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Research Article

Environmental education and digital tools: A case study of pollution of local ecosystems by students as future ecologically responsible citizens

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ABSTRACT

Within this teaching scenario, students will have the opportunity to critically examine the contribution of tourism to the pollution of local ecosystems. The target group is upper high school students (grades 10-12), and the study is based on the care-know-do method to promote ecological mindfulness, critical thinking, and active citizenship. Students participate in experiential learning activities that combine field-based observation, geospatial data analysis, and community interaction, including parent questionnaires. The educational intervention aligns with sustainable development goals 12, 14, and 15, focusing on interdisciplinary learning, environmental responsibility, and the development of problem-solving skills. Digital platforms can be leveraged to foster collaboration and data-informed inquiry, thereby motivating students to become active agents of change within their local contexts. The findings highlight the potential of combining environmental literacy and digital competence in school-based sustainability initiatives.

Keywords: environmental education, digital tools, sustainable development goals, care-know-do method, tourism, pollution

INTRODUCTION

The study of the environment is a fundamental need in the modern world, as human activity has brought about significant changes in natural ecosystems. It is essential to understand how living organisms interact with their environment in order to address environmental challenges and ensure a sustainable future. In this context, environmental education (EE) plays a crucial role. EE is defined as the systematic effort to impart knowledge regarding the functioning of natural ecosystems and, particularly, the impact of human behavior upon them, to promote sustainable management. Although the term is often used in the context of interventions in the educational sector, ranging from primary school to tertiary education, its extension to general understanding and sensitization is still valid (Yarkandi & Yarkandi, 2012). The integration of EE into school curricula has been a recognized effort since the 1970s, aimed at fostering responsible citizenship and ecological awareness. This initiative is crucial for developing students' understanding of sustainability and their role in promoting ecological balance (de Albuquerque et al., 2024).

The EE in schools globally plays a crucial role in fostering awareness and action towards environmental issues among students. It encompasses various initiatives, such as environmental clubs and curriculum integration, aimed at developing ecological citizenship and character building. Schools are seen as vital spaces for disseminating knowledge and promoting proactive attitudes towards environmental protection (Carmo, 2023; Costa & Aguiar, 2020). EE helps in building creativity, critical, reflective thinking skills among students, which are requisite for building an ecologically just society. It guides students to know about their duty toward the environment and inspires them to engage in significant efforts for environmental protection. Moreover, EE must be incorporated into everyday school practices. This approach allows students to engage with local environmental issues and develop a sense of agency in addressing these challenges. Also, students' active participation promotes ecological citizenship values (**Table 1**) (Alam, 2017; Nada et al., 2021).

In the modern educational context, digital tools are slowly becoming catalytic agents of EE upgrades. Their integration into the pedagogy reality is not just a technological add-on, but a paradigm-shifting redefinition of learning processes aimed at cultivating environmental consciousness and fostering sustainable practice.

Digital tools, such as virtual simulations, interactive games and geographic information systems, can make it possible for

Table 1. The benefits of EE for students encompass enhanced environmental literacy

Benefit	Description	Examples
Enhanced environmental awareness	Understanding the relationship between humans and nature, and the impacts of human activities.	Studying the effects of climate change, observing ecosystems, respecting biodiversity.
Development of critical and creative thinking	Analyzing complex environmental issues and proposing solutions.	Evaluating scientific studies, designing sustainable solutions for resource management.
Promotion of active civic participation	Participating in sustainability initiatives and critiquing policy decisions.	Participating in beach cleanups, awareness campaigns, submitting proposals to agencies.
Practical skills for a sustainable lifestyle	Gaining knowledge and applying practices for resource conservation and environmental protection.	Recycling, using renewable energy sources, composting, reducing plastics.
Health and mental well-being	Contact with nature and enhancement of emotional balance.	Bird watching, tree planting, hiking, gardening.
Inspiring careers and professional orientation	Discovering new fields and acquiring in-demand skills.	Environmental engineering, ecological policy, renewable energy technology, data analysis.
Interdisciplinary learning	Combining knowledge from different scientific fields to understand environmental issues.	Studying the socioeconomic impacts of climate change, designing art installations with recycled materials.
Global perspective and solidarity	Understanding the global dimension of environmental problems and enhancing compassion.	Studying deforestation, learning about the effects of sea-level rise.
Sense of responsibility and empowerment	Enhancing self-esteem and maturity through the feeling that actions have an impact.	Participating in actions as "agents of change" in the community.
Adaptation to the technological revolution	Using digital tools to address environmental problems and becoming familiar with modern concepts.	Using GIS, pollution monitoring apps, studying the circular economy and artificial intelligence in sustainability.

learners to experience in-depth environmental phenomena experientially and interactively due to the following reasons:

1. The ability to visualize information and interact with virtual environments enhance understanding of environmental challenges and the development of critical thinking.
2. The direct access to information on climate change, pollution and loss of biodiversity through online sources and applications assists in informing and sensitizing students.
3. Using multimedia resources such as videos and photos makes EE livelier and instils an emotional connection to responsibility towards the environment.
4. The computer tools encourage cooperation among pupils by enabling teamwork and communication.
5. Utilization of online tools in order to put into practice environmental projects and to share good practices reinforces participation and collective action.
6. The digital tools enhance students' problem-solving and critical thinking capabilities by data analysis, information evaluation, and solution development to environmental problems.
7. Participating in online forums and exchanging views with experts broadens minds and inspires the search for innovative solutions.
8. The use of software to monitor water and energy usage, participation in web-based campaigns that support recycling and adoption of environmentally conscious practices in daily life, made possible through information technology and encourage the adoption of green behavior.
9. Employing simulators to measure the carbon footprint and understand it can inspire students to change their behaviors and get greener.
10. Using electronic resources to organize environmental activities in the community, participating in electronic networks of environmental organizations, and disseminating information on sustainable practices

Table 2. Overview of digital tools that can be used in EE, helping students enhance their learning and action for sustainability

Category		Tools	Used
Online platforms	Google Earth	Google Earth, Google Maps	Exploring environmental changes and visualizing data
	iNaturalist	iNaturalist	Recording and classifying plants and animals
	Eco-Challenge	EcoChallenge	Monitoring and promoting sustainable practices
Educational programs	Khan Academy	Khan Academy	Courses and seminars on ecology and sustainability
	coursera	Coursera	On line courses from universities
	NATIONAL GEOGRAPHIC KIDS	National Geographic Education	Educational resources and activities
Data analysis		Excel, Google Sheets	Analyzing and visualizing environmental data
	tableau	Tableau	Creating interactive charts and maps
Collaboration & communication	Google Classroom	Google Classroom	Group collaboration and idea sharing

Table 2 (Continued). Overview of digital tools that can be used in EE, helping students enhance their learning and action for sustainability

Category		Tools	Used
Collaboration & communication	Microsoft Teams	Microsoft Teams	Group collaboration and idea sharing
	padlet	Padlet	Creating online boards and collecting information
Mobile apps	olio	Olio	Reducing waste through food and item sharing
	JouleBug	JouleBug	Tracking sustainable practices and motivating users
Virtual & augmented reality	Google Expeditions	Google Expeditions	Virtual field trips to natural environments
	WWF	WWF Free Rivers	Exploring the impact of human activities on rivers
Project management	asana	Asana	Organizing and managing environmental projects
Content creation	Canva	Canva	Designing posters and presentations
	Prezi	Prezi	Dynamic presentations

enhances the sense of community involvement and active action for environmental protection (**Table 2**).

In order to better understand and address pollution in local ecosystems affected by tourism, this research aims to develop, implement, and assess a pedagogically grounded educational scenario that combines EE with digital tools. The study intends to support high school students' (10^{th}-12^{th} grade) ecological awareness, critical thinking, and active citizenship through the care-know-do methodology. This is in line with sustainable development goals (SDGs), which also encourage students to engage in community-based sustainable actions while enhancing their problem-solving abilities.

METHODS AND MATERIALS

Research Hypotheses

EE is a valuable tool for raising environmental awareness and promoting sustainable behavior. Incorporating it into school curricula can enhance students' critical thinking, creativity, and active participation in environmental protection. Furthermore, leveraging digital tools can deepen the students' understanding of environmental issues while encouraging collaboration and innovative solutions.

Study Area Selection Criteria: The Importance of Preliminary Investigation by Teachers or Those Responsible for Environmental Programs

A fundamental criterion for the student's selection of the study area is the initial investigation by the teachers or those responsible for the environmental program. This investigation aims to determine whether the specific area is among the most important tourist destinations in the region. This information will determine the suitability of the area for the student's preparation of the study.

Characteristics such as natural beauty and ease of access are important factors that contribute to attracting a large number of visitors, especially during the holiday season. However, in many cases, the natural environment, and especially coastal areas, may become an unjustified receiver of pollutants (solid, liquid, gaseous or energy forms) originating from tourist activities, with the possibility of potentially degrading the natural environment of the area in the future (Fandé et al., 2014; Khrisnamurti et al., 2017; Lazaris et al., 2020).

Design of an Educational Scenario Focused on Scientific Action and the Sustainable Development Goals

Through the proposed educational scenario, students should initially understand the two-way relationship between the natural environment and the tourism sector as a socio-economic phenomenon. In particular, students can explore the special characteristics of their region through the online collection of data on the natural environment (coasts, forests, lakes, agricultural lands) and their built environment (recording of houses and tourist accommodations in different municipal units of the island). Additionally, the students' experiential and research involvement will include indexing special bibliographic references and information guides related to the natural environment from the internet (Google Scholar, iNaturalist, websites of environmental organizations and research institutions and universities). In this way, students will develop environmental literacy, applying their knowledge in both their personal and social lives, guided by the values of sustainability, solidarity, and social cohesion.

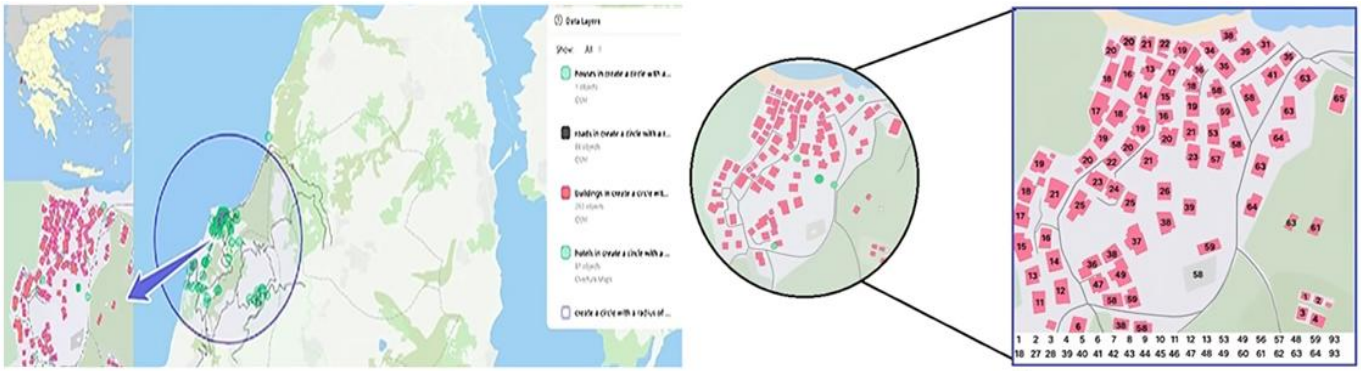
The inclusion of the SDGs in EE scenarios for secondary school students is an interdisciplinary and innovative training in the subjects of science, geography, ecology and social and political education (Aznar et al., 2018; Hoque et al., 2022). The selection of SDGs 12, 14 and 15 for this environmental project is deliberate and pedagogically strategic. Each of these goals was strategically chosen for specific pedagogical and substantive reasons, contributing to a holistic and effective learning experience (**Table 3**). Through the exploration of these specific goals, students are encouraged to develop ecological awareness, develop critical thinking and take an active role as citizens, helping to promote a more sustainable future for the planet.

Data Collection

Inquiry-based learning is the backbone of the proposed program, a methodology that fosters student critical thinking and enhances their understanding. To achieve these goals, collecting data can be done using several alternative

Table 3. Analysis of strategic selection of SDGs 12, 14, and 15 for implementing a holistic environmental program for students

Topic/goal	Key ideas/arguments	Reasons for selection in the program	Connection to other goals/concepts	Questions for further thought
SDG 12: Responsible consumption and production	- Fundamental for addressing environmental challenges - Directly links daily consumer choices to environmental impacts - Encourages critical thinking about product life cycles, waste reduction, sustainable practices - Connects individual action to collective environmental footprint	- Direct relevance to students' everyday lives - Potential to highlight individual responsibility - Practical applications and behavioral changes	- Connection to economics, production, circular economy - Related to waste management (though not directly mentioned as an SDG)	- How can students identify and reduce their own environmental footprint? - What are the responsibilities of businesses for responsible production?
SDG 14: Life below water	- Of utmost importance, especially for your area - Critical value of marine and aquatic ecosystems - Understanding the complexity and significance of oceans, seas, and lakes - Highlighting threats (pollution, overfishing, climate change) - Strengthening ecological awareness for protection - Interdependence of life in water and life on land	- Geographical significance for area - Raising awareness about vulnerable ecosystems - Understanding global and local impacts	- Connection to fishing, tourism, climate change, biodiversity	- What are the main sources of pollution in aquatic ecosystems in your area? - How does overfishing affect marine ecosystems?
SDG 15: Life on land	- Complements environmental protection efforts - Focuses on terrestrial ecosystems, biodiversity, combating desertification - Examination of human activity impacts (deforestation, land degradation, species loss) - Importance of sustainable land management and restoration	- Comprehensive perspective on environmental protection (land and water) - Highlighting the importance of biodiversity - Understanding the impacts of human intervention	- Connection to agriculture, forestry, urban development, climate change	- What are the main causes of deforestation in your area? - How does the loss of biodiversity affect ecosystems?
Overall program purpose	- Providing a cross-curricular and comprehensive understanding of environmental challenges - Linking consumption/production with the protection of aquatic/terrestrial ecosystems - Encouraging the development of ecological awareness and critical thinking - Promoting students' active role as citizens for a sustainable future	- Creating connections between different scientific and social fields - Empowering students to become agents of change - Preparing for active participation in sustainability issues	- Connection to all SDGs (indirectly), sustainable development, environmental education	- How can students translate the knowledge they gain into concrete actions in their community? - What is the role of the school in promoting sustainable development?



a b

Figure 1. (a) Example of spatial data analysis of the island of Lefkada (Agios Nikitas area) using the Aino platform (https://beta.aino.world/auth), focusing on the recording and visualization of buildings, hotels and road network within a defined radius & (b) Cartographic depiction from counting accommodations with the help of artificial intelligence (https://chatgpt.com)

approaches to allow thorough investigation of the subject matter and heighten the validity of the results.

- *Recording and analyzing the density of tourist accommodation using geospatial tools and artificial intelligence*. The density of tourist accommodations across various areas can be recorded using geospatial platforms such as Google Earth or Beta Aino–an AI-powered tool for spatial data analysis (part a in **Figure 1**). Students can efficiently identify and count accommodations with the help of artificial intelligence (part b in **Figure 1**).
- *Geospatial analysis of local habitats*. For the analysis of local habitats, students can utilize tools such as land use classification, habitat suitability analysis, and spatial modeling of ecological processes. Additionally, connectivity analysis of environmental networks and detection of changes over time provide important

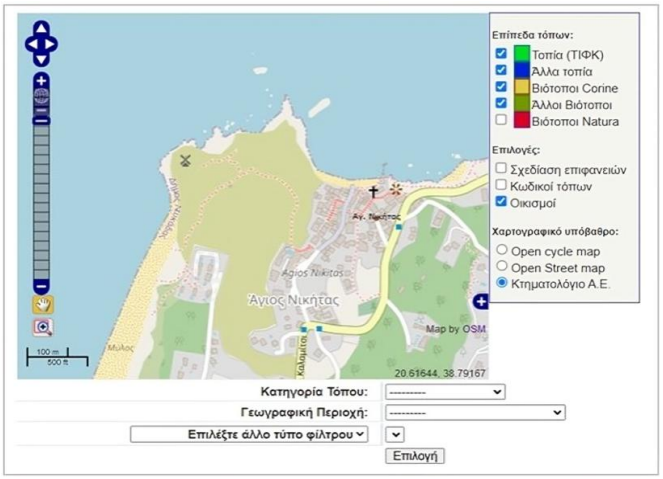


Figure 2. Cartographic depiction of Agios Nikitas, on the Island of Lefkada, from the Φ Ι Λ Ο Τ Η Σ database (https://filotis.itia.ntua.gr/), which contains significant elements of natural ecosystems and landscapes (this is part of a research and educational initiative by the National Technical University of Athens, aiming to collect, organize, and make available documented information on the natural environment of Greece)

information for understanding and protecting habitats (ArcGIS Pro [Esri], Google Earth Engine, GeoDa, etc.) (**Figure 2**).

- *Questionnaires for students' parents*. The purpose of the questionnaire is to gather information on the perceptions and habits of parents (and citizens in general) regarding environmental pollution in their area. The questions should be understandable, short, and cover different aspects of the issue. It is proposed that the questionnaire be divided into four main sections: recording basic demographic information about participating in parents, perceptions of pollution in the local community, the relationship between tourism and environmental impacts, attitudes and suggestions from parents as active citizens regarding pollution in the area (**Table 4**).

APPLYING THE CARE-KNOW-DO METHOD

Care-know-do EE is a hands-on approach to learning that enables students to develop important life skills necessary for creating a more sustainable future. Instead of merely

Table 4. Example of questionnaire structure for parents, aiming to record perceptions and attitudes regarding pollution and the environmental impacts of tourism in the local community

Question category	Question	Answer options
Demographic information about participating parents	• Gender:	☐ Male ☐ Female
	• Age:	__ years old
	• Occupation:	_____
	• Do you permanently reside in this city?	☐ Yes ☐ No
	• How long have you been a resident of this area?	☐ Less than 5 years ☐ 5-10 years ☐ More than 10 years
Perceptions of pollution in the local community	• How serious do you consider the problem of pollution in our city?	☐ Not serious at all ☐ Slightly ☐ Moderately ☐ Very ☐ Extremely
	• Which forms of pollution do you observe most often?	☐ Air pollution ☐ Noise pollution ☐ Sea/coastal pollution ☐ Litter in the streets
	• Do you believe the situation has worsened in recent years?	☐ Yes ☐ No
	• What do you consider to be the main causes of pollution in our city?	(Open-ended answer or multiple choice)
	• Which form of pollution do you consider most prominent in our city? (You can select more than one)	☐ Air pollution ☐ Noise pollution ☐ Water pollution ☐ Soil pollution (litter, landfills) ☐ Other: _____
	• What do you believe are the primary causes of pollution in the city?	☐ Traffic congestion/vehicles ☐ Industrial or commercial activities ☐ Lack of public awareness ☐ Lack of infrastructure (bins, sewage, green spaces) ☐ Other: _____
	• How much does the issue of pollution concern you in your daily life?	☐ Not at all ☐ A little ☐ Moderately ☐ A lot
	• Do you believe there are enough green spaces in your city?	☐ Yes ☐ No ☐ Not sure
Relationships between tourism and environmental impacts	• Do you believe that tourism contributes to the pollution of our city?	☐ Yes ☐ No
	• Which tourism sectors do you think affect the environment the most?	☐ Hotels ☐ Transportation ☐ Food services ☐ Entertainment ☐ Coasts/beaches
	• Do you observe an increase in litter/pollution during the tourist season?	☐ Yes ☐ No
	• Do you believe there are sufficient measures by the municipality/organizations to address the environmental impact of tourism?	☐ Yes ☐ No ☐ Don't know
	• Have you observed damage to the natural environment (e.g., litter on beaches, destruction of vegetation) due to tourist activity?	☐ Yes ☐ No
	• Do you believe visitors respect the environment of our area?	☐ Yes ☐ No ☐ Sometimes

Table 4 (Continued). Example of questionnaire structure for parents, aiming to record perceptions and attitudes regarding pollution and the environmental impacts of tourism in the local community

Question category	Question	Answer options
	• Which type of pollution do you think increases most due to tourism?	☐ Air pollution (vehicle emissions) ☐ Water pollution (sea, rivers) ☐ Pollution from waste ☐ Noise pollution
	• Do you believe tourism mostly benefits or mostly burdens our area from an environmental perspective?	☐ Mostly benefits ☐ Mostly burdens ☐ Both equally
Attitudes and suggestions from parents	• How important do you consider combining tourism with environmental protection?	☐ Not at all ☐ Slightly ☐ Moderately ☐ Very ☐ Extremely
	• Do you believe tourists are sufficiently informed about the environment of the area?	☐ Yes ☐ No
	• What measures do you suggest to reduce pollution from tourism in our city?	(Open-ended answer or with options such as: ☐ More bins ☐ Awareness campaigns ☐ Vehicle restrictions ☐ Enhanced recycling etc.)
	• Would you participate in clean-up or environmental awareness activities?	☐ Yes ☐ No
	• Are you aware of how you can contribute to environmental protection?	☐ Yes, quite a lot ☐ Yes, a little ☐ No
	• Would you participate in volunteer activities for environmental protection?	☐ Yes ☐ Maybe ☐ No
	• How often do you use eco-friendly modes of transport (e.g., bicycle, walking, public transport) for your commutes in the city?	☐ Very often ☐ Fairly often ☐ Rarely ☐ Never
	• Do you recycle your waste?	☐ Yes, always ☐ Yes, most of the time ☐ Rarely ☐ No, never
	• What types of waste do you recycle? (You can select more than one)	☐ Paper ☐ Plastic ☐ Glass ☐ Metal ☐ Batteries ☐ Electrical/Electronic devices ☐ Other (e.g., clothes, oil): _____

instructing facts, the method links knowledge to on-the-ground action in community so students grasp environmental problems in a more meaningful way. A key advantage is that it promotes core skills such as problem solving, emotional engagement, and scientific citizenship, which are essential for addressing environmental challenges (Okada et al., 2024). Programs that use the learning-by-doing approach have shown significant success in enhancing environmental awareness among elementary school students, leading to increased participation in conservation efforts (Pambudi et al., 2022). Schools serve as vital platforms for instilling environmental values, as children often share their learning with their families, amplifying the impact of education beyond the classroom (André & Mendes, 2014; Castillo, 2016).

The care-know-do model, which promotes experiential learning and the development of skills related to environmental awareness, is the foundation of the suggested teaching strategy.

The care module, the program's first section, introduces students to the scenario's topic through lectures on environmental pollution and the different kinds of pollutants that result from tourism. Watching educational videos that highlight the environmental issues that local ecosystems and tourist destinations face helps to reinforce understanding of the concepts. Students can create a concept map in this situation to visualize the relationships between the island's tourist and non-tourist areas as well as the potential forms of pollution.

The second module, know, involves the exploration of scientific literature and the search for numerical data related to their area's natural environment and tourism. In addition, students collect qualitative data from testimonies of their family environment regarding their place. Simultaneously, they utilize online databases to identify local habitats. Within the framework of this module, online and in-person meetings are also held with scientists and local organizations active in the field of environmental protection, while information leaflets and questionnaires are distributed to the parents of participating students.

The third and final module, do, focuses on the application of knowledge and the production of results. Students record and analyze the data from their research, confirming or rejecting their initial hypotheses and formulating well-documented conclusions. The evaluation of the learning and metacognitive process is carried out through an online reflection questionnaire (Google Forms). Additionally, the social skills developed during the action are also examined. The results of their work may be presented in electronic information material, which is posted on the school website. Additionally, a relevant article can be published in the school newspaper with the aim of highlighting the importance of protecting the natural environment of their area. Finally, the results of the action are shared with the school's educational community (teachers, students and parents), strengthening collective environmental awareness (**Figure 3**).

CRITIQUE OF THE RESEARCH PROTOCOL: BENEFITS AND POSSIBLE LIMITATIONS

The proposed research protocol is well-structured and pedagogically meaningful, combining EE with digital literacy. One of its key pillars is the integration of the care-know-do model, which promotes experiential learning and encourages students to engage in real environmental problems. The project effectively connects students to local tourism-related

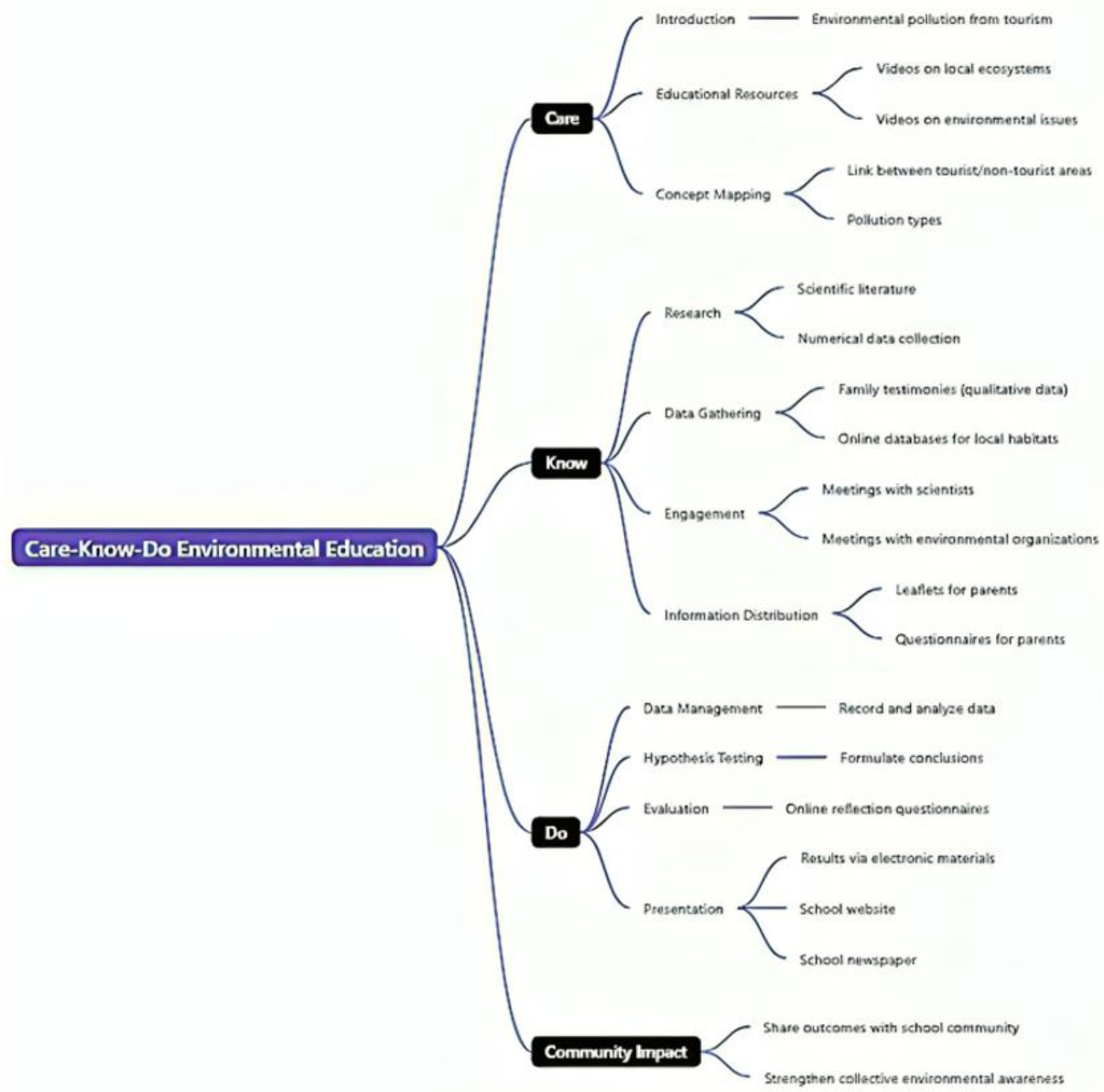


Figure 3. Diagrammatic representation of the care-know-do model of the proposed environmental teaching project (Source: Author's own elaboration)

pollution issues–a topic of particular importance for the study area. The integration of the SDGs can ensure that the action complies with international standards for sustainability education. This model can also contribute to the development of problem-solving skills, emotional engagement, and scientific awareness. At the same time, the use of digital tools and data analysis platforms will enhance students' critical thinking, digital literacy, and collaborative learning–skills that are crucial for ecological citizenship.

However, some limitations should be considered. First, the response rate to the questionnaire may be low. Some parents might not complete the questionnaire due to time constraints or lack of interest, which could make the data less reliable or representative. In addition, parents' opinions may be influenced by personal biases or a lack of information, which should be considered when interpreting the results. Second, another key limitation is the need for appropriate guidance for students. Specifically, the collection and processing of data from questionnaires requires educational support to ensure that the data is valid and the results are not biased or misinterpreted. Furthermore, if there is no feedback provided to the community or practical application of the findings, the pedagogical benefit of the action may be diminished.

In summary, this research effort demonstrates strong educational value and innovation. However, methodological improvements and additional support are recommended to address potential limitations, thereby maximizing its research contribution and achieving the intended learning objectives.

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Disclosure of interest: The author declares that there are no competing interests associated with the research presented in this article. There are no financial or personal relationships that could potentially bias or influence the interpretation of the findings.

Availability of data: All data generated or analyzed during this study are available for sharing upon request. Interested parties are encouraged to direct their inquiries to the corresponding author, who will facilitate the provision of the data in a timely and appropriate manner.

REFERENCES

Alam, S. (2017). Environmental education: Role of physical environment in students' learning in Gilgit-Baltistan, Pakistan. *Journal of Education and Vocational Research, 8*(2), 22-33. https://doi.org/10.22610/JEVR.V8I2.1859

André, C. F., & Mendes, M. O. (2014). Educação ambiental nas escolas públicas [Environmental education in public schools]. *Professare, 3*(1), 131-141.

Aznar, P., Calero, M., Martínez-Agut, M. P., Mayoral, O., Ull, À., Vázquez-Verdera, V., & Vilches, A. (2018). Training secondary education teachers through the prism of sustainability: The case of the Universitat de València. *Sustainability, 10*(11), Article 4170. https://doi.org/10.3390/SU10114170

Castillo, R. M. (2016). Educación ambiental para el desarrollo sustentable [Environmental education for sustainable development]. *Revista Estudios, 1*, 32-47.

Costa, F. W. D., & Aguiar, P. R. (2020). A formação da cidadania ecológica articulada à educação ambiental na escola [The formation of ecological citizenship linked to environmental education at school]. *Revista Cerrados, 18*(2), 245-274. https://doi.org/10.46551/RC24482692202017

de Albuquerque, C. V., Cordeiro, A. M. R., Alcoforado, L., & de Carvalho, J. A. R. (2024). Eco-education: An intervention in the curriculum and in the training process of teachers in the Feira Nova-PE school system. *Caderno Pedagógico, 21*(10), Article e10000. https://doi.org/10.54033/cadpedv21n10-426

do Carmo, W. M. F. (2023). Educação ambiental nas escolas [Environmental education in schools]. *Revista Científica FESA, 3*(6), 67-78. https://doi.org/10.56069/2676-0428.2023.286

Fandé, M. B., & Pereira, V. F. G. C. (2014). Environmental impacts of tourism: A study on the perceptions of residents and tourists in the Municipality of Paraty-RJ. *Revista Eletrônica Em Gestão, Educação E Tecnologia Ambiental, 18*(3), 1170-1178. https://doi.org/10.5902/2236117013864

Hoque, F., Muhamad Yasin, R., & Sopian, K. (2022). Revisiting education for sustainable development: Methods to inspire secondary school students toward renewable energy. *Sustainability, 14*(14), Article 8296. https://doi.org/10.3390/su14148296

Khrisnamurti, K., Utami, H., & Darmawan, R. (2017). Dampak pariwisata terhadap lingkungan di Pulau Tidung Kepulauan Seribu [The impact of tourism on the environment on Tidung Island, Seribu Islands]. *Kajian, 21*(3), 257-273.

Lazaris, D. C., Drosos, V. C., Tasionas, G., & Liampas, S.-A. (2020). Comparison of potential pollution levels in coastal areas of an Ionian Island using hierarchical cluster analysis. In *Proceedings of the 8th International Conference on Remote Sensing and Geoinformation of the Environment* (vol. 11524, pp. 115241S). SPIE. https://doi.org/10.1117/12.2571706

Nada, H. N., Fajarningsih, R. U., & Astirin, O. P. (2021). Environmental education to build school members' character. *Jurnal Pendidikan Biologi Indonesia, 7*(1), 43-52. https://doi.org/10.22219/JPBI.V7I1.14283

Okada, A., Panselinas, G., Bîzoi, M., Malagrida, R., & Torres, P. L. (2024). Fostering transversal skills through open schooling with the CARE-KNOW-DO framework for sustainable education. *Sustainability, 16*(7), Article 2794. https://doi.org/10.3390/su16072794

Pambudi, P. A., Fardiani, S. N., Zaenab, S., Hidayati, A. N., Permana, lalan, & Arofah, N. H. (2022). Penguatan nilai kepedulian lingkungan pada siswa jenjang pendidikan dasar [Strengthening environmental awareness values in elementary school students]. *Darmadiksani, 2*(2), 88-99. https://doi.org/10.29303/darmadiksani.v2i2.1934

Yarkandi, A. H., & Yarkandi, N. H. (2012). Strengthening environmental education in school curricula. *Journal of Education and Vocational Research, 3*(8), 264-270. https://doi.org/10.22610/JEVR.V3I8.77