

Introducing children in the primary school to the concept of ecosystem services

Noemi Rota, Claudia Canedoli, Martina Fava, Emilio Padoa-Schioppa

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Keywords: natural capital; primary education; environmental education; cultural services.

Abstract. *The respect for Earth and life in all its diversity and the protection of the integrity of the environment are two of the fundamental principles declared in the Earth Charter 2000, which aims to build a just, peaceful, and sustainable global society. Due to the increasing effects of the environmental crisis, there is a need for a greater environmental sensibility and consciousness, and one path to reaching this goal passes through environmental education*



projects with children. Here we carried out a project for the involvement of children in environmental-related issues, using as a teaching tool the concept of ecosystem services (ES). The project aims to develop in children a sensitivity towards the environment, good social and civic competence, and make them more aware of environmental issues through the discovery of their territory. The topic of ES was introduced through a storytelling approach, and we described in a simplified version six ES, asking children to point out in the city map where they found these services in their town. The 17 children taking part in the project were 9 years old, we tested the considerations obtained with questionnaires appropriate to their age and level of comprehension, to evaluate the acquisition of new information and long-term knowledge. Then videos of urbanized and degraded environments in our territory were shown, and afterward, children were asked to make a proposal for the recovery of a degraded area in their town. Children had the chance to put into practice their proposal with an outdoor activity for recovering a forest in their town. After one year, a meeting with the children took place and they were asked to fill out a questionnaire regarding the project, and the consequences it had for their lives. The results highlighted that the majority of children remember this project with a positive feeling and had an improved competence and critical sense regarding the environment and ecosystem services.

1. Introduction

1.1 Children and environmental education

Currently, children grow up in a context saturated with environmental issues and threatened by human activities (Melia, 2003). Thus, generally, children that are aware of environmental issues have a perception characterized by pessimism, a feeling of sadness, and a sense of helplessness about the future of the planet (Barraza, 1999; Strife, 2012; Iliopoulou, 2018). Educators should help children in developing a critical but positive environmental awareness (Piske et al., 2021). There is evidence that through a nature-based education program, with the experience of an intellectual, emotional, and sensory perception of the

environment, children develop an awareness of places and the living organisms that surround them and develop a sensibility toward them (Collado et al., 2020). There is a growing number of studies that relate nature-based education and the development of personal environmental stewardship (Kuo et al., 2019). Environmental citizenship is one of the goals set by the 2030 European Strategy, which can be achieved through an appropriate model of environmental education (Monte & Reis, 2021), developing the necessary skills and values to approach the upcoming environmental changes (Hadjichambis & Reis, 2020). Education at the early stages of life represents a useful tool to achieve proper environmental citizenship, thus primary education is an appropriate life stage to develop a long-term environmental awareness and sensitivity (James Farmer, Doug Knapp, 2007; So & Chow, 2019).

Teachers have a role in this development, being responsible for providing an adequate education background to develop environmental sensitivity (Boca & Saraçlı, 2019; Türkoğlu, 2019), correcting misconceptions, and influencing children's conception of the environment (Lwo et al., 2017; Yalcin & Yalcin, 2017). Dewey (1954) stressed the necessity to create a new education to change and improve society, an education based on direct experience, open dialogue, cooperative learning, and critical and democratic thought development, all of which is still today an open topic. Tiziano Fratus, defining *Puer Radix* (Fratus, 2013), stated that children have an inherited curiosity with which they observe the natural world around them, and they are also inclined to take care of it. The *Puer Radix* needs help to come outside and needs to be motivated and guided by parents, teachers, and educators encouraged in taking care of a piece of landscape, the garden of the house, or the tree on the lawn in front of the school. We approached the children's sensitivity towards the environment through an educational project in primary school, using different methodologies and Cultural Ecosystem Services (CES) (MEA, 2005) as an educational tool. In particular, we used CES because of its intrinsic relationship with the non-material context, leading children to an intellectual but emotional perception of the environment and raising awareness of ecological issues (Maraja et al., 2016).

1.2 *Ecosystem services as an educational tool*

Ecosystem Services (ES) are defined as the benefits that people derive from the environment (MEA, 2005; Costanza et al., 2014). This concept highlights the strict relationship between natural capital and human well-being. There has been an increasing interest in the concept of ES since its first appearance in 1981 (Costanza et al., 2017), reaching a broader audience every year. The evaluation of

ecosystem services can be used as a tool to protect biodiversity and reduce the exploitation of natural resources performed by human activities. There are four categories of ES (MEA, 2005), while for our study we focused only on the category of Cultural Ecosystem Services (CES), which are defined as the non-material benefits that we obtain from ecosystems. ES can be seen as an emerging issue to encourage and strengthen positive environmental attitudes in children and educate them on sustainability topics (Almers et al., 2021). We used CES as a learning topic and tool for increasing environmental awareness and sensitivity in children, mostly because of the connection to the emotional sphere. The CES categories encompass values such as aesthetic, religious, recreational, education, and sense of place (MEA, 2005; Haines-Young, 2018), which can be easily understood by primary school children.

The main aim of this project was to introduce children to the concept of ES as a tool to discover nature, enhance their knowledge of it, intervene concretely in developing active citizenship and discover their territory. This topic was proposed to the students both as an environmental concept and a tool for developing an interest in respect for the environment. The project was divided into four phases, which resume the four main questions that we asked children: 1. What is Nature for you? 2. How is the environment where you live? 3. What does Nature do for us? 4. What can we do for the nature?

2. Materials and methods

The project was realized with a class of the primary school Rita Levi Montalcini in Torbole Casaglia (BS), a small town of approximately 6500 inhabitants in the low plain of North Italy called Pianura Padana and encompassing the Po Valley, the geographical area that coincides with the river basin of Po.

The class participating in the project comprised 17 9-year-old students (12 males and 5 females), from primary school with diverse socio-economic backgrounds. The teacher was a trainee teacher at the University of Milano Bicocca, Faculty of Primary Teacher Education, and an active and inclusive teaching methodology was used to introduce children to the concept of ecosystem services and to put them in contact with nature. The work was organized according to the cooperative learning method (Gillies and Ashman, 2003) whereby each student has to collaborate in groups, has a role, and contributes to the project. To do this, it was essential to encourage the improvement of the mediation competence to face and solve conflicts in the groups, a very important feature of active citizens (Colombo & Passerini, 2013).

The project was developed through five meetings and two outdoor trips. To introduce the topic of nature to the class, every meeting started reading a chapter of the story “Magical Tree-Castle” (Hill, 1998) and ended with a discussion in the class. The story served as an introduction to create a positive interaction between the teacher and the students, establishing a relaxed and confident relationship, and also representing symbolically that they were starting their work together. The teacher was present during all the stages of the project, to help and support children during the assignments. The first meeting was an introduction to nature and biodiversity, in which children had to think about what nature represented to them. We took as a reference area the neighbourhood of the school, focusing on the Po valley and Pianura Padana. The children were asked to express their ideas and opinions about the word “Nature” through brainstorming (Bezzi and Baldini, 2006). The children were told that no judgment on the opinions of others was allowed, which was a key statement to allow children to freely express their thoughts and increase children's participation. After the brainstorming, the class was divided into 4 groups, language difficulties and disabilities were taken into account during the creation of groups in order to apply the peer tutoring principle (Barnard, 2002). We assigned each member of the group a role, to empower all the children concerning the outcome of the project. The four roles chosen were: 1. *the clock*, that controlled the time expiry, 2. *the writer*, that wrote the proposals of the team, 3. *the voice controller*, that was responsible for the loudness of the team, 4. *the representative*, that directly interfaces with the teacher. Thus, each group had the task of creating an acrostic with the word “nature” to explain how they perceive nature and its elements (Fig.1), choosing from the words of the brainstorming activity.

The second and third meetings were about the question “How is the environment where you live?”. The topic was split into two meetings due to the need for reflecting on theoretical knowledge of geography and learn new concepts. The second meeting was a plenary session about the environment of lowlands and their representation in the Italian context. We focused on Pianura Padana and Po Valley, its biodiversity, and the nature-related resources. During the third meeting, we tested the new knowledge from the previous lesson through a questionnaire. We organized a workshop where each group recreated a small model of Po Valley, using stone, sand, clay, soil according to the typical natural environment. The children were very enthusiastic and curious about this activity because they could directly experience natural elements and apply practically what they had studied in the previous meeting.



Figure 1. Example of an acrostic created during the first meeting of the project. The acrostic is composed by “Nascosti nella Terra Umida Respirano Animaletti” (Hidden in the moist soil little animals breathe).

The concept of ES was introduced during the fourth meeting. This part was related to the third question (“What does Nature do for us?”). To simplify the concept of ES to children, we used as examples areas in the town that they already knew, such as parks and green areas. A questionnaire about Torbole Casaglia was submitted to the class, which aimed to understand how much children knew about the territory and its peculiarities. Then, we introduced the Millennium Ecosystem Assessment (MEA, 2005) definition in a simplified version to make it more comprehensible to children. We defined ES as all the benefits that *the Earth gives us without asking anything back*. Hence, the children had to think about some examples and share them with the whole class. Then some videos were shown to them about the nature of the neighbourhood. The peculiarity of the territory is the presence of karst springs, which were introduced as a concrete example of ES that they studied. Successively they discovered the CES through some simple definitions readjusted concerning the age and comprehension skills of students (Tab.1), for instance the heritage value was readjusted using the term “memory” and was mostly focused on direct experiences of children instead of identification with the culture and history of the place. We divided the class into the groups of the past meetings to carry out an activity regarding ES using a crowdmapping approach. Crowdmapping is a methodology that leads to the visual representation of individual perception and value of the city (Hennig, 2019). Students mapped the CES, and the teacher

introduced them to their city map. This activity helped children to raise their awareness regarding the city in which they live, with the possibility of adding a specific value to different areas. We gave the children a city map of Torbole Casaglia and they had to identify and highlight places in the map that were considered sources of CES and identify which one of those previously presented (Tab.1). At the end of the activity, it was very important to discuss with the whole class the results of every group and the issues that emerged.

CES explained to children	CICES V5.1 CODE	Simple descriptor (CICES V.5)
Recreational places where you can have fun	3.1.1.1	Using the environment for sport and recreation using nature to help keep fit
Community and Friendship places where you can meet with relatives and friends	3.3.X.X	Other
Well-being places where you can do sports and relax	3.1.1.1	Using the environment for sport and recreation; using nature to help keep fit
	3.1.1.2	Watching plants and animals where they live; using nature to de-stress
Beauty and Creativity places that you visit because are beautiful and that inspire your creativity	3.1.2.4	The beauty of nature
	3.3.X.X	Other
Memory places that remember you moments of your life	3.1.2.3	The things in nature that help people identify with the history or culture of where they live or come from
Environmental Education places where you can learn something about Nature and how to take care of it	3.1.2.2	Studying nature (Characteristics of living systems that enable education and training)

Table 1. Example of descriptions of CES and the related ecosystem service CODE (Classification CICES V.5)

During the last meeting, we wanted to reply to the question “What can we do for Nature?”. We showed a video during the meeting about the “O₂ Wood”, an artificial wood created 20 years ago by the municipality to plant greenery in the town. In the video, we explained the necessity of recovering that area, showing both natural elements (such as trees and blooms) and elements related to the abandoning and degradation of the area, such as domestic garbage. After the video, we explained to children that the abandoning of the area was causing a depletion in the provisioning of ES. The children agreed to take action and wrote

a letter to the Mayor of Torbole Casaglia (S1, Supplementary Materials) explaining their concern about the “O₂ Wood”. The letter was written using the cooperative learning approach, whereby the children were divided into groups, then each group made its proposals to recover the “O₂ Wood” and presented them to the others. The proposals were summarised in the letter, and some drawings were added. We organized a trip to the Mayor’s office, where children brought and personally read the letter to the Mayor. The Mayor agreed with some of the children’s ideas and decided to help them, also involving the civil protection volunteers, which is a corps of national volunteers that take action to defend life, settlements and the environment from damage by natural hazards. Afterwards, a trip to “O₂ Wood” was organized to put into practice what was proposed by the class and clean the area, also with the help of civil protection volunteers. Furthermore, since only a small number of students had already been to the area, the trip was an opportunity for many to discover a new environment in the town.

During the project, the assessment of the children’s learning and their work was carried out by the teacher with the evaluation of practical activities, questionnaires, and discussions. Also, we used the self-assessment method to make the children aware of their changing perceptions of the studied topics and a later follow-up assessment, which consisted in administrating a questionnaire to children after one year, to investigate the long-term knowledge acquired.

3. Results and discussion

3.1 The concept of nature and CES

To achieve the main aim of the project, in particular the use of CES as a tool to improve the knowledge and perception of nature, it was necessary first to introduce children to the general concept of nature (Torkar and Krašovec, 2019) and to improve their knowledge of the environment surrounding them. The teacher reported that the first answers to the question “What is Nature for you?” were quite vague and sometimes not relevant, some examples were the words “agriculture” or “irrigation” which did not fully match the assignment. For this reason, the teacher concentrated initially on this part of the project and helped children to think about nature more broadly, trying to enhance their intrinsic naturalistic intelligence (Gardner, 1983) through storytelling and outdoor activities. This approach introduced the children to new words related to nature, such as “beauty”, “roots”, “bark”, and “freedom”. The expression of these words

emerged in the acrostic activity, where children cooperatively shared their feelings, choosing the best words to create the acrostic.

In particular, regarding CES, the activity of crowdmapping (“What does nature for you?”) was fundamental for the application of the new definitions learned about ES. The children were asked to tell stories, sensations, and personal experiences about some environments that they already knew. Moreover, the children were supposed to put all these feelings and perceptions into a map, and with this we sought to deepen their awareness of their town, going beyond their general knowledge of the areas, and adding a personal description. A total of 28 areas were indicated by the children for the provision of the CES identified in the project (Tab.1). The recreational service, which is linked to leisure moments of play and enjoyment, emerged as predominant (Fig.2), resulting in the most recognized component of the city map with a percentage of the 36% of the total (10 areas).

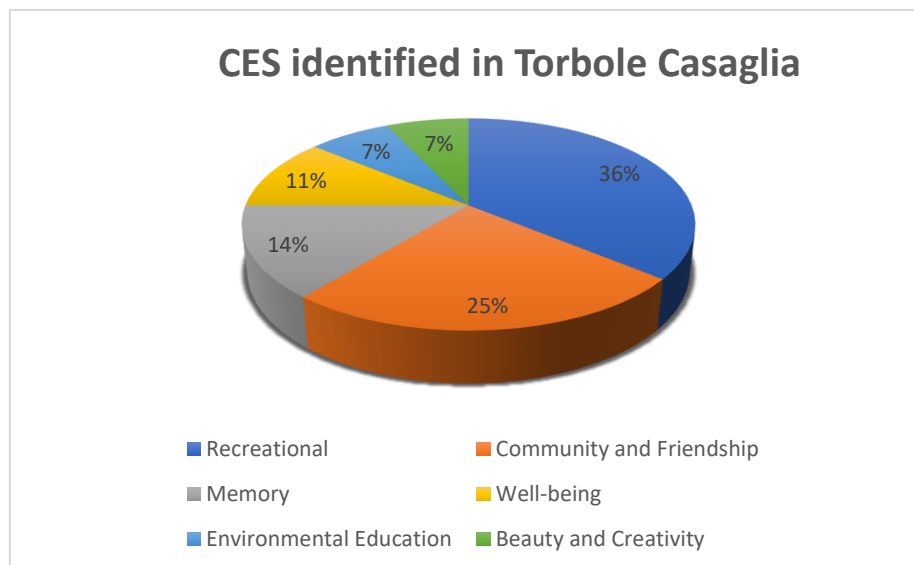


Figure 2. Results of the crowdmapping in terms of percentage of identifications of CES on the city map

This was identified in all the places where children usually play together, such as public Parks and green areas. Next, the children recognized the community and

friendship service, described as the places to meet friends and to share moments, as the second most represented (7 areas) with a percentage of 25% of the total, highlighting places linked to their social life such as public parks and the oratory. The memory value, which is the service related to memories of the past and emotions linked to a special place, was identified in the city with a percentage of 14% (4 areas). The well-being value, described as places where children could relax and do sports, resulted only in 11% of areas (3 areas) belonging to this category, including the sports field, cycle, and jogging paths. Both environmental education and beauty and creativity had the lowest scores (2 areas), reaching 7% of the total. It is interesting to note that the “O₂ Wood” was recognized as a place related to the educational service instead of recreational, underlining the feeling of children about the activity carried out in recovering the degraded area and learning about the neighbourhood. The beauty and creativity value was perceived in the cycling and jogging paths. Thus, activities related to leisure and recreational values were those most recognized by children, while the aesthetic value of the study area and educational values were the least considered. From the results, it emerged that children understood the ecosystem services concept and that they feel nature like a special place where they can have fun, with family and friends.

The children showed greater recognition of services in which they could concretely recognize themselves in activities, such as playing or meeting with friends, while more reflective and abstract services had lower values. The most important result here was the efficiency of using CES as tool to develop in children new environmental perceptions, that went beyond their prior knowledge of nature, only related to personal experiences. In fact, as emerged from the crowdmapping, the most perceived service related to nature is the recreational service, but other services less linked to concrete and practical experience were identified and mapped. The high values for the recreational services could be due to the relation with nature that children had experienced prior to the project.

Thus, nature and green areas of the town, were explored mostly for recreational purposes. The fact that the aesthetic value of nature, for instance, was not highly evaluated was not surprising, as the aesthetic value is highly dependent on experiences, learning and social support (Van Wieren and Kellert, 2013). Thus, for the development of the aesthetic value of the environment, we suppose that children needed to have prior experience a contemplative view of nature. Another explanation of this result could be related to the age of children in our class. According to Rejeski (1982), children develop a sense of nature in steps related to the age, and by 9-10 years children develop a playful attitude towards

nature, having internalized physical actions as mental actions. We assumed that these abstract values will be developed during the early adolescence, when the capacity of reflecting on their own thoughts and be more separated from the concrete thinking develops (Rejeski, 1982). Despite the low score, the educational value emerged in the crowdmapping, and it mapped as related to a green area. This result was interesting because it suggested that children were developing a new perception of the natural areas of the town that went beyond the recreational value, but that was more related to the new experiences and knowledge acquired during the project.

Thus, we can affirm that the children appreciated the activity and the use of CES was a tool for developing a new perception of the surrounding environment. Children are important elements of society, being future citizens and decision-makers, and for this reason they need to be motivated and included in these sorts of activities to raise their awareness of their surroundings and to participate in city development (Hennig, 2019). The results were discussed in the classroom and some issues emerged related to the understanding of a city map and the legend. The children enjoyed observing their town through the map, finding their houses, and discovering how many places they had never been to, even though some children stated they had difficulties in recognizing places through the map. After the discussion, the children were followed during a second round of crowdmapping to avoid any kind of bias, which led to the results here presented. Moreover, they themselves suggested some improvements to the activity, such as the use of a dictionary in case of difficult terminology, and more detailed explanations of the assignment. Hence, we discussed the perception of the city after the crowdmapping and the children confirmed having a new perception of the city related to a better knowledge of the green spaces and new feelings and emotions, based on the CES studied. CES was a useful tool to create new perceptions of the green areas and to first introduce new concepts, such as the active approach to nature. Using this tool, we could introduce the part aiming to promote active citizenship, to reconsider their view of nature and of themselves within it, where human beings depend on nature for the provision of many essential services for survival and well-being, and for this reason it is necessary to intervene in the protection of nature.

3.2 Cooperative learning and active citizenship

Since the activities were carried out using cooperative learning, we asked the children during the discussions their opinion regarding this methodology. Children were enthusiastic about this way of working, and many students stated

that doing assignments together motivated them to carry on the activity having more fun (Mueller and Fleming, 2001). Through cooperative learning it was possible for them to work in groups, be together with their classmates, and also be more autonomous than during a normal class. In the beginning, working in groups and cooperating was at times disorienting for the children, but after a while they started to work together effectively on the assignment. There was then an improvement in the independence and individual sense of responsibility, and these together led to the children becoming more autonomous in each activity. Sometimes arguments inside the groups happened, and during a subsequent discussion a children stated that “I have learned that if you argue you cannot complete the assignment, you need to be patient”, and another stated that “to respect your turn is very important to work peacefully”. These statements demonstrated a good capacity for self-control and respect for each other’s work, even though sometimes the teacher had to intervene to stop the arguing.

From the individual self-assessment (S2, Supplementary Materials) at the end of the project, it emerged that almost half of the students found difficulties in working in groups. Building their own personal point of view is indispensable for children to assess competences acquired and gives them the chance to develop an awareness of the personal learning experience, results, skills, and weaknesses (Bouffard et al. 2009). Asking students to participate in the assessment changes their position from passive to active, carrying out an assessment process that normally involves them only in a passive way. Hence, the student is active, and has responsibility and power. The teacher has only to decide the rules of the assessment and share them with the class. The self-assessment by children showed that particularly in the first part of the project, there were some conflicts that they did not know how to face, and difficult moments in which they felt confused and not considered by the rest of the group. Once they understood how to work together and exchange points of view with each other, their interaction became increasingly more positive. Social competence is a fundamental point of growth on which it is necessary to work from childhood to prepare children to enter society and to promote social cohesion.

Furthermore, knowledge in children emerges in different ways, and the direct interaction with nature leads to the development of knowledge through senses, emotions, and experiences, representing a tool for arousing environmental awareness (Veselinovska et al., 2010). The trip to the “O₂ Wood” represented the chance to act and put into practice the new knowledge acquired during the more theoretical parts about nature (“What is nature for you?”) and their town (“How is the environment where you live?”). Children could enjoy the experience

of the wood, its elements and act for its safeguarding. This is a fundamental point in Environmental Education (EE) as a tool to guide individuals to more sustainable behaviours during their lives (Michelsen & Fischer, 2017; Collado et al., 2020). EE works through the development of Environmental Attitudes (EA) and Environmental Behaviours (EB) using direct experience and overcoming the incentives and punishment strategy (De Young, 2000). Moreover, many authors stated that the outdoor experience of nature is far more effective than exclusively indoor lessons for encouraging EA and EB, being an opportunity to explore nature directly (Braun & Dierkes, 2017; Lekies et al., 2015; Evans et al., 2007). In this way, during the project the children had the chance to build a theoretical background regarding nature and their town through plenary sessions and also going on an outdoor trip where they could explore and directly experience nature. In particular, during this part of the project, we aimed to develop in children active citizenship during the proposal and application of strategies to recover the “O₂ Wood”. Furthermore, children in this age group (9-10 years old) were traditionally considered by scholars as holders of a passive perception of humans in nature, perceiving that man does things in nature and not to nature (Rejeski, 1982), while during the project we successfully developed an active perception in the children, which resulted in a pro-active attitude, whereby they proposed many implementations for the “O₂ Wood” to improve the quality of the environment and had direct field-based experience enabling them to take action and safeguard green spaces.

3.3 Later assessment

Eventually, a questionnaire administrated one year later was used as a follow-up assessment the learning path offered to the students and the influence of what they learned. From the results some positive aspects emerged. All 17 students remembered well the project of the “O₂ Wood”, 50% of the students visited again the “O₂ Wood” after the project with family and friends, whereas 40% did not return and 10% did not remember. 60% of those that visited the “O₂ Wood” again stated that they did it for fun, and 40% stated that the purpose was relaxing. All of those who took part in the project said they appreciated the experience conducted together and also the entire learning path undertaken before the “O₂ Wood” trip. Moreover, analysing the open question in the questionnaire, some further elements emerged. The children emphasized an appreciation for working together, highlighting the fun of a project structured in working groups and not individually, cooperating to achieve a common purpose. They underlined in the later questionnaire (S3, Supplementary Materials) their desire for respecting the planet as something that all humans have to do, expressing an ethical

responsibility of everyone. Moreover, the children autonomously made many statements regarding the need for taking care of the planet and the strict relationship with our well-being, also expressing the bidirectionality of the relationship human nature, as stated by C. "I have learned that nature needs us and so do we". Based on the results obtained from the later questionnaire, we can assume that children started developing during the project both an environmental sensitivity, which leads them to the feeling of a need for intervention and recognition of natural elements, and an active citizenship approach, by understanding what the environment needs, making proposals, acting, and expressing a shared desire for taking care of nature. Considering the results obtained, we can affirm that children's perceptions of nature changed as the project progressed and in terms of the lasting impact the experience had. Thus, we can infer that attention to and care of nature are acquired skills, dependent on children prior knowledge of nature and personal experiences (Burgess and Mayer-Smith, 2011), but open to being developed through an appropriate educational program and outdoor experiences.

4. Conclusions

From the results of the project emerged that there was a positive change in children's perception of the environment. The cooperative learning method was highly appreciated by the children and helped to facilitate the lessons and maintain the interest of the class. Also, the teacher adopted a collaborative approach during all the activities, aiming to obtain thoughts and perceptions that emerged from each meeting. The project characteristics of self-assessment, discussion, and cooperative working are fundamental to developing children's curiosity, also promoting inclusivity and active cooperation from each student. The most challenging concepts were proposed through plenary sessions, to facilitate learning and the consequent activities. The main aim of the project was the development of knowledge and sensitivity towards nature, and the active role of children, who through the project could develop a long-term sensitivity to the environment and a renewed perception of their city and its CES. The project is a step in the direction of developing lifelong learning skills, in line with the eight competencies identified in 2006 by the European Parliament and the Council of the European Union for lifelong learning (European Parliament, 2006), using teaching methodologies in schools that allow children to directly experience and discover for themselves, thereby making possible the development of lasting, conscious and meaningful learning.

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Authors

Noemi Rota, University of Milano-Bicocca, Department of Earth and Environmental Sciences, Piazza della Scienza, 1-20126 Milan, Italy. rota.noemi@gmail.com
Corresponding author

Claudia Canedoli, University of Milano-Bicocca, Department of Earth and Environmental Sciences, Piazza della Scienza, 1-20126 Milan, Italy.

Martina Fava, University of Milano-Bicocca, Department of Earth and Environmental Sciences, Piazza della Scienza, 1-20126 Milan, Italy.

Emilio Padoa-Schioppa, University of Milano-Bicocca, Department of Earth and Environmental Sciences, Piazza della Scienza, 1-20126 Milan, Italy.

Authors' contributions

Writing – review and editing, N.R., methodology, C.C., E.P.S.; investigation, M.F.; data analysis, N.R, C.C., E.P.S.; supervision, C.C., E.P.S. All authors have read and agreed to the published version of the manuscript.

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