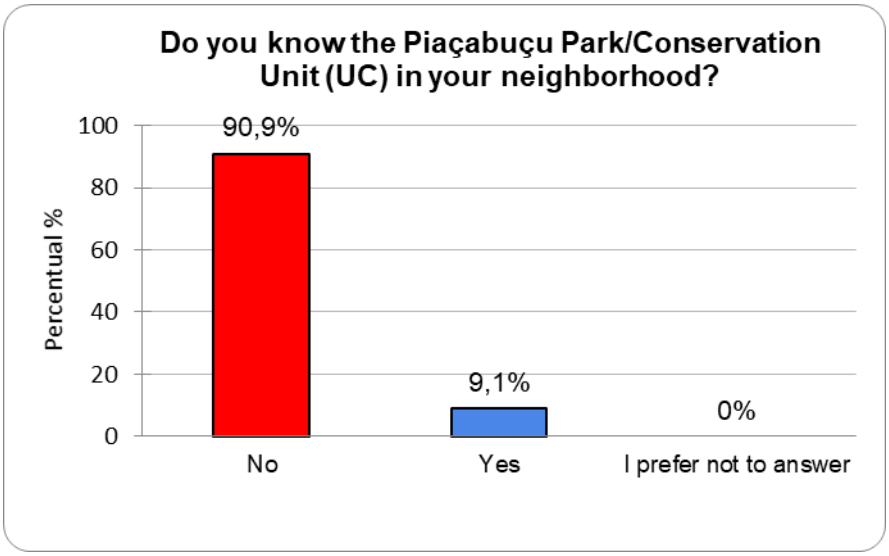

Figure 5. Distribution of respondents about knowledge of Piaçabuçu Park at the school unit surrounding Piaçabuçu Park, Praia Grande, SP.
Source: Prepared by the author

This characterization of the problem of not knowing and not belonging to the protection of conservation units near the school offers opportunities for the development of interventions and the improvement of teaching and learning processes. Its implementation can occur in various ways in the school environment, encouraging reflection on environmental problems, their causes, and strategies for mitigation, solution, or prevention in conservation and protection. These themes should be integrated into the curriculum and daily practices of schools (De Souza, 2020).

Figure 6 shows the responses of students about their knowledge of the Piaçabuçu Park. On a scale of 1 to 5, what is your degree of knowledge about the park? (From: 1 know very little, to 5 know everything about the Park). We found that 81.30% of students indicated that they knew very little about the Piaçabuçu Park (Figure 6), which is consistent with the fact that most respondents are unaware of the Park´s existence in the neighborhood (Figure 5).

These results highlight the significant knowledge gap about the Park surrounding the school and the lack of Environmental Education programs at the school that could help in its preservation.

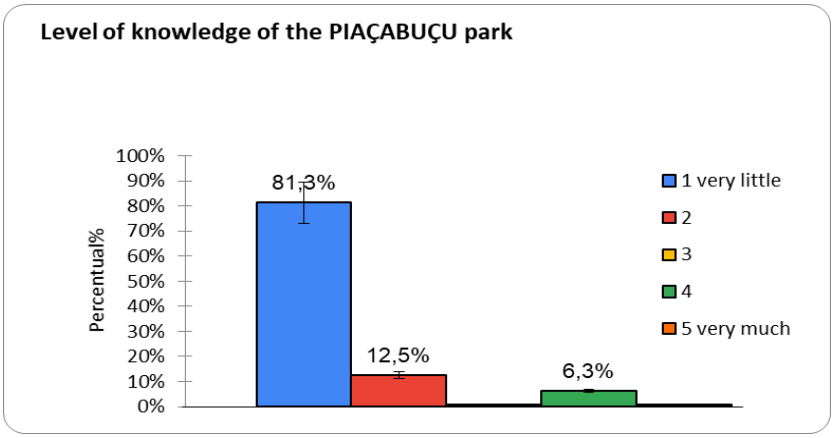

Figure 6. Percentage of respondents about the degree of knowledge of Piaçabuçu Park at the school unit surrounding Piaçabuçu Park, Praia Grande, SP.

Source: Prepared by the author.

In this context, the importance and involvement of all school subjects in the process of knowing their surroundings is essential for teaching to understand as a collective process of social construction involving people and places in constant construction. Critical reflection, ethical commitment, and student engagement in the face of current socio-environmental challenges served as guidance for future actions to transform their individual and collective environment (Colagrande, 2021).

The student perception about the existence of environmental studies in the Park area shown in figure 7. The results showed that less than one-third of the students have knowledge about the school's Environmental Education projects related to the park (Figure 7).

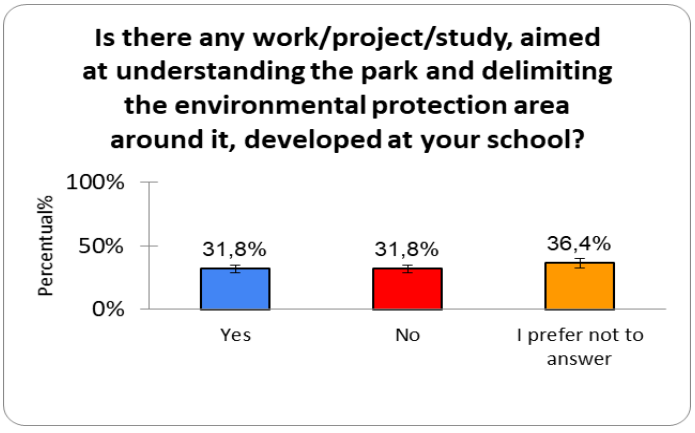

Figure 7. Technical tie on whether there is any work/project/study aimed at knowledge of the park and the delimitation of the environmental protection area around Piaçabuçu Park, developed at EE Alfredo Reis Viegas - Praia Grande - SP. Research conducted from 12/13/2024 to 03/10/2025.

Source: Prepared by the author

However, 95.5% of students reported considering school projects and assignments related to the Park as important. Among them, 66.7% classified these actions as important or very important for the school context.

It is noted how the implementation of environmental education projects in schools is of great relevance for the development of a culture of sustainability among students and the school community. These projects enable meaningful learning that goes beyond theory by involving students in concrete practices related to environmental care. Through them, it is possible to address interdisciplinary topics such as conscious consumption, biodiversity preservation, waste management, rational use of water, and climate change. In addition to promoting knowledge, the projects stimulate critical reflection, social responsibility, and youth protagonism, contributing to the formation of more conscious and active citizens (Faccin e Aquino, 2023).

Recognizing environmental problems around the school is the first step to promoting conscious and effective actions for sustainability. This identification of impacts such as deforestation, pollution, water scarcity, soil degradation, and climate change allows understanding the causes, consequences, and dimensions of these issues at local and global levels (Vieira et al., 2021).

When asked whether the surroundings of the Piaçabuçu River in the Park are polluted, 66.3% of the students were unable to answer this question. Of the 18.2% of students who considered the river polluted, most of them (58.8%) perceived it as slightly polluted, but reported pollution caused by urban solid waste (50%) and sewage (13.6%).

However, 81.8% of the students considered that there are environmental problems in the surroundings of the Park and the school. Of this total, 14.3% of the students ranked these problems as of little importance, while 57.1% classified them as important or very important.

Regarding the perception of these problems in the neighborhood, the students identified improper solid waste disposal (95.5%) and air pollution (77.3%) as the main problems (Figure 8). Also notable were the perceived problems of fire, deforestation, and pollution of water (Figure 8).

Active participation of students in recognizing problems is essential, allowing them to express their views and values. Similarly, in defining the measures being adopted, both students and their families should have the opportunity to express their priorities, which should be considered in the decision-making process, being agents of transformation (Zanini e Rocha, 2020; Aguiar, 2023).

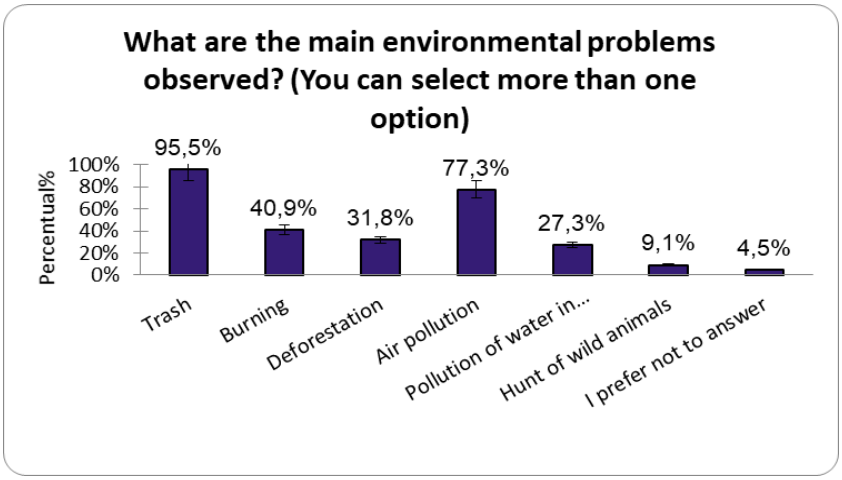

Figure 8. Response to the main environmental problem perceived in the section of the Piaçabuçu river/park in the neighborhood. E.E. Alfredo Reis Viegas - Praia Grande - SP. Research conducted from 12/13/2024 to 03/10/2025.
Source: Prepared by the author

In the section of the Piaçabuçu River, located in the vicinity of the neighborhood, the main environmental problem identified by the students is the discharge of solid waste and domestic effluents. This same problematic was found by Soares (2021), in the Zutiwa River in the municipality of Arame (MA, Brazil). The authors highlighted that various anthropic actions on the Zutiwa River, such as irregular occupation of the banks by the population within the urban area, discharge of solid waste, domestic effluents, and deforestation of riparian forests, cause silting of the watercourse. The study pointed out that the impacts on the Zutiwa River result in consequences on the lives of residents in the urban perimeter, possibly the case of the residents of the neighborhood surrounding the Piaçabuçu River.

The absence of adequate waste collection and lack of basic sanitation infrastructure favor the degradation of water quality, compromise aquatic biodiversity, and put the health of the local population at risk. Additionally, the irregular disposal of waste on the banks contributes to the silting of the river and the loss of riparian vegetation, further aggravating environmental impacts and hindering the conservation of the ecosystem present in the protected area (Luz, 2005).

When asked about responsibility for preserving Piaçabuçu Park (Conservation Unit), most students (59.1%) indicated that this responsibility should be shared by society as a whole. Additionally, 22.7% attributed it to the municipal government, while 9.1% identified the school and another 9.1% pointed to neighborhood residents as key actors in park conservation.

However, 59.1% of students were unable to state whether their individual actions contribute to the preservation of Piaçabuçu Park. Approximately 30% reported that they do contribute, primarily by avoiding improper waste disposal.

Regarding actions considered important for implementation by the municipal government to raise public awareness and ensure the preservation of Piaçabuçu Park and its surroundings, students highlighted the following: park promotion, environmental monitoring, reforestation, installation of solid waste disposal points, area cleaning, and, most notably, the development of Environmental Education initiatives within schools and local communities.

The use of satellite images on environmental education perception of vegetational changes in landscape

Aiming to contribute to the Environmental education programs on vegetation preservation, figure 9 below present the clipimage of the municipality of Praia Grande using images from the MapBiomas collection, approximated in the area where the interface between the Urban Zone where the school is located and the Conservation Unit. An increase in the yellow area (urban expansion) is observed in 2023 even after the creation of the Piaçabuçu Park in 1996. The application of semi-automatic classification filter techniques in remote sensing mapping distinguishes urbanized areas in yellow and areas occupied by vegetation in green. The polygon in red highlights the area where the school is located.

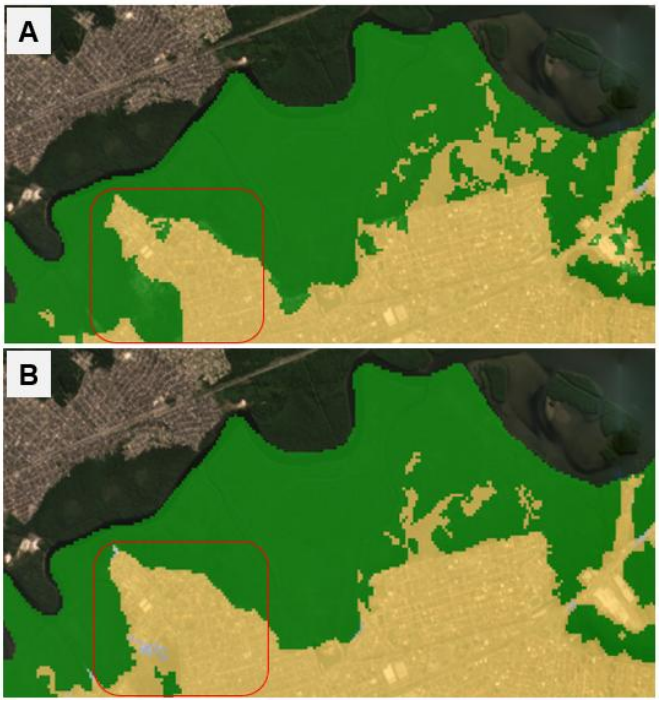

Figure 9. Urbanized area (yellow) and the Piaçabuçu Park area (green) in 1996 (A) and 2023 (B). Highlighted in red, the area of the neighborhood where the State School is located, whose students were the subject of the study..

Source: MapBiomas Project – Collection V.9.0. Version of the Annual Series of Land Cover and Use Maps of Brazil, accessed on March 29, 2025 modified by the author

In figure 10, the spatial coverage graph corresponding to figures 9 A and B shows a detection of the percentage increase in urban area coverage in yellow from 30.58% in 1996 to 32.79% in 2023.

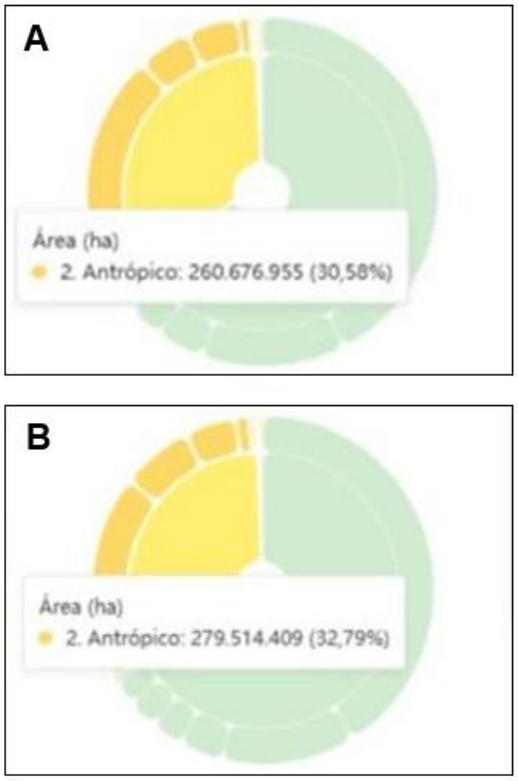

Figure 10. Natural (green) and anthropic (yellow) action in the Piaçabuçu Park in 1996 (A) and 2023 (B).
Source: MapBiomas Project – Collection V.9.0. Version of the Annual Series of Land Cover and Use Maps of Brazil, accessed on 03/29/2025.

In all protected PPA areas, there are impacts of various natures, such as solid waste generation, liquid effluent generation, vegetation suppression, topography alteration, among others. Several studies have focused on analyzing the anthropization process around Conservation Units (UC), particularly through the detection of subdivisions and constructions. These studies often employ rapid and automated methods capable of identifying anthropogenic features, which are essential for monitoring and controlling irregular occupations within the Zone of Amortization (ZA). Such methodologies serve as strategic tools to support territorial management (Santos e Ventorini, 2017). We can draw a parallel with the Piaçabuçu Park specifically, where the areas surrounding the school tend to be better preserved, when the school's context includes knowledge about UC and the need to preserve them as providers of ecosystem services.

The establishment of norms for the use, occupation, and monitoring of already anthropized areas is essential to avoid disorderly expansion and inadequate occupation within the limits of UC. This regulation is as important as the management of these units itself. It is worth noting that, although the Buffer Zone (ZA) is not part of the conservation unit, the legislation determines that it is subject to specific zoning, which may restrict or allow certain economic activities and land subdivision (Brasil, 2000).

Thus, from a legal standpoint, ZAs have well-established definitions, functions, and management guidelines. Studies that analyze the process of anthropization around UCs, including the detection of subdivisions and constructions, are fundamental for the inspection and control of irregular occupations. The use of quick and automated methods to identify anthropic features strengthens this process, offering strategic tools for territorial management. The performance of ZAs in UC must be constantly evaluated to ensure their effectiveness in fulfilling the role of environmental protection (Dos Santos Junior, 2024).

Environmental risk assessment in the Piaçabuçu Conservation Unit is an essential process for maintaining the ecological integrity and environmental functions of this region, which stands out for its biodiversity and relevance for the conservation of natural resources. This unit houses fragile ecosystems that, due to their location and characteristics, are susceptible to various threats, both natural and caused by human activity. In this context, the identification and analysis of environmental risks become fundamental to implementing effective protection and sustainable management measures, ensuring the preservation of local biodiversity and mitigating negative impacts on the environment (Nascimento, 2021).

The need for a systematic approach to risk assessment intensifies in the face of external pressures, such as disorderly urbanization and climate change, which directly affect local habitats and fauna and flora. Therefore, this study aims to provide an overview of students' environmental perceptions of Piaçabuçu Park and the school's surrounding area, identifying environmental issues. Studies and proactive actions involving the community, government agencies, and non-governmental organizations in implementing effective management, preservation, and environmental education strategies. Through a rigorous methodology, it will be possible to outline a detailed profile of the risks and their implications, promoting a dialogue between science, politics, and society (Miranda e Ayach, 2023), which is essential for building a sustainable future for the Piaçabuçu Conservation Unit

When assessing environmental risks in conservation units, the aim is especially to ensure the preservation of ecosystems and the sustainability of these protected areas. This process often involves identifying, analyzing, and mitigating threats that may compromise biodiversity and ecosystem services. The main risks in conservation units include deforestation, fires, and landfilling caused by invasions, illegal exploitation, and climate change, water and soil

pollution, such as untreated sewage runoff, direct impacts on soil and watercourses (Brandão, 2021, Campos et al., 2023).

A viable solution would be simulations to predict future impacts of human activities and climate change. Interviews and consultations with local communities to identify risks and mutual conflicts of interest with the aim of achieving risk mitigation and management strategies, environmental education, and community involvement, encouraging community participation in the protection of the unit. Recovery of degraded areas to minimize environmental impacts, strengthening partnerships between environmental agencies, NGOs, and the private sector for biodiversity protection. Development of effective management plans to support and guide the conservation and sustainable use of resources. The implementation of this tool consists of continuous and adaptive evaluation, which is fundamental to ensure the resilience of conservation units in the face of environmental challenges (Campos et al., 2023).

Some studies show the strengthening of environmental education in the school environment, opening multiple paths for significant educational practices. In a recent study (Sanchez, 2024), the insertion of environmental education in state schools in Paraná, located in the Toledo Regional Nucleus, was analyzed. The theme observed by the authors focused on the advances and consolidation of school environmental education, highlighting the need for improvement and the importance of consolidating strategic priorities in current public policies aimed at schools. In this process, teachers play a fundamental role as mediators, facing a challenge of great complexity. This is because environmental education is not limited to a unidirectional approach exclusively aimed at students but is configured as a multidirectional process involving all school subjects and the community as a whole (Colagrande et al., 2021).

Therefore, it is understood that the teaching of environmental education (EA) should be seen as a process of social construction, in which educational actions aim to form conscious citizens capable of understanding the complexity of the relationships between society and the environment. This perspective requires the development of innovative pedagogical practices. Many weaknesses are observed in this context, but actions that articulate theory and practice and promote critical reflection, ethics, and engagement in the face of contemporary socio-environmental challenges should be fostered (Silveira e Lorenzetti, 2021).

Conclusion

The results of this study highlight the importance of integrating Environmental Education into school curricula, particularly in regions with environmental preservation areas near schools. This integration should begin with basic concepts of conservation and preservation, progressing to broader theme such as the social and environmental responsibility of relevant

authorities. Through this process, students can understand the relevance of everyday actions, such as the correct disposal of solid waste, and other actions as part of future Environmental Education Programs.

Developing skills and competencies of the students in areas such as preservation by local community, environmental education, and the balance between environmental protection and sustainable use in buffer zones is essential. Proposals for Environmental Education projects aimed at controlling and mitigating environmental impacts, especially those incorporating remote sensing and geoprocessing technologies, are expected to support the conservation of natural resources and promote harmony between human activities and environmental preservation.

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