



Università
Ca' Foscari
Venezia

Master's Degree in Environmental Humanities
LM- 1 R (Antropologia culturale ed etnologia)

Master's thesis

CULTIVATING CONNECTION

**Biophilia and the Educational Vegetable Garden as Tools for
Childhood Well-Being and Environmental Awareness**

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2024 / 2025

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Abstract

This thesis explores biophilia - the innate human tendency to seek connection with nature - as a foundation for promoting healthier lifestyles and more sustainable environmental practices. It examines the school garden as a practical approach to restoring children's contact with nature.

Using attention tests and questionnaires administered to students, teachers, and parents, the study assesses the restorative effects of natural environments on cognitive functioning and well-being. It also investigates parents' and teachers' perceptions of school gardening, as well as the challenges educators face in maintaining such initiatives. The findings contribute to research on nature-based education and highlight the potential of school gardens to foster psychological restoration and environmental awareness.

INTRODUCTION

During my studies, I became personally involved in the question of why humanity appears increasingly misaligned with modern life, and I felt the need to understand not only how this mismatch affects human health, but also how it impacts the many other species with which we constantly interact - and, ultimately, the health of the planet as a whole. I encountered fragments of possible answers across a wide range of disciplines, including anthropology, literature, pedagogy, ecology, and others.

What I found particularly compelling about the Environmental Humanities MA Master's degree was its commitment to fostering dialogue among these diverse fields of study through a shared guiding thread: the environment. During my undergraduate degree in anthropology, I had already explored the relationship between humans and nature; however, enriching this perspective through engagement with additional disciplines - such as geology, economics, history, pedagogy, and many others - significantly expanded my analytical framework.

Ecology, in particular, offered me a look of the human species beyond culture. It was here that my attention settled most firmly. A concept that especially captured my interest was the Biophilia hypothesis. As Barbiero writes, "Protecting nature is an expression of our biophilia" (Barbiero, 2017).

As climate change is no longer an abstract or distant phenomenon but a reality we can directly experience, I began to reflect on what I could personally do to move, even in small steps, in what might be considered the "right direction" - that is, toward a way of living more closely aligned with our evolutionary and biological nature.

The aim of this thesis is to examine scientific studies to investigate whether prolonged contact with natural environments may generate measurable benefits for human well-being. In addition, this work seeks to contribute to the discourse on climate change by proposing a perspective that fosters a deeper connection with nature, thereby encouraging greater respect for the natural environment and a reduction in human impact on it.

Ultimately, this work seeks to reflect on what changes are necessary, or perhaps what practices we need to recover, in order to reshape our habits in a more sustainable way, for ourselves as part of the broader web of life.

During my university internship, I engaged with what I believe may represent one of the possible pathways for reconnecting humans with nature and, consequently, fostering greater care for it: the vegetable garden - specifically, the school vegetable garden.

Through my exploration of Biophilia and the study of various pedagogical approaches that recognize the garden as an educational tool, I developed a particular interest in this field, which I chose to explore further in this thesis. On a personal level, I consider the affective dimension to be a meaningful and effective way of cultivating a sense of affiliation with the natural world, and I believe that the vegetable garden can offer precisely this opportunity.

In a time when the fight against climate change has become increasingly urgent, I have often reflected on what might help humanity, as a species, develop a stronger motivation to change its habits and reduce its impact on the planet. At the same time, I have been paying attention to the frenetic pace of modern life and how it affects our happiness and overall well-being. I often feel that contemporary societies have become deeply disconnected from their own essence, and that this disconnection contributes to many forms of discomfort and unease.

In reflecting on these topics, Klein says:

“There are ways of preventing this grim future, or at least making it a lot less dire. But the catch is that these also involve changing everything. For us high consumers, it involves changing how we live, how our economies function, even the stories we tell about our place on earth. The good news is that many of these changes are distinctly un-catastrophic. Many are downright exciting.” (Klein, 2014).

I find myself in profound agreement with this perspective. We often assume that altering course necessarily entails significant hardship and substantial sacrifice. Yet what if changing direction were instead to offer us the opportunity to experiment with a more fulfilling way of life?

As human beings, we have inhabited this planet for far longer than the relatively recent capitalist era. Our genes evolved under conditions radically different from those shaped by contemporary consumer societies. Our authentic well-being does not ultimately depend upon consumerism, but rather upon elements that - perhaps surprisingly - are rooted in the natural world, which, until quite recently, constituted our everyday environment.

“Sono nell’altopiano etiopico 40.000 anni fa. Salgo in cima a un poggio da cui posso osservare l’intero orizzonte della savana africana. Al termine della giornata, il sole sta tramontando e colora di rosso il cielo all’orizzonte. Posso godermi la leggera brezza che rinfresca la pelle. Pur essendo lontano dal campo, è un luogo che conosco bene, il mio preferito per dare rifugio alla mente. La mia vista si stende su tutto l’orizzonte. Riconosco i suoni che la brezza mi riporta. Mi sdraio sull’erba soffice e fresca. Sento il profumo dei fiori. E’ il mio mondo. Mi appartiene e sento di esserne parte. E’ il mondo in cui sono nato, cresciuto e che presto lascerò. Esplorerò nuovi continenti, ma questo mondo rimarrà nel mio cuore. Le immagini, i suoni, i profumi verranno con me e li trasmetterò ai miei figli, e ai figli dei miei figli. E ogni volta che incontrerò un luogo che ricorda il luogo dove io e i miei antenati siamo nati, la mia anima si ristorerà, la mia mente troverà riposo.”¹

Barbiero, 2017.

¹ “I am on the Ethiopian plateau 40,000 years ago. I climb to the top of a small hill from which I can observe the entire horizon of the African savanna. At the end of the day, the sun is setting and colors the sky on the horizon red. I can enjoy the light breeze that cools my skin. Although I am far from the camp, it is a place I know well, my favorite place to give refuge to the mind. My gaze stretches across the entire horizon. I recognize the sounds that the breeze carries back to me. I lie down on the soft, cool grass. I smell the scent of flowers.

It is my world. It belongs to me, and I feel that I am part of it. It is the world in which I was born, raised, and which I will soon leave. I will explore new continents, but this world will remain in my heart. The images, the sounds, the scents will come with me, and I will pass them on to my children, and to the children of my children. And every time I encounter a place that recalls the place where I and my ancestors were born, my soul will be restored, my mind will find rest.”

HUMAN EVOLUTION AND THE LOSS OF CONTACT WITH NATURE

Where do we come from? How different are we from our ancestors? From an evolutionary perspective, not much time has passed since humans left their natural environments and began to draw a sharp distinction between what is considered wild and what is considered domesticated. Yet today, in 2026, we often experience a profound sense of disconnection from the natural environment (as opposed to the anthropic environment) in which our species lived until relatively recently.

The nature-culture dichotomy is deeply embedded in our cultural framework and continues to shape the way we think about ourselves and the world. We tend to perceive humanity as something separate from nature; as an entity distinct from it. But what if this separation is an illusion? Perhaps precisely because so little time has elapsed since our way of life changed so radically, many of the fundamental mechanisms of our bodies are still shaped to address challenges associated with living in natural contexts. From this perspective, biophilia can be understood as a defining human trait, one that reflects our evolutionary history and our enduring biological connection to the natural world.

The biophilia hypothesis can be effectively introduced through the concept of evolutionary mismatch, for which Lieberman provides a clear and useful definition: over time, natural selection adapts organisms to specific environmental conditions (a process known as *matching*). If, at some point, an organism comes to live in different conditions and in the presence of altered environmental stimuli, it may no longer be able to produce responses that are adequate to the new demands, resulting in the emergence of maladaptive phenomena (Lieberman, 2017).

Indeed, although natural selection did not cease after the Paleolithic period, it operates over extremely long timescales - on the order of tens or hundreds of thousands of years - which is clearly incompatible with the accelerating pace at which cultural and technological changes, as well as lifestyle modifications, have occurred and continue to occur.

The environment has changed, and so have human lifestyles, culminating in the extreme transformations of the post-agricultural and post-industrial eras. Although the human body has continued to change, these changes have been relatively minor and insufficient to keep pace with environmental transformations. Our bodies have not yet evolved to prevent weight gain in an environment characterized by the widespread availability of energy-dense and highly refined

foods; nor have they evolved to sustain a sedentary lifestyle, to function optimally with reduced sleep, or to rely predominantly on near vision.

In a very short period of time - evolutionarily speaking - the human body has been confronted with technological and economic changes that have had a profound impact on multiple aspects of life. In addition to the foods we consume daily, the medications we take, the types of work we perform, the pollutants we are exposed to, and the levels of stress we experience represent novel factors for our organism. These changes have occurred so rapidly that biological evolution has been unable to keep pace.

It is precisely this mismatch between our genetically adapted physiology and the modern environment that may underlie conditions such as type 2 diabetes, as well as dental caries, chronic stress, anxiety, depression, and myopia (Lieberman, 2017).

From this perspective, the biophilia hypothesis can be introduced. Biophilia can be understood as a defining human trait shaped by evolutionary pressures. As Barbiero explains, if biophilia has become embedded in the human genome, it is because it served as an important evolutionary function. In other words, an innate affiliation with the natural world contributed to the survival and adaptive success of our ancestors, whose evolutionary history unfolded within close and continuous interaction with natural environments (Barbiero, 2017). Indeed, our species has spent the vast majority of its evolutionary history immersed in natural, wild environments. As we said before, from an evolutionary perspective, only a very small amount of time has been spent living in cities - so little that our biological constitution has not yet had the opportunity to change or adapt sufficiently to favor urban environments over nature in terms of well-being. The theory of evolutionary mismatch provides a compelling explanation for this issue: the human body has not yet adapted to the conditions of modern life. No matter how firmly we attempt to assert an ideological separation from nature, a deeper introspective awareness reveals that we are intrinsically embedded within it, just like all other animals and living species.

Perhaps, if we seek to restore and reconfigure our relationship with the environment, it is precisely from this recognition that we must begin.

It is within this conceptual framework that the notion of biophilia acquires particular significance. Biophilia may be understood as a fundamental dimension of human temperament: an innate, biologically grounded affinity between human beings and the natural world - quite literally, a love of life (Barbiero, 2021). According to Barbiero, this trait developed because it played a crucial role in enabling humans to survive for such a long time on this planet. Throughout

human history, our species has faced significant challenges that have repeatedly put its survival at risk. As Barbiero notes, there is abundant evidence showing that the survival of human communities has depended on their ability to correctly interpret the surrounding environment, first and foremost plants and animals (Barbiero, 2017).

The scientific study of this characteristic of our species began with Erich Fromm, who described biophilia as a psychological tendency to preserve life and to oppose death, a primary potential intrinsic to human biology. According to Fromm, the biophilic personality is characterized by four fundamental qualities: *care*, understood as concern for the growth and well-being of those we love; *responsibility*, defined as the ability to respond to and meet the needs of others; *respect* for the autonomy and independence of loved ones; and *knowledge*, meaning a deep understanding of others without the desire to dominate them (Fromm, 1964).

Biophilia can thus be considered a primary form of adaptation, one that has successfully passed the test of evolution. This implies that natural selection has favored and preserved preferences, motivations, and decision-making processes that support caring for, understanding, respecting, and taking responsibility for one's offspring (reproduction), as well as exploring and settling in safe environments rich in the resources necessary for survival.

The biophilia hypothesis was later further developed by E. O. Wilson (Harvard University) and S. R. Kellert. According to these authors, biophilia is structured around two fundamental constructs: fascination and affiliation (Kellert, Wilson, 1993).

Fascination refers to a mental state elicited by nature that activates a form of involuntary attention, one that does not require conscious effort. When involuntary attention is engaged, directed attention (that is, concentration) is able to rest and recover.

Affiliation, by contrast, is a trait of human temperament, or personality, that can be developed over time and reflects a predisposition to relate effectively to the natural world. This relationship may involve both attraction toward nature (biophilia) and fear of certain natural elements (biophobia).

A strong sense of affiliation - feeling safe and at ease within a natural environment - has been shown to reduce stress. Together, fascination and affiliation contribute to the development of naturalistic intelligence, understood as the capacity to recognize, classify, and comprehend elements of the natural world, such as plants, animals, and environmental phenomena, while demonstrating sensitivity to and connection with nature (Barbiero, 2021). Conversely, individuals who are not exposed to natural environments may fail to develop a sense of

affiliation with nature and may therefore experience difficulties in cultivating this dimension of emotional and relational intelligence (Barbiero, Berto, 2016).

In a world increasingly shaped by urbanization, where access to natural spaces is becoming more and more limited, how can these fundamental human characteristics be fostered and developed?

LEARNING IN AND THROUGH NATURE: PEDAGOGICAL APPROACHES

"[...] we² all made ourselves prisoners voluntarily (of the artificial life created by urban cohabitation), and we ended up loving our prison and pass it on to our children. Nature has been gradually restricted, in our mind, to the flowers that grow, and domesticated animals useful for our nutrition, for our work, or for our defense. With this, even our soul has become numb..." (Montessori, 1999).

As discussed so far, connectedness to nature and the capacity to perceive the restorative qualities of environments characterized by natural elements can be understood as personal attributes that are partly innate and partly shaped through experience. Biophilia, therefore, is not solely an inborn disposition but is also influenced by individual and collective experiences and by a range of cognitive, affective, and sociocultural factors.

However, as urbanization continues to expand, both the availability and the accessibility of spaces that enable direct interaction with natural ecosystems are progressively diminishing. This is not merely the result of the physical expansion of built infrastructure and the steady advance of concrete within urban environments. It is also the outcome of broader socio-spatial dynamics that reshape how green areas are distributed, regulated, and experienced. Increasingly, access to nature within cities is mediated by economic barriers, as certain green spaces require entrance fees, thereby limiting opportunities for lower-income groups to engage with natural environments. At the same time, such spaces are often scarce, unevenly distributed, and located at considerable distance from residential areas, making them particularly difficult to reach for children. Furthermore, concerns related to violence and crime, exposure to road traffic risks, and inadequate maintenance or sanitary conditions may undermine their perceived and actual safety. Taken together, these factors contribute to a gradual erosion of everyday, spontaneous contact with nature, especially for younger generations (UNICEF, 2028). This reduction in everyday contact with nature complicates the development of a sense of affiliation with the natural world and raises concerns about individuals' ability to benefit from the psychophysical restorative effects typically associated with natural environments (Stocco, et al., 2023).

In light of this scenario, an essential question emerges: is it possible to re-establish meaningful contact with nature within contemporary societies?

In recent decades, numerous educational perspectives have sought to address this very issue by reaffirming the importance of sustained and meaningful interaction with the natural world. Approaches such as forest schools and outdoor education have reimagined learning as an

² "We" refers to industrialized and economically affluent societies, particularly the Global North.

experience that extends beyond the physical and symbolic boundaries of the classroom, positioning nature not as a backdrop to education, but as an active and formative context for it.

This renewed attention to nature-based learning is not entirely recent. Rather, it builds upon pedagogical traditions developed throughout the twentieth century. Influential thinkers such as Maria Montessori, John Dewey, and Mahatma Gandhi each recognized the profound educational significance of direct engagement with the natural environment. For these authors, contact with nature was not a marginal or recreational complement to formal instruction, but a foundational dimension of human growth and development (Infanti, 2014).

In addition to emphasizing natural spaces more broadly, these thinkers paid particular attention to the educational potential of school vegetable gardens. Such gardens were understood as tools for creating a tangible and meaningful connection between children and the natural world. The role of the vegetable garden as an educational instrument - especially in contexts where access to green spaces is limited - is a central focus of this thesis. It is therefore useful to introduce the concept of the educational garden through the perspectives of those who have studied it as a pedagogical tool.

Maria Montessori placed particular emphasis on sensory education as the foundation of intellectual growth. She regarded the vegetable garden as both a moral and educational space, in which caring for living organisms could nurture responsibility, attentiveness, and a sense of purpose in children. Through the act of looking after plants, children were encouraged to recognize their role within a living system and to develop an ethic of care grounded in direct experience.

Similarly, John Dewey emphasized school vegetable gardens as places that allowed students to study scientific concepts - such as plant growth, soil composition, and ecological relationships - not as abstract notions, but as lived experiences. Learning in this context became active, contextualized, and deeply connected to everyday life. Mahatma Gandhi also underscored the importance of rural and natural environments as formative educational settings, advocating for the integration of manual work and craftsmanship as essential components of human development, rather than as inferior alternatives to intellectual labor (Infanti, 2014).

Within such perspectives, learning unfolds through direct engagement with natural environments, enabling children to discover ecological principles firsthand while developing a sense of connection with the land.

In recent decades, scholars such as David W. Orr and Fritjof Capra have further developed this perspective. Orr, in particular, emphasizes the importance of early childhood as a phase characterized by heightened openness and sensitivity to the natural world. According to Orr, before patterns shaped by consumerism, technology, and urban lifestyles become dominant, children often exhibit a spontaneous attraction to living systems. When this innate inclination is nurtured by attentive and knowledgeable adults, it can mature into ecological awareness and, eventually, into a more intentional and responsible way of living (Infanti, 2014).

In this sense, such a process can be understood as a concrete expression of the effectiveness of biophilia.

According to Capra:

“When we teach these principles in our schools, it is important to us that the children not only understand ecology, but also experience it in nature - in a school garden, on a beach, or in a riverbed. Otherwise, they could leave school and be first-rate theoretical ecologists, but care very little about nature, about the Earth. Pedagogy oriented toward connecting actions with full appreciation of nature’s processes - the breath of life - is therefore more than just a matter of teaching about biology and chemistry. [...] we want to create possibilities for developing abiding relationships with the natural world” (Capra, 2007, pg. 17).

Garden-based learning therefore represents a valuable educational opportunity to foster greater awareness and responsibility in relation to our ways of living. As an educational approach, it holds significant potential to support child development, promote ecological awareness, and contribute meaningfully to contemporary educational practices (Infanti, 2014).

As discussed in the previous chapter, outdoor education also offers substantial benefits in terms of psychological restoration. Giuseppe Barbiero has devoted a significant part of his research to the study of attentional restoration through outdoor activities. In “How Does Psychological Restoration Work in Children? An Explanatory Study” (Barbiero, et al., 2025), he demonstrates that certain natural environments are able to activate involuntary attention - referred to as fascination - in children. This process allows directed and sustained attention to rest and regenerate.

Together with psychologist Rita Berto, Barbiero further showed that children are capable of perceiving the restorative value of natural environments. However, their findings also highlight that sporadic or occasional contact with nature is not sufficient to produce lasting changes in children’s sense of connectedness to the natural world, a point of particular relevance for educational practice (Barbiero et al., 2025).

Barbiero also conducted attention tests similar to those presented in the following chapters of this thesis. In his study, the tests administered to the participating children were carried out in three different settings: a school courtyard in a primary school in Turin, a public urban garden in the city of Turin, and a natural environment in Gressoney. The results clearly showed that exposure to natural environments, because of the mechanism of fascination, consistently produced positive effects on children's attentional performance.

AIMS OF THE CASE STUDY

The data collection process for this thesis was structured around two main objectives, each of which was examined using a distinct data collection method.

The first objective was to examine whether, and to what extent, children's attention changes or improves after participating in an outdoor activity.

The second objective was to obtain an overview of teachers' and parents' opinions regarding the school vegetable garden as an educational tool. In particular, the study aimed to explore whether the vegetable garden is perceived as effective in achieving the following outcomes: stimulating curiosity towards nature; fostering collaboration, teamwork, and a sense of personal responsibility; restoring attention and concentration; enhancing learning and self-control; and developing a sense of belonging both to the school and to nature itself. Additionally, data were collected on the level of difficulty teachers experience in maintaining a vegetable garden, considering their overall workload during the school year, as well as on teachers' feelings and attitudes towards conducting educational activities outdoors.

The overall aim of the thesis is therefore to provide a comprehensive overview of the usefulness of the school vegetable garden, from the perspectives of teachers and parents, as a tool to reconnect children with nature and to promote a sense of belonging both to the natural environment and to the school as an educational setting. Furthermore, the study seeks to understand, by listening to teachers' perspectives, how feasible it is to implement and sustain such a project, taking into account factors such as workload, staff availability, and bureaucratic demands. Finally, the research aims to determine whether children are effectively more relaxed and focused after participating in garden-based activities, compared to after completing activities conducted exclusively indoors.

MATERIALS AND METHODS

The data analyzed in this study were collected from two primary schools located in Friuli Venezia Giulia region, in north-eastern Italy (figure 1). Both schools are situated in urban contexts and serve children attending city-based educational institutions. Each school includes an outdoor garden area; however, these spaces are highly anthropized, in the sense that the grass is regularly and meticulously maintained and the trees have been deliberately planted rather than having developed naturally. As a result, the areas are predominantly characterized by built or structured elements, with a limited presence of spontaneous natural features. The characteristics of these school environments are relevant for contextualizing the outdoor activities implemented and for interpreting their potential effects on children's attentional performance.

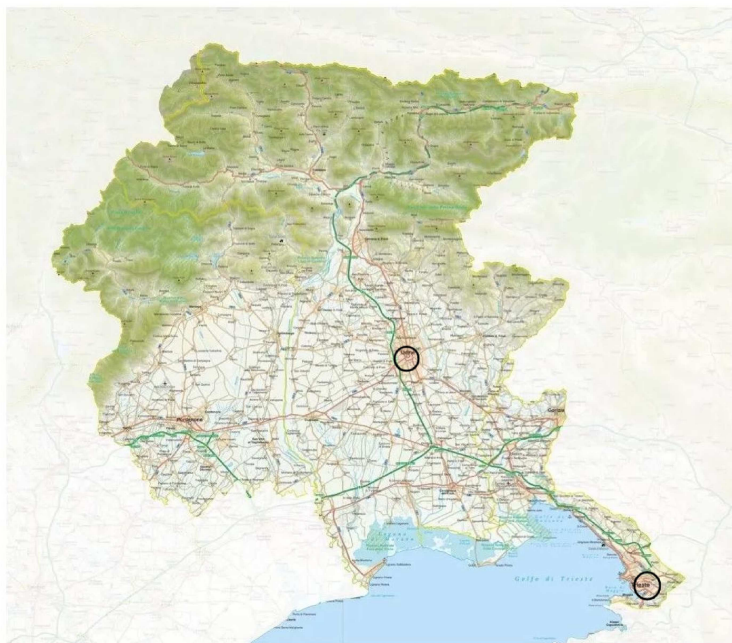


Figure 1. Map of Friuli Venezia Giulia. Black circles indicate the cities where the schools participating in the study are located.

Data were collected using two different methodological approaches: to assess whether participation in an outdoor activity influenced children's attentional performance, a standardized attention test developed by Cornoldi (Marzocchi, et al., 2010) and readapted by Ca' Foscari University of Venice was administered.

The paper-pencil test consisted of visual search grids in which participants were required to identify and mark a predefined target sequence (FZB) whenever it appeared (as shown in figure 2). The time taken by each participant to complete the test was recorded during administration.

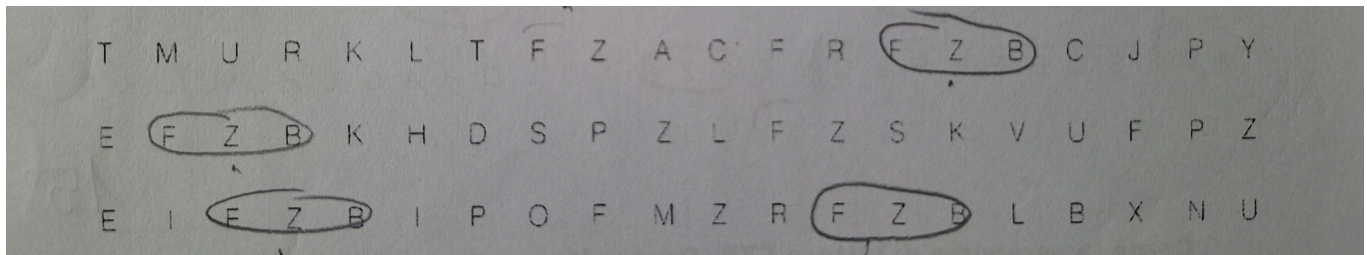


Figure 2. Example of an FZB sequence to be identified and underlined, taken from one of the tests completed in class.

After completion, the total number of correctly identified target sequences was determined for each participant. These measures allowed for the quantification of attentional performance in terms of both task completion time and number of detected sequences. The final score of the test was considered in terms of seconds taken for the completion of the test, as declared by participants, to which an additional time of +5 seconds was added for each omission or incorrect target that might have occurred.

To obtain an overview of teachers' and parents' opinions regarding the school vegetable garden as an educational tool, two distinct questionnaires were developed: one addressed to schools that currently have an active school vegetable garden and one to schools that do not.

Both questionnaires aimed to investigate parents' and teachers' perceptions of the educational value of using a school vegetable garden, as well as the perceived feasibility of maintaining such a garden over time. The survey items were organized into two main thematic areas:

The first area explored the extent to which teachers and parents believed that a vegetable garden could contribute to specific educational and developmental outcomes, including curiosity toward nature, collaboration and group work, personal responsibility, attention and concentration, learning processes, self-regulation, sense of belonging to nature, sense of belonging to the school community, and opportunities for outdoor learning activities.

The second area focused on the perceived complexity of maintaining an active school vegetable garden and the main challenges associated with it. These included lack of time, limited natural or material resources, insufficient collaboration among teaching staff, climatic and seasonal constraints, limited student interest, and the potential abandonment of the garden during the summer period due to school closure.

The same set of questions was administered in both schools with and without an existing school vegetable garden. In schools with a vegetable garden, responses were based on

participants' direct experience, whereas in schools without it, responses reflected perceptions, expectations, and attitudes toward the potential implementation of a vegetable garden, including whether it was considered a desirable and effective educational resource.

The questionnaires included both open-ended and multiple-choice questions.

The questionnaire sent to schools with a vegetable garden included items aimed at investigating: the frequency of activities conducted in the garden; the children's behavioral and attitude changes, as perceived by teachers and parents, as a result of using the garden as an educational tool - particularly in terms of curiosity toward nature, collaboration and teamwork, personal responsibility, attention and concentration, learning, self-control, sense of belonging to nature, sense of belonging to the school, and engagement in new outdoor activities. It also examined which activities aroused the greatest interest among children; the main challenges in managing a lesson in the garden (such as lack of time, insufficient natural resources, limited collaboration among teachers, climatic or seasonal difficulties, low pupil engagement, and scarcity of funds for gardening activities); classroom management and the level of teacher fatigue; bureaucratic difficulties; teachers' willingness to be supported by an external figure in conducting garden-based activities; suggested modifications or improvements; how often children shared their gardening experiences at home; and parents' feedback regarding their children's emotional well-being.

Conversely, the questionnaire sent to schools without a garden was designed to gather perceptions and feelings related to the garden as an educational tool. The questions were similar to those in the survey for schools with a garden, but were formulated to collect opinions and attitudes from teachers and parents rather than concrete data.

Please note that some of the questionnaire items - both in questionnaires sent to schools with a garden and without it - were identical for teachers and parents. The graphs presented in this thesis refer to the questions that were the same for both parents and teachers; therefore, the responses were reported together in two graphs: one dedicated to the responses collected from schools with a garden, and one to the responses collected from schools without a garden.

The questions related to the graphs asked teachers and parents to indicate, on a scale ranging from *significantly decreased*, *decreased*, *no evident change*, *increased*, to *greatly increased*, the extent of changes observed in children with respect to several variables, that will be indicated next to each graph.

The responses to the questions addressed exclusively to teachers and those addressed exclusively to parents are reported here in written form (meaning without a graph).

In conclusion, two open-ended questions were administered. For teachers at the school with an educational garden, the first question asked whether they believed that support from an external professional during garden-based activities would be beneficial. The second question explored what changes they would like to make to their school's educational garden.

For teachers at the school without an educational garden, the first question asked what factors would most motivate them to participate in a school garden project. The second question investigated whether support from an external professional could assist them in managing students during garden-based activities.

RESULTS

On the results of tests.

The tests were administered to one class in the school without a garden and to one class in the school with a garden. In the school without a garden, 15 children completed the test, whereas in the school with a garden, 17 children participated.

Figure 1 presents the results of each participating student based on the time taken to complete the questionnaires.

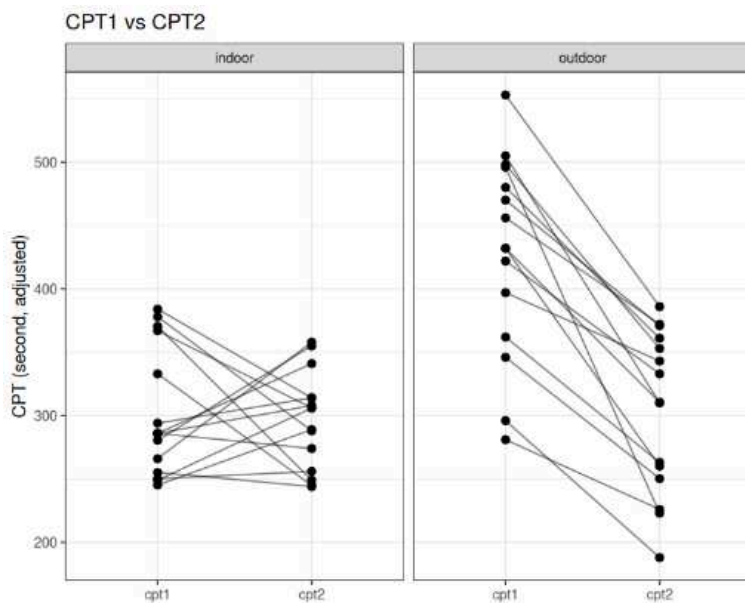


Figure. 1 Scores obtained by each participant (one dot = one participant) before the activity (cpt 1), and after the activity (cpt2); left panel = indoor activity, right panel = outdoor activity.

Indoor activity: when comparing the questionnaire results obtained before the indoor activity with those obtained after the activity, the findings appear to be mixed. Specifically, some children required more time to complete the test prior to the activity, while others required less time.

Outdoor activity: in the graph displaying the pre- and post-outdoor activity results, it can be observed that all children took less time to complete the test after participating in the outdoor activity.

As can be observed from figure 1 during the first test (baseline), the children who participated in the outdoor activity required a longer completion time compared to the children who took part in the indoor activity. This difference might be attributed to the timing of test administration: the

indoor activity group completed the first test at 8:30 a.m., shortly after the beginning of the school day, whereas the outdoor activity group completed the first test after approximately one hour of teacher-led classroom instruction. Consequently, the latter group may have begun the assessment in a more fatigued state compared to the former sample.

Nevertheless, as shown in figure 2, in the indoor condition, the table shows that, overall, children required a longer average time to complete the test after the classroom activity (mean difference = -16.33 seconds, SD = 69.54 seconds).

In contrast, the outdoor condition clearly indicates that children required significantly less time to complete the test after the outdoor activity (mean difference = -119,53 seconds, SD = 59,88 seconds).

Figure 2 illustrates the performance results of the children before and after the indoor activity, as well as those of the children who completed the tests before and after the outdoor activity, highlighting the mean scores. For the indoor group, the CPT1 (baseline) and CPT2 (time taken to complete the test after the indoor activity) do not differ significantly (Wilcoxon test p-value = 0.847). On the contrary, for the outdoor group, the average time needed to complete the test after the outdoor activity - CPT2 - is significantly lower than the average time required to complete the baseline test - CPT1 (Wilcoxon test p-value = 0.000725).

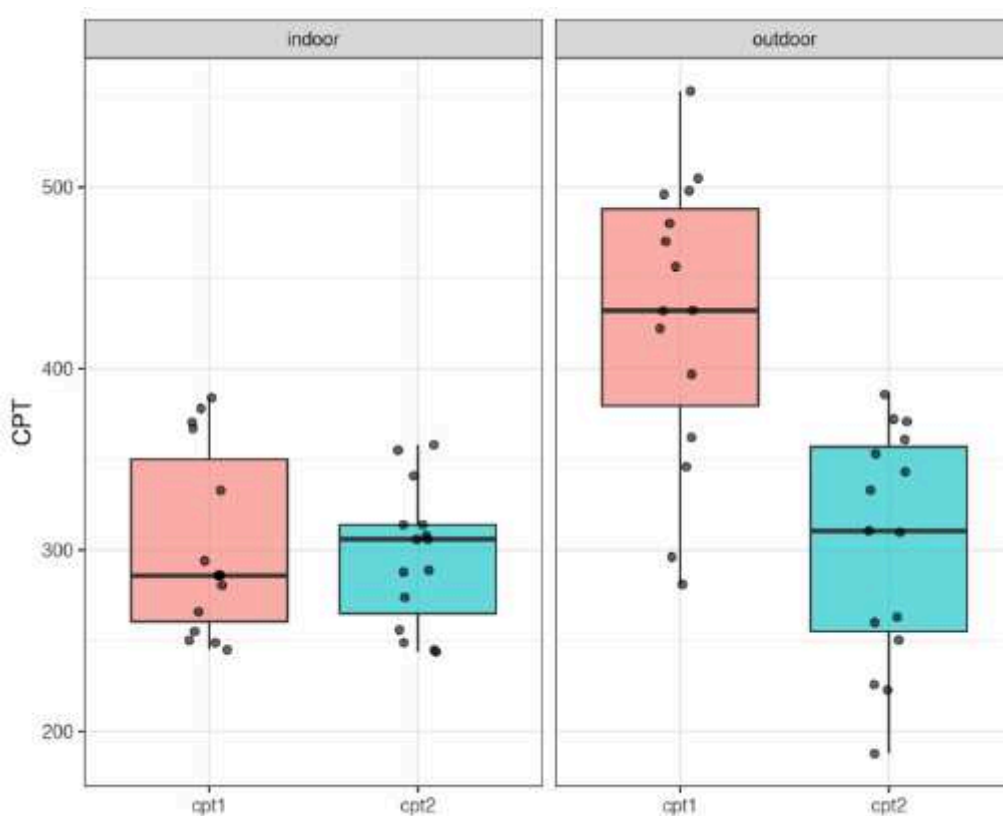


Figure 2. Scores obtained by each participant (one dot = one participant); pink and blue shaded areas delimit the time range within which the majority of children completed the test; thick line = mean time required to complete it; left panel = indoor activity; right panel = outdoor activity.

Figure 3 presents the variation in test completion time from the baseline assessment (CPT1) to the post-experience assessment (CPT2), illustrating how performance time changed after the intervention. In this context, “Delta” refers to the difference between the time taken to complete the after-experience test, cpt2, and the time taken to complete the baseline test, cpt1, according to the equation:

$$\Delta\text{CPT} = \text{CPT2 [seconds]} - \text{CPT1 [seconds]}$$

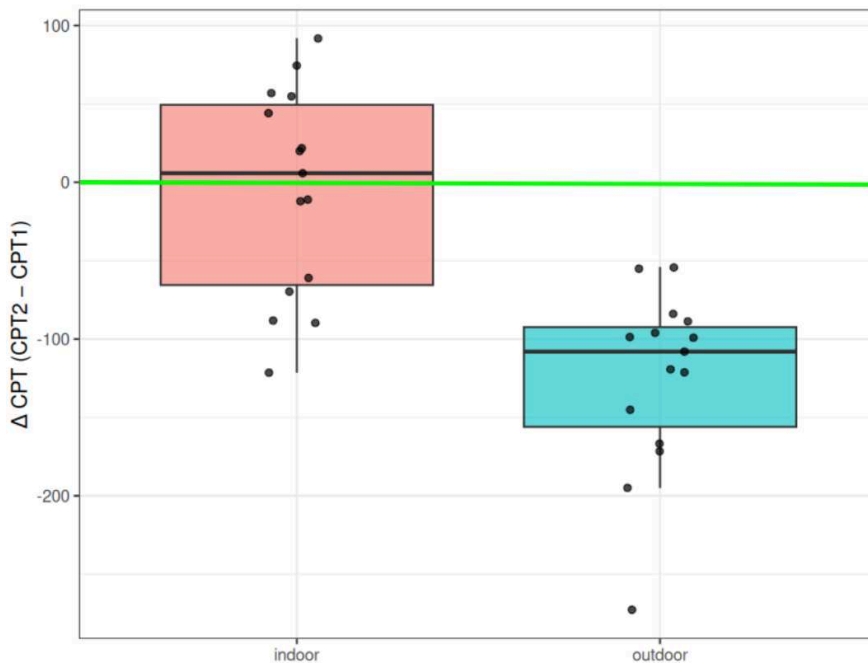


Figure 3. Scores obtained by each participant (one dot = one participant). pink and blue shaded areas delimit the time range within which the majority of children completed the test; pink box = indoor activity; blue box = outdoor activity; thick line within each panel = median; green line = highlight the value Delta =0 (no difference between CPT2 and CPT1).

The variation of the time taken to perform the test is significantly different in the two groups (Wilcoxon test on pairwise differences p-value = 0.000147). Specifically, the group of students who were engaged in the indoor activity not only resulted in a CPT2 similar or even higher time taken than CPT1, with a mean difference of -16.33 (±69.54 s.d.) seconds; the group engaged in the outdoor activity scored better in CPT2 than in CPT1, with a mean difference of -119.53 (±59.88 s.d.) seconds, that is, more than a minute and a half saved, on average.

On the results of questionnaires.

Results of the teacher/parent questionnaires - schools with a garden.

The questionnaires developed for this thesis were distributed to two local schools. The estimated number of potential respondents was approximately 20 teachers in the school without a garden and a maximum of 15 teachers in the school with a garden. In the school without a garden, responses were received from 18 teachers and only one parent, whereas in the school with a garden, 7 teachers and 11 parents completed the questionnaire.

Figures 1 - 7 group together teachers' and parents' responses regarding the types of changes they observed in their students/children behavior and attitudes since the garden has been used as an educational tool.

Figure 1 presents the percentage distribution of teachers' and parents' responses to the question: 'Have you observed changes in *attention and concentration* in your child or student following the introduction of the school vegetable garden?'.

All subsequent figures present graphical representations of teachers' and parents' responses to the same question shown in figure 1, but with respect to a different variable, namely: figure 2, *Learning*, figure 3 *Self-control*, figure 4 *Collaboration and Teamwork*, figure 5 *Personal responsibility*, figure 6 *Sense of belonging to nature*, figure 7 *Sense of belonging to school*.

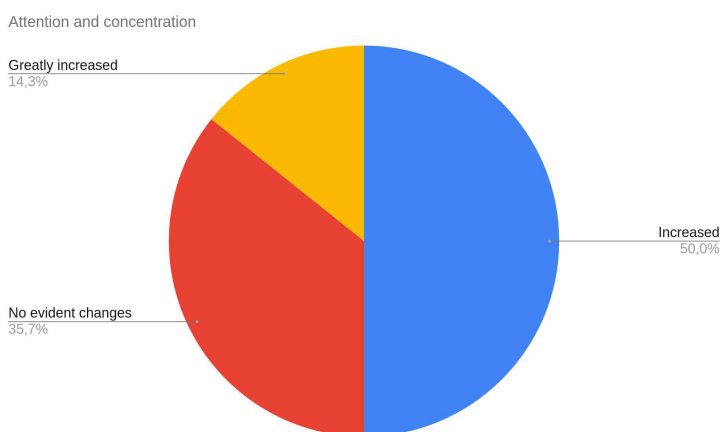


Figure 1. Pie chart showing responses to the variable *Attention and concentration*.

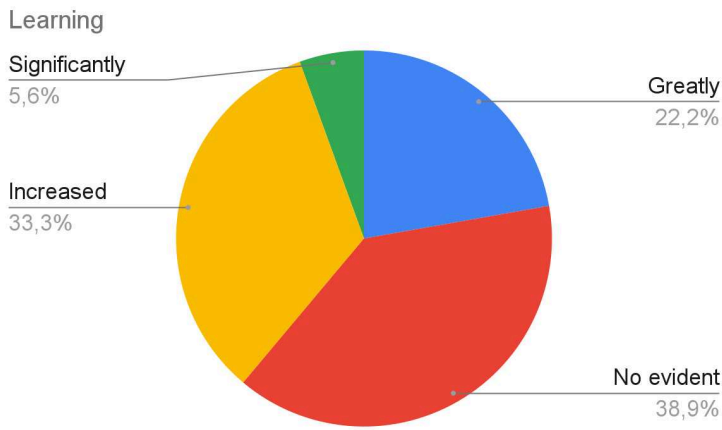


Figure 2. Pie chart showing responses to the variable *Learning*.

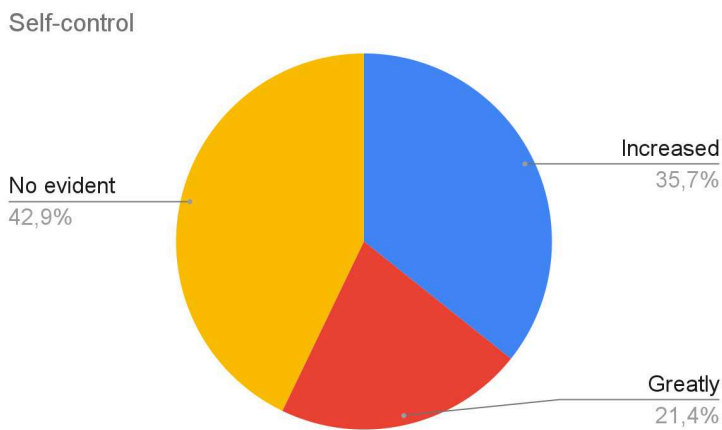


Figure 3. Pie chart showing responses to the variable *Self-control*.

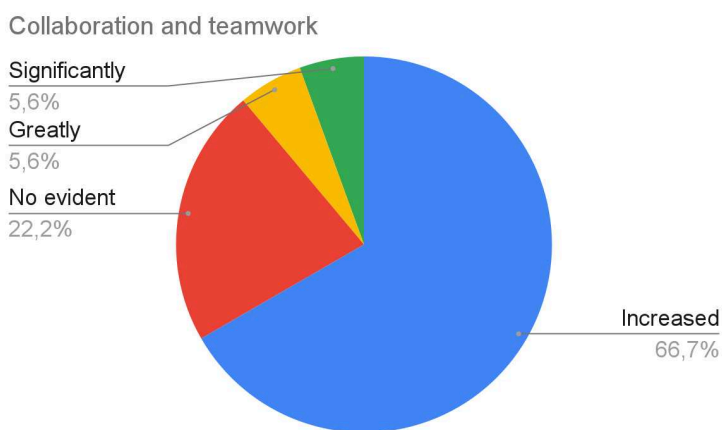


Figure 4. Pie chart showing responses to the variable *Collaboration and teamwork*.

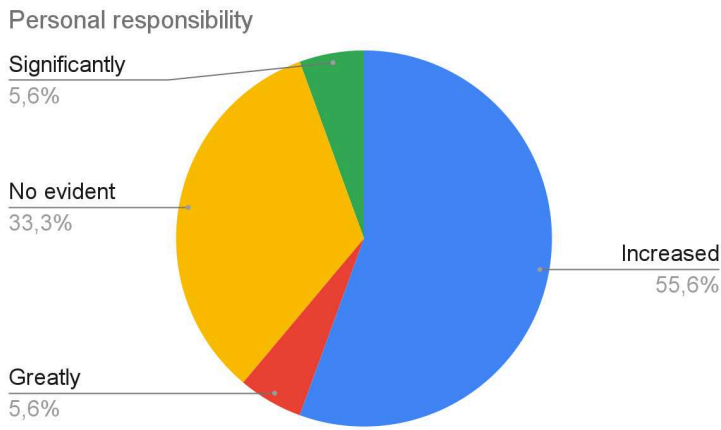


Figure 5. Pie chart showing responses to the variable *Personal responsibility*.

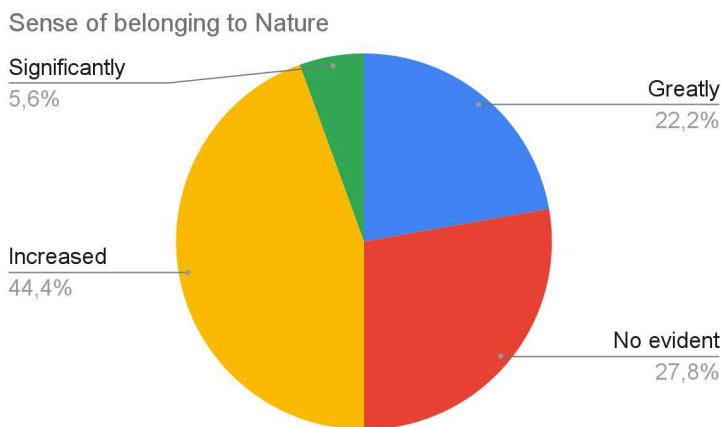


Figure 6. Pie chart showing responses to the variable *Sense of belonging to nature*.

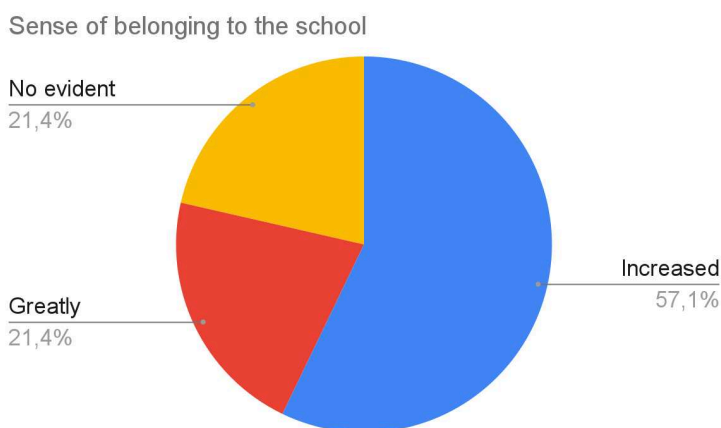


Figure 7. Pie chart showing responses to the variable *Sense of belonging to the school*.

Teachers' responses to questions specifically addressed to them.

Based on teachers' answers to the questionnaire, a series of trends can be highlighted.

- *Activities perceived as most engaging for children in the school garden.*

The majority of teachers reported that they are able to carry out garden-based activities two or more times per month, predominantly during the spring season.

- *Frequency of garden-based activities.*

Teachers observed a significant number of students interested in garden activities, which included hands-on laboratory activities, measurements, soil preparation, maintenance, harvesting, direct use of their hands in the soil, sowing, watering, discovering seeds in fruit, caring for and cleaning the spaces, and waiting for the plant life cycle to unfold.

- *Classroom management.*

Using a scale that included the options *more difficult*, *slightly more difficult*, *the same*, *slightly easier*, and *easier*, 33.3% of teachers indicated that classroom management was slightly more difficult, 33.3% reported it was the same, 16.7% that it was slightly easier, and the remaining 16.7% that it was easier.

- *Teacher's personal fatigue in managing the classroom during garden activities.*

Using a scale including the options *very little*, *little*, *neither little nor much*, *much*, and *very much*, 14.3% of teachers stated that the level of personal fatigue resulting from managing a lesson in the garden was *little*, 57.1% reported that it was *neither little nor much*, and 28.6% reported that the level of fatigue was *much*.

- *Difficulties they encounter on a daily basis in managing the educational garden.*

For each of the issues listed below, the percentage of teachers who reported the corresponding difficulty is also provided.

A lack of daily time to carry out garden-based activities was reported by 57.1% of teachers; 14.3% reported a lack of natural resources; 28.6% indicated limited collaboration within the teaching team; 42.9% reported climatic or seasonal difficulties; 14.3% experienced difficulties in accessing dedicated funding; and 14.3%, in addition to a lack of funds, also reported excessively long waiting times for obtaining the materials necessary for the creation and maintenance of the garden.

- *Bureaucratic aspects:*

Teachers were asked to rate the following issues on a scale ranging from *not encountered*,

encountered but easily overcome, to *encountered and impossible to manage*: authorization and permits for land use, for which 57.1% reported no difficulties and 42.9% reported difficulties that were easily overcome; school regulations related to child safety, for which 28.6% reported no difficulties and 71.4% reported difficulties that were easily overcome; funding and expense management, for which 14.3% reported difficulties that were impossible to manage, 28.6% reported no difficulties, and 57.1% reported difficulties that were easily overcome; and insurance requirements, for which 16.7% reported difficulties that were impossible to manage, while 83.3% reported no difficulties.

- *Responses to open-ended questions.*

In response to the question focusing on the opportunity to be supported by external expertise, all teachers indicated that being supported by another person would be helpful. Some teachers specified that such support would be highly beneficial; others stated that it would be useful only on certain occasions; and others indicated that they would prefer this person to be a support teacher, as this would simplify classroom dynamics.

In response to the question about possible operational changes and suggestions, many teachers emphasized the need for better spaces and tools dedicated to the garden, such as higher-quality soil, greater sun exposure, and appropriate equipment for mowing and tilling. One teacher expressed a desire to increase the involvement of parents and/or grandparents, both in managing the garden and in caring for it during the summer months, when the school is closed. Another teacher reported a wish to be able to taste the vegetables produced in the garden; however, this was currently not possible because the garden does not meet the legislative requirements necessary for food consumption.

Parents' responses to questions specifically addressed to them.

- *Responses to open-ended questions.*

Parents were asked whether, in their opinion, the garden experience could have a positive impact on their children's emotional well-being and, if so, in what ways. All parents reported perceiving a positive impact, citing the following reasons: children learn to understand the outcomes of their own work; they enjoy working with nature; they learn to protect it; they develop greater patience and improved self-control; they are highly engaged in outdoor activities, which makes them happier and more involved; and they show strong interest in plants, gardening tools, and soil.

Parents were also asked whether they would like to change anything about the school's educational garden. Some stated that they would not change anything, while others expressed a desire for garden activities to be carried out more frequently and throughout the entire year, in order to help children better understand the value of the work carried out in the garden. One parent expressed the wish for greater parental involvement, while another suggested introducing more creative activities that encourage children to spend more time in contact with nature and to take greater care of plants.

Results of the teacher/parent questionnaires - schools without a garden.

Figure 1 presents the percentage distribution of teachers' and parents' responses to the question: 'Have you observed changes in *Curiosity towards nature* in your child or student following the introduction of the school vegetable garden?'.

All subsequent figures present graphical representations of teachers' and parents' responses to the same question shown in Figure 1, but with respect to a different variable, namely: figure 2 *Collaboration and Teamwork*, figure 3 *Personal responsibility*, figure 4 *Attention and concentration*, figure 5 *Learning*, figure 6 *Self-control*, figure 7 *Sense of belonging to nature*, figure 8 *Sense of belonging to school*, figure 9 *New outdoor activities*.

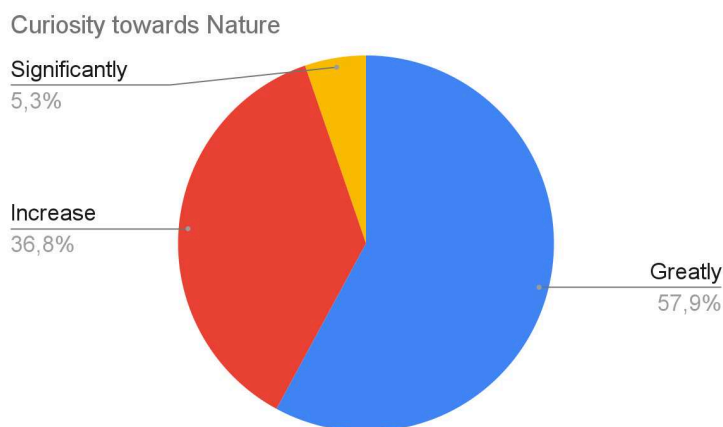


Figure 1. Pie chart showing responses to the variable *Curiosity towards nature*.

Collaboration and teamwork

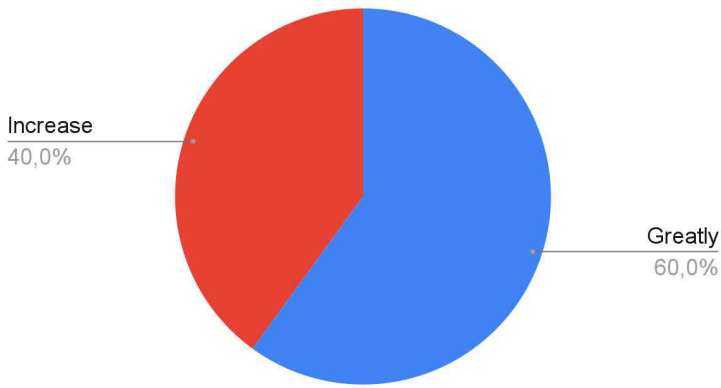


Figure 2. Pie chart showing responses to the variable *Collaboration and teamwork*.

Personal responsibility

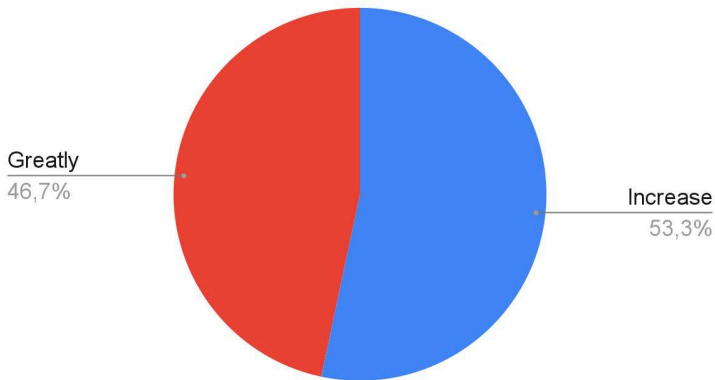


Figure 3. Pie chart showing responses to the variable *Personal responsibility*.

Attention and concentration

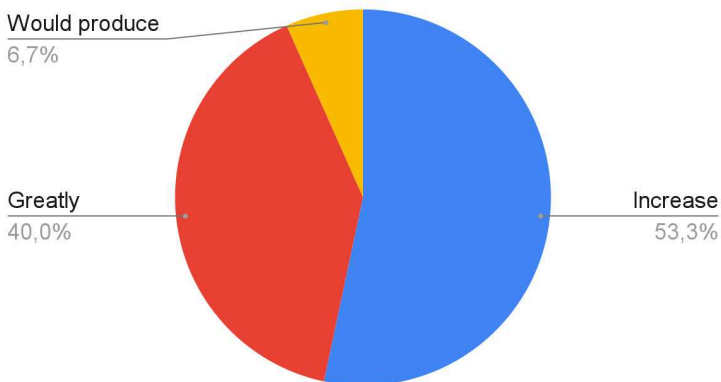


Figure 4. Pie chart showing responses to the variable *Attention and concentration*.

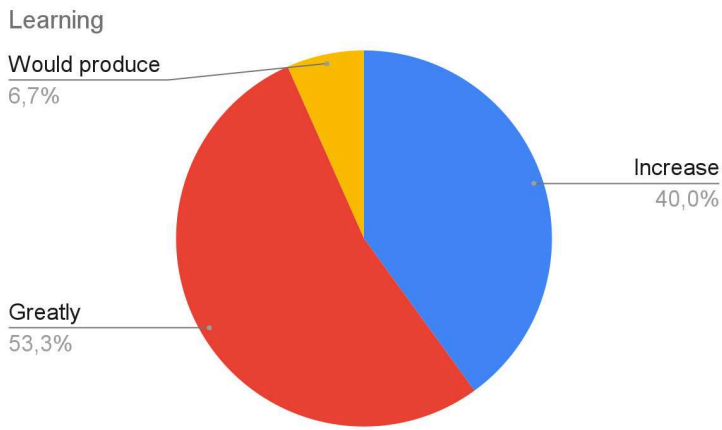


Figure 5. Pie chart showing responses to the variable *Learning*.

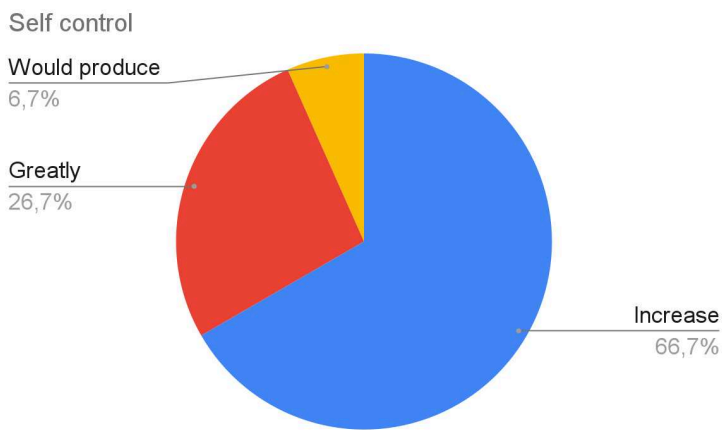


Figure 6. Pie chart showing responses to the variable *Self-control*.

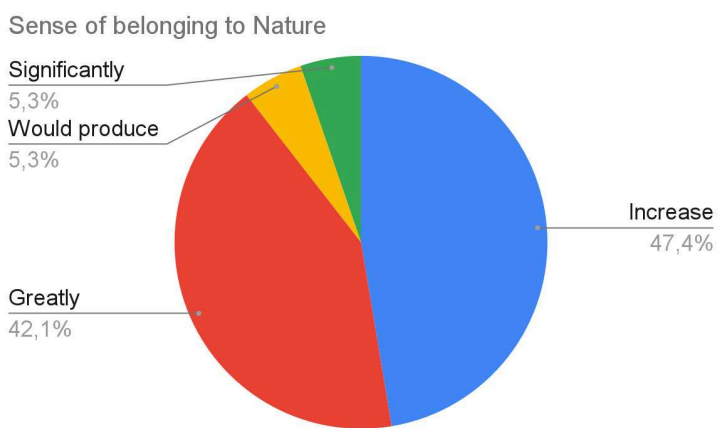


Figure 7. Pie chart showing responses to the variable *Sense of belonging to nature*.

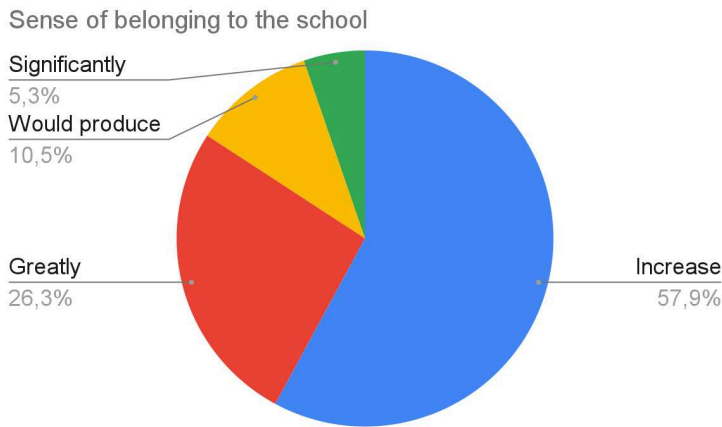


Figure 8. Pie chart showing responses to the variable *Sense of belonging to the school*.

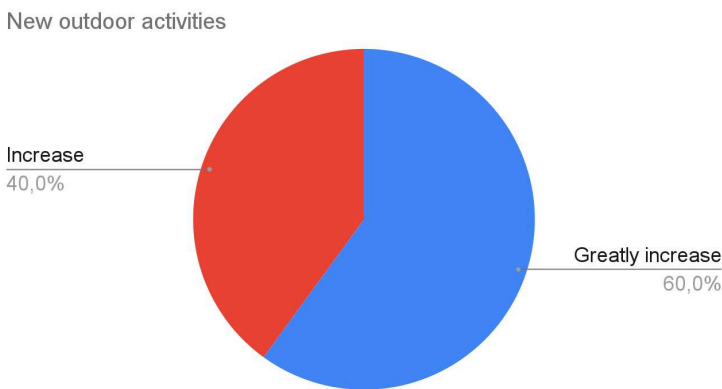


Figure 9. Pie chart showing responses to the variable *New outdoor activities*.

Teachers' responses to questions specifically addressed to them.

- *Desired and realistic time commitment.*

Teachers were asked a series of questions to assess whether they had an interest in establishing a school garden, how much time they would like to devote to it, and how much time, realistically, they would be able to dedicate to garden-based activities.

Overall, 88.9% of teachers indicated that they would like to have a school garden, 5.6% stated that they would not, and the remaining 5.6% reported having had one in the past.

When asked about the amount of time they would like to devote to the garden on a weekly basis, 5.9% stated that they would dedicate less than 30 minutes, 64.7% between 30 and 60 minutes, 23.5% between 1 and 2 hours, and 5.9% more than two hours.

With regard to the amount of time teachers could realistically devote to the garden, considering

their current workload, 5.6% reported that they would have no time available, 55.6% indicated that they could devote less than 30 minutes, 33.3% reported that they could devote between 30 and 60 minutes, and 5.6% reported that they could devote more than two hours.

- *Responses to open-ended questions.*

In response to the first question, teachers indicated that the factors which would motivate them to participate in a school garden project include: the involvement of an external expert; collaboration with parents and grandparents; the possibility of linking practical garden activities with science and other curricular subjects; the use of garden produce in the school kitchen; offering children the opportunity to care for something within the school environment that they can perceive as their own; transforming the school into an extension of the classroom; the intrinsic pleasure of cultivating the land; the opportunity to implement new outdoor activities; having more time available; and developing a shared project involving fellow teachers, families, and external institutions.

Regarding the second question, out of 14 responses, 11 teachers stated that being supported by an external organization would assist them in managing both students and garden-related activities (one respondent explicitly described such support as a valuable resource). One teacher answered “perhaps,” while two responded negatively. Of the latter, one specified that relying on internal school resources or family involvement would, in their view, make the work more manageable.

- *Responses to answers formulated for teachers who had a school garden in the past.*

Teachers who had previously managed a school garden were asked to specify how long the garden had remained active in their school, what difficulties they encountered in its use (both bureaucratic and non-bureaucratic), and, through an open-ended question, the reasons that ultimately led to the discontinuation of the project.

Overall, 14.3% of teachers reported that the educational garden project had remained active for less than one year, 42.9% for 1–2 years, 28.5% for 3–5 years, and 14.3% for more than five years. The most frequently reported difficulties were lack of time (reported by 50% of teachers), limited collaboration within the teaching team (reported by 33.3% of teachers), weather or seasonal difficulties, lack of natural resources, and the summer closure of the school, which made it difficult to harvest vegetables during the most productive period of the year (each of these latter three issues was reported by 16.7% of teachers).

The reasons reported as leading to the abandonment of the project included lack of time, difficulties in managing the garden during periods without teaching activities, staff turnover within the school (specifically, one of the two teachers responsible for the garden retired and the other was transferred to another school), as well as issues with the local municipality, which considered the garden to be “visually unattractive” during certain periods of the year.

DISCUSSION AND CONCLUSIONS

One effective way to promote a future in which individuals recognize the value of nature and are motivated to protect it is to nurture a strong sense of connection with the natural world from early childhood. Developing this bond early in life, together with the ability to perceive natural environments as restorative, may lay the groundwork for lasting pro-environmental attitudes. As Stocco et al. say, research has shown that adults who feel a deep sense of affiliation with nature are less likely to engage in behaviors that harm the environment or other living beings. Similarly, children who experience a close connection with nature tend to display sustainable behaviors from a young age and are more inclined to take part in environmental initiatives as they grow older (Stocco et al., 2023).

Fostering an emotional bond with living organisms and helping children experience the restorative qualities of natural settings can therefore be seen as an essential step toward encouraging appreciation, respect, and active engagement with the environment. At the same time, connectedness to nature and pro-environmental attitudes do not emerge automatically; rather, they develop through a complex interaction between innate predispositions and socially learned norms. Without adequate support during early childhood, this connection may weaken during adolescence. Because early developmental stages are characterized by significant cognitive growth, direct and meaningful exposure to nature during childhood represents one of the most effective ways to cultivate a positive and enduring emotional relationship with the natural world (Stocco et al., 2023).

This study offers the opportunity to consider the school vegetable garden as an educational tool capable of bringing children closer to nature, even in urban contexts where wilder natural environments are often distant or scarcely accessible. Given that a large number of schools are now located in urban areas, and that many urban green spaces - even those outside school grounds - present multiple issues related to safety, accessibility, and distance from residential areas, denying children regular and direct contact with nature may prove detrimental. Such a lack of exposure can have negative consequences not only for their psychophysical well-being, but also for the development of a sense of affiliation with the natural world, which is closely linked to the adoption of attitudes and behaviors oriented toward environmental care and responsibility.

As this study was not conducted over multiple years, it provides only immediate evidence regarding the restorative effects of nature on students. It therefore does not assess the long-term impact of gardening activities on children's sense of connectedness to nature or on

the development of biophilia. With regard to the effects of biophilia, numerous authors already cited in this thesis have demonstrated its significance. What clearly emerged from the tests, however, is that all students completed them more quickly after spending time outdoors. Even brief contact with nature appears to produce beneficial effects in terms of attentional restoration, likely due to the inherently fascinating quality of natural environments (Barbiero et al., 2025).

The questionnaire results reveal an interesting contrast between teachers who do not currently have a school vegetable garden and those who do. Teachers who do not yet have a garden but would like to implement one expressed very positive expectations regarding its educational value. In particular, they perceive the vegetable garden as a potentially effective tool for stimulating curiosity toward nature; fostering collaboration, teamwork, and a sense of personal responsibility; restoring attention and concentration; enhancing learning and self-regulation; and strengthening students' sense of belonging both to the school community and to the natural environment.

By contrast, among teachers who already have a school vegetable garden, at least 21% consistently reported that they had not observed evident changes in their students. Nevertheless, the remaining teachers did report noticeable effects, which were predominantly positive and aligned with the dimensions mentioned above, especially in terms of increased curiosity toward nature and improvements in related cognitive and social variables.

These findings raise an important question: even when a school vegetable garden is available, do children spend sufficient time engaging with it to fully benefit from the restorative and developmental effects associated with contact with nature? It is possible that limited or sporadic exposure may reduce the overall impact of such initiatives, suggesting the need for more consistent and structured integration of garden-based activities into the school curriculum.

A considerable proportion of teachers working in schools with a vegetable garden reported that activities are carried out less than once a week. This limited frequency is particularly relevant in light of the findings of Barbiero, Berto, and Maculan, according to whom occasional exposure to nature is not sufficient to significantly modify an individual's level of connectedness. Rather, a genuine sense of affiliation with the natural world appears to develop only after approximately 18 months of continuous and meaningful contact (Barbiero et al., 2025).

In this perspective, it would be valuable to investigate whether regular and long-term engagement in school gardening activities could foster affiliation with nature to a degree comparable to experiences in more explicitly wild environments.

Evidence from the study conducted by Infanti on educational vegetable gardens suggests that children who actively participate in gardening activities develop greater awareness of sustainable practices, including behaviors that promote both planetary sustainability and personal health (Infanti, 2014). However, Infanti's findings also indicate that children who, despite having access to a school vegetable garden, engage in only a limited number of activities throughout the year do not show significant improvements in terms of connectedness to nature.

Taken together, these observations highlight the importance not merely of providing access to a school garden, but of ensuring consistent, structured, and long-term involvement in garden-based activities in order to generate meaningful developmental and relational outcomes.

Why, then, has the school garden not been used more extensively in many of the schools that already have one?

For the purposes of this thesis, it was important not only to examine whether teachers and parents were supportive of a more experiential form of education - based on hands-on activities and direct contact with the soil - but also to explore the critical issues encountered in practice. In particular, attention was given to the challenges reported both by teachers who would like to implement a school garden project and by those who already manage one. Understanding the difficulties that have, over the years, impeded the establishment, maintenance, or continuity of school gardens is essential in order to assess the feasibility of such initiatives.

Collecting and analyzing opinions specifically related to these obstacles is therefore crucial. Identifying the practical, organizational, or structural barriers involved may help determine whether such challenges can be addressed effectively and whether, once resolved, there would be sustained motivation to initiate or continue a school garden project.

One of the most frequently reported challenges was the lack of time and the limited collaboration within the teaching team. Only a very small number of teachers expressed reluctance toward the idea of being supported by an external expert. This finding is particularly noteworthy: the presence of an external facilitator responsible for managing the garden and guiding students in related activities could potentially make the implementation process smoother and more sustainable. Based on the responses collected through the questionnaires, teachers appear to be generally open to this possibility, suggesting that such an approach may be worth considering in practice.

No significant bureaucratic obstacles emerged from the data, which is encouraging in the event that new school gardens are to be established. Moreover, the region of Friuli Venezia Giulia stands out as the only Italian region where schools are permitted to consume the vegetables grown on school gardens, thanks to a specific agreement with the local health authority (ASUGI, 2023). This represents an important institutional support that could further incentivize the development of educational gardens.

Another frequently mentioned issue concerns the lack of adequate space. At the same time, many respondents highlighted the desire to involve grandparents and parents in garden-related activities - a willingness that appears to be shared by families themselves. This suggests that, despite certain structural limitations, there is a strong community interest that could be harnessed to strengthen and sustain school garden initiatives.

“The human environment on Earth will likely undergo further degradation. Already today, in many regions it is becoming detrimental to human health and life. That is why environmental education by means of nature and its preservation has become one of the basic problems of our civilization. Therefore, today, starting with primary education, and even with preschool education, people should be made more aware of the importance of the natural environment for human existence and they should be prepared for nature protection better than ever before” (Jagiello, et al., 2021).

As discussed throughout this thesis, children are born with a “physiological” affiliation with Nature; however, it is their lived experiences that determine whether this innate tendency is maintained or gradually lost over time (Stocco et al., 2023). Unfortunately, the modern world offers far fewer green spaces than were available prior to the current phase of intense urbanisation. In an increasingly built-up environment, how can individuals develop a meaningful affiliation with Nature if it is largely absent from their everyday lives?

The availability of natural spaces within residential neighbourhoods proves to be essential (UNICEF, 2018). Children’s independent mobility is typically limited, and their daily experiences tend to unfold within a relatively short distance from home or school. Consequently, access to nearby green areas plays a crucial role in sustaining regular contact with natural environments.

Stocco et al. (2023) further argue that even agricultural landscapes can contribute to nurturing biophilic traits during developmental years. Although farmlands and croplands do not always guarantee free access to environmental affordances, outdoor play in vegetated settings - even in rural landscapes predominantly characterised by crops - can help maintain a connection with nature.

According to Stocco et al. (2023), the accessibility and visibility of authentic natural spaces represent compelling factors that deserve particular attention from urban planners, especially in northern Italy, an area characterised by some of the highest rates of land consumption in the country. Numerous strategies may be adopted to address this challenge, encouraging both exploration and creativity. Among the most effective actions are the creation of mini-forests within urban environments as alternatives to conventional urban parks; the enhancement of trees and natural elements along streets and among buildings; the development of green spaces dedicated to physical activity; and the widespread implementation of nature-based solutions, such as a vegetable garden. Nevertheless, increasing the availability of semi-natural and natural environments should be considered only one component of a broader strategy, which must also encompass social and pedagogical transformations.

In this regard, the school vegetable garden may represent a valuable tool for fostering children's more direct and continuous contact with Nature. By engaging in gardening activities, children are offered hands-on experiences that promote active interaction with natural processes, thereby strengthening their sense of connection with the living environment. The questionnaire results therefore suggest that there are no insurmountable obstacles to the creation and maintenance of a school garden. This is undoubtedly a positive finding, as it indicates that there may be fertile ground for meaningful change.

Considering that children spend a substantial portion of their daily time in schoolyards under the guidance of teachers, with whom they establish meaningful educational relationships, it would be advisable to make these educational spaces greener and more ecologically enriched.

In conclusion, fostering children's connection with Nature requires a multidimensional approach that integrates urban planning, educational practices, and social awareness. While the increasing urbanisation of contemporary environments has reduced everyday opportunities for spontaneous contact with natural settings, strategic interventions - both within residential neighbourhoods and educational contexts - can help counterbalance this trend. Among these, the school vegetable garden can be a meaningful and feasible initiative. By embedding regular, hands-on experiences with natural processes into children's daily routines, schools can play a crucial role in sustaining biophilic tendencies and nurturing environmentally responsible attitudes. Strengthening the ecological quality of schoolyards and educational spaces is therefore not merely an aesthetic improvement, but an investment in children's well-being and in the cultivation of future generations capable of caring for the natural world.

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