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Exploring the Effect of Environmental Programs on Primary School Pupils' Knowledge and Connectedness Toward Nature

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Abstract

In recent years, environmental education has focused on developing pupils' knowledge of the natural environment rather than enhancing their connectedness with nature, which could have a greater contribution to addressing the environmental problems caused by human activity. This study explores the impact of an environmental education program on participants' nature connectedness using Schultz's Inclusion of Nature in Self emotional scale (INS). The analysis of data collected from 283 primary school students indicated the positive effect of outdoor activities on pupils' knowledge and awareness. In addition, it was found that students with previous experience of environmental education programs tend to feel more connected with nature but also retain the knowledge obtained compared to other students.

Keywords

environmental education, inclusion of nature in self (INS), nature connectedness, outdoor education

Introduction

Modern environmental problems are inseparable from the human relationship to nature. The need to improve humanity's behavior toward the natural world becomes ever more clear. Individuals who appreciate nature values and feel connected with the natural environment are more likely to exhibit environmentally responsible behavior (Clayton, 2003; Dunlap et al., 2000; Frantz et al., 2005; Nisbet et al., 2009). In order to address environmental problems, humankind must re-establish its bonding with the natural world (Braun & Dierkes, 2017). Hence, the path that they must follow, in order to achieve sustainability through environmental awareness, is to believe that they are one with nature (Schultz, 2002).

On the other hand, the environmental impact of our behaviors has been obscured by the biophysical disconnectedness caused by our modern way of life (Saravanakumar, 2020), industrialization, and global trade flows (Dorninger et al., 2017). The disconnection between humans and nature has led us to consider nature to be a separate entity (Folke et al., 2011), and this has resulted in the development of attitudes and behaviors detrimental to both our physical and mental health, while having an irreversible impact on the environment (Fang et al., 2017; Mayer & Frantz, 2004). Numerous studies have linked our connection with nature to a range of well-being measures, including hedonic and eudemonic indicators, which justifies the importance of this sense of connection (Capaldi et al., 2014; A. J. Howell et al., 2011; Nisbet & Zelenski, 2013; Pensini et al., 2016). Therefore, connection with nature plays a fundamental role, not only in maintaining good health, but also in the protection of nature (Braun & Diekers, 2017). Consequently, studying, understanding, and nurturing our relationship with nature is crucial.

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This study evaluates the effect of an environmental program on primary school pupils with a focus on nature connectedness. Schultz's Inclusion of Nature in Self (INS) scale provides an uncomplicated, standardized measurement approach that is recognized worldwide (Maurer & Bogner, 2019). To detect the connectedness we used as a direct measurement the INS scale, which is a single-item graphical design based on self-report responses.

Literature Review

This section discusses the nature connectedness of humans, outdoor education, and learning activities.

Nature Connectedness

Clayton (2003) considers environmental identity as a component of one's self-concept. It reflects how much a person sees himself as a part of nature and how essential nature is in shaping his or her self-perception. Furthermore, Nisbet et al. (2009) established the concept of *nature relatedness* and Schultz (2002) the *inclusion with nature*. This study relies on nature connectedness' definition as the degree to which people rationally understand nature as a component of their own identity (Nisbet et al., 2011; Schultz, 2002).

Schultz (2002) defines human connection to nature as "*the extent to which an individual incorporates nature inside his cognitive picture of self*." From another point of view, Mayer and Frantz (2004) see connectedness as an individual's affective and experimental connection to the natural world, while Perrin and Benassi (2009) suggested that in addition to affective connection, connectedness is an individual's beliefs and attitudes regarding their connection to nature. Geng et al.'s (2015) approach defines connection with nature, as both the emotional and cognitive feelings of the individual. Other researchers describe nature connectedness in a simpler manner. For instance, it can be perceived as (emotional affinity) love for nature (Kals et al., 1999). It can also be defined as how much humans believe they identify with nature (Dutcher et al., 2007) or simply if they feel emotionally connected with it (Mayer & Frantz, 2004). The nature connectedness term is also known as nature relatedness; an emotional affinity toward nature or inclusion of nature in self (Schultz, 2002).

Despite the emphasis that a number of authors place on the emotional base of the concept of nature connectedness, (Mayer & Frantz, 2004; Müller et al., 2009; Nisbet et al., 2009; Raudsepp, 2005) another perspective underlines the role of the natural environment in individuals' identity (Clayton, 2003). The term 'nature connectedness' explains the extent to which individuals include nature as part of their identity (Schultz, 2002). It also assumes the acceptance and appreciation of our interconnectedness with all beings on earth (Nisbet et al., 2009). Schultz (2002) describes the three components of the "nature connectedness" term. The cognitive component is the core of nature connectedness, which refers to how integrated one feels with nature. The affective component demonstrates an individual's attitude to the care of nature, while the behavioral one refers to the individual's commitment to protecting the natural environment. These three components are required for a healthy relationship with nature. A person who feels connected to nature is more likely to protect it and take positive environmental actions (Schultz, 2002). Although various authors consider nature-relatedness to be a stable character trait of each individual, its intensity can change according to one's experience with nature. Consequently, the longer one spends in nature, the more one feels connected to it and cares about its protection (Mayer & Frantz, 2004). Otto et al. (2021), adding another view, have reported that connectedness to nature and pro-environmental behavior seems to be more empowered in members of groups. His research dealt with groups of humanists and environmentalists in relation to the general population. Furthermore, exposure to nature provides a sense of well-being (Mayer et al., 2009; Perea et al., 2019). Otto and Pensini (2017) have also proved that the increase in children's participation in nature-based environmental education leads to increased ecological behavior, through environmental knowledge and connectedness to nature.

In spite of the many benefits derived from nature, our modern lifestyle means we spend a considerable length of time indoors; 90% according to Evans and McCoy (1998). As a result, we are less connected to nature and feel less responsible for protecting the environment (Schultz, 2002). However, the modern world is facing environmental issues (e.g., climate change, deforestation, loss of biodiversity) caused by human intervention (Global Footprint Network, 2016; McNeill, 2000; WWF, 2014). The disconnection between individuals and nature may have contributed to these burgeoning environmental problems (Jordan, 2009; Tacey, 2000). Environmental educators must determine the factors that affect the intensity of connectedness with nature and consider how to reinforce the connectedness with educational experiences (Phenice & Griffore, 2003).

Outdoor Learning/Education

Research findings also reinforce the developmental importance of children's and adolescents' contact with nature (Louv, 2008). Consequently, positive outdoor experiences could constitute a base for environmental education (Dillon et al., 2006; Kaiser et al., 2008; Schultz, 2002). Jung (2009) underlines the importance of

emotional experiences in nature during childhood so as to engage children's interest in environmental education. According to Otto's et al.'s (2021) findings, the increased interest and fascination could be used as a motivational component for deeper learning.

Various recent studies have explored the relationship between humans and nature (Bruägger et al., 2011; J. L. Davis et al., 2009; Frantz et al., 2005; Schultz & Tabanico, 2007). B. Davis et al. (2006) indicated that spending time outdoors could develop positive values concerning nature. In Forest Schools, pupils make significant progress in developing both their interaction skills and their connection with nature (Harris, 2017; McCree et al., 2018; Tiplady & Menter, 2020). A study from Norway has shown that pupils who spend time outdoors in pre-school may develop their attention skills (Ulset et al., 2017). Wells and Evans (2003) claimed that a home situated in close contact with nature affects children's psychological well-being. Also, according to Staempfli (2009), outdoor play helps pupils to understand the world and enables them to face real problems.

Although environmental awareness seems to be determined by childhood nature experiences (Chawla & Cushing, 2007), youth appear to have continuously less contact with nature (Louv, 2005) over the last decades. Under another perspective explored by Louv (2005), he concludes that the unfamiliarity many parents have with the natural world means that, in turn, their children do not have contact with nature.

In the last few decades, education decision-makers from many countries have tried to overcome the aforementioned disconnection by providing curriculums, which include environmental outdoor programs (O'Brien & Murray, 2007). Outdoor learning and education encompass a range of activities and concepts such as outdoor play and recreation, environmental education, experiential education, place-based learning, and adventure activities (Institute for Outdoor Learning, 2016). Outdoor learning seems to increase children's interests, motivation, and school achievements as well as personal, social, and emotional development (Hattie et al., 1997; Office for Standards in Education, 2008; Ryan et al., 2010). Also, Ofsted—Office for Standards in Education (2019) reports that:

> *The curriculum and the provider's wider work support learners to develop their character – including their resilience, confidence and independence – and help them know how to keep physically and mentally healthy*.

According to Potter (2010), environmental education programs constitute a vital tool in resolving environmental issues, by focusing on raising pertinent knowledge and awareness, which is important, but insufficient in providing solutions (Fančovičová & Prokop, 2011), given that it does not form a strong basis for nature protection in the way that nature connectedness does (Kaiser et al., 2008; Kals et al., 1999). Therefore, in order to lead to more sustainable practices, environmental education at the primary school level should emphasize the development of nature connectedness, rather than merely providing knowledge (Liefländer et al., 2013). Another perspective coming from Schaal et al. (2018) demonstrates that game-related enjoyment can significantly influence an increase in students' attitudes toward nature.

Priest (1986) defined outdoor education as a learning method while Smith (1955) described it as a learning process for a subject, which cannot be taught in a classroom. Additionally, in a descriptive list of guiding principles for Environmental Education, the following are contained: "*Environmental Education should relate environmental sensitivity … to every age, but with special emphasis on environmental sensitivity to the learner's own community in early years*" (United Nations Educational, Scientific and Cultural Organization, 1978, pp. 26, 27). However, the most important factor is that outdoor education allows teachers to incorporate the concept of human and nature development into their teaching plans.

Outdoor education and experiential learning require the full use of the six senses (sight, sound, taste, touch, smell, and intuition) and involve the three domains of learning, (cognitive, affective, and motoric). Recent research in the UK (Tiplady & Menter, 2020) demonstrates that Forest School (an educational experience undertaken in woodland) could positively affect children's emotional wellbeing.

Outdoor environmental education has been found to help students with emotional, cognitive, and behavioral disabilities concentration and decreased disruptive behaviors (Szczytko et al., 2018). Long-term environmental programs have developed positive effects on behavioral levels (Bogner, 1998) and on their attitudes toward nature and knowledge (Mygind, 2016; O'Brien & Murray, 2007). Ernst and Theimer (2011) found that the positive effect on connectedness could be achieved only with a "condensed time frame of sufficient duration" program. On the other hand, Drissner et al. (2010) and Schultz and Tabanico (2007) reported the positive effects of a short-term intervention in environmental behaviors and nature connectedness respectively, even after a half-day program. Kosta and Tsagarakis (2019) have also shown that even a 1-hour intervention could provide significant information for environmental policies. Nevertheless, short-term implementation needs further follow-up research, in order for it to be integrated in a sustainable manner into the school curriculum (Kossack & Bogner, 2012).

Table 1. The number of Pupils' Participation per Evaluation Test According to Their Age.

Grade	Pre-test (*T*1)	Post-test (*T*2)	Retention-test (*T*3)
Third (9 years)	5	0	0
Fourth (10 years)	24	17	17
Fifth (11 years)	103	88	91
Sixth (12 years)	151	132	137
Total	283	237	245

The present study investigates the effects of an environmental program on primary school pupils, aged 6 to 12 years. We aimed at investigating the effects of the intervention with a focus on nature connectedness. Grade, age, and previous participation in environmental programs are evaluated as independent factors. We also investigate how pupils evaluate the "nature connectedness" of their parents before and after our intervention.

Methodology Approach

Data was collected from schools that implement a 1-day environmental educational program. This section discusses the sample, measures, and the procedure followed for the data collection.

The Sample Composition

In total, two hundred eighty-three students ($N = 283$) participated in this work, coming from seven primary schools in the Xanthi region (northern part of Greece). They attended a daylong outdoor environmental education program during the school year, 2018 to 2019. The majority of participants in outdoor environmental education programs are pupils of third, fourth, fifth, and sixth grade, aged from 8 to 12 years. Age refers to the maximum age of students in the grade. Our sample's mean age was 11.41 years ($SD = 0.721$), 152 (53.7%) were boys and 131 (46.3%) were girls. Due to bad weather conditions, one school failed to implement its program, which justifies the missing values of *T*2 and *T*3 (see Table 1 for details).

Measures

To detect and monitor the connectedness, we used as a direct measurement the Schultz's Inclusion of Nature in Self (INS) scale, a single-item graphical design based on self-report responses, which provides an uncomplicated, standardized, and worldwide (Maurer & Bogner, 2019) measurement approach. The chart of overlapping circles (Figure 1) is easy to use by young students and has been found to be very accurate in measuring individual differences in students' connectedness with nature (Kossack & Bogner, 2012; Liefländer et al., 2013), compared to other multiple-item scales (e.g., Disposition to Connect with Nature: Brügger et al., 2011; Connectedness to Nature Scale: Navarro et al., 2017; Connectedness to Nature: Mayer & Frantz, 2004). According to Schultz et al. (2004) reliability of INS, test-retest correlations seem to increase when a retest is performed 1 or 4 weeks after the initial test.

Since in our study we elicit participants' beliefs and knowledge under the same protocol and study within-subject effects, the use of a control group is not fully applicable. We conducted a quantitative design in order to explore the effect of three, full-day, outdoor environmental education interventions on primary school students, which took place in the Old (typical) Town of Xanthi, Nestos River (Natura 2000: GR1120004), and Vistonida Lake (Natura 2000: GR1130010). Firstly, we provided all principals, teachers and students of primary schools in the Xanthi region (located in the north part of Greece) with information concerning the research intervention aims and scope, and the research protocol for the data collection.

INS scale contains seven circle pairs; one circle representing "nature" and the other the student himself, referred to as "self." Each pair of circles differs to the degree in which they overlap each other. The values ranged from 1 to 7, from the complete separation between nature and myself to the complete connection of nature and myself (Figure 1). We asked the pupils for the three questionnaires: "*How interconnected do you feel with nature?*" and "*Choose the picture which better describes your relationship with nature*."

Procedure

Two weeks before the outdoor intervention, the pupils completed a pre-test (*T*1) at school. Then subsequently, at the end of the program, they filled in a second 1 (*T*2—post-test) and about 4 weeks later a retention-test (*T*3). Initially, the three questionnaires included Schultz's Inclusion of Nature in Self (INS) scale. In *T*1 and *T*3 there were also two additional INS scales for the pupils to select the picture, which better described their fathers' and mothers' connectedness with nature. In *T*2 and *T*3 there were three knowledge check questions, with increasing difficulty, relevant to the content of the program they attended (just after their attendance and 4 weeks later). The pupils had to select the correct option out of the three choices given. The questions for the three destinations are listed as follows.

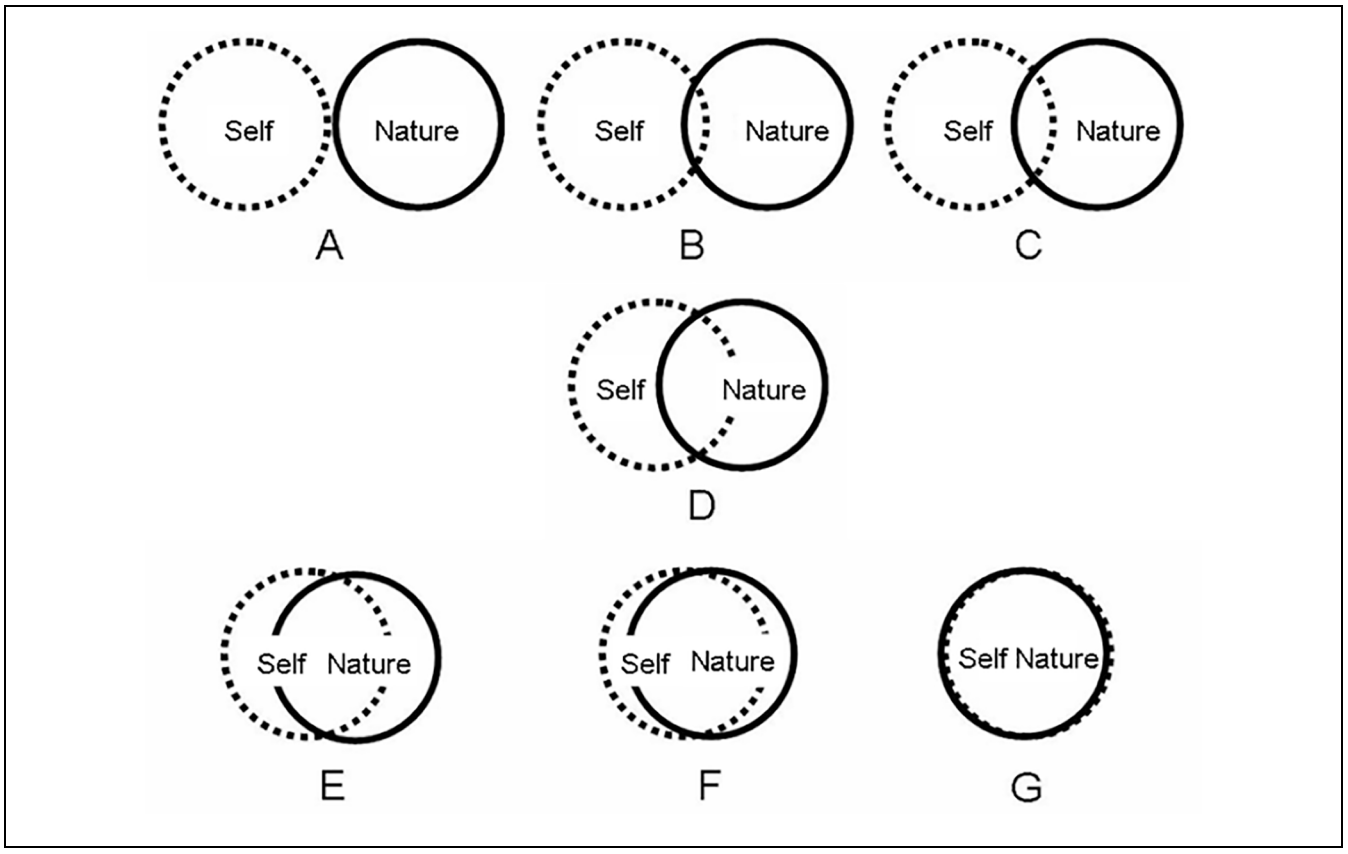

Figure 1. Inclusion of nature in self-scale
Source. Adapted from Schultz (2002).

A. Questions for the Old Town attendees: Circle the correct answer.
Q1a: In which of the following pictures do you see "sahnisi"?
Q2a: What is a hani (inn)?
Q3a: Why do we find so many mansions in the old town?
B. Questions for the Nestos River attendees: Circle the correct answer.
Q1b: Where are the headwaters of the Nestos River?
Q2b: What does the word meanders mean?
Q3b: Which of the following are plants that we find in Mediterranean flora?
C. Questions for the Vistonida Lake attendees: Circle the correct answer.
Q1c: How many bird species do we find in Vistonida Lake?
Q2c: The salinity changes in which of the following cases?
Q3c: Which of the following birds is the cormorant?

The questionnaire included questions exploring the participants' profiles, such as grade, gender, and previous involvement in environmental and outdoor educational programs. The aim of the latter was to investigate and locate confounding variables that might have influenced the participants' connectedness with nature. Each student was coded (from 1 to 283) so that his/her answers during the three tests were comparable.

To study the effect of time in retaining the knowledge obtained by the outdoor activities we created three new variables (Q1, Q2, and Q3) resulting from the sum of (Q1a, Q1b, and Q1c), (Q2a, Q2b, and Q2c), and (Q3a, Q3b, and Q3c) correct responses, respectively, for $T3$ and $T2$. By subtracting the correct responses between the 2 stages we have located those pupils that "lost" some of the obtained knowledge during the 4 weeks interval period. The study of negative sign values of this "Knowledge loss" variable and its relation with other recorded variables, will give further insights into the successful implementation of outdoor programs.

Data Analysis and Results

This section consists of an analysis of the descriptive statistics and the statistical comparisons of pupils' and their parents' answers using the SPSS software (D. C. Howell, 2006; IBM Corp, 2017).

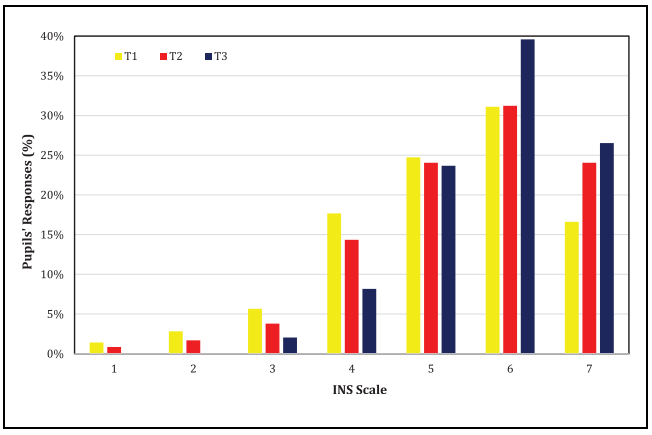

Figure 2. Pupils' responses to INS scale (*T*1–*T*2–*T*3) in percent.

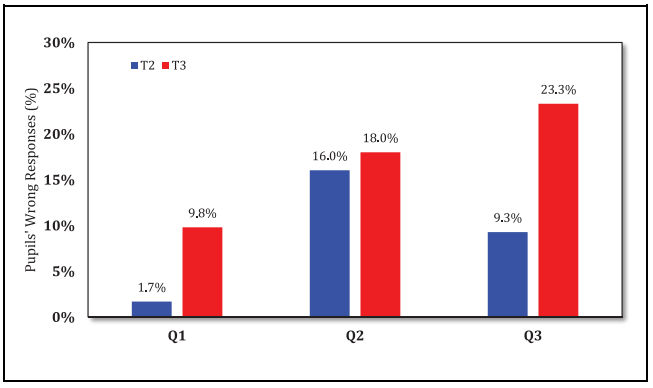

Figure 3. Pupils' wrong responses to knowledge question after the intervention (*T*2) and 4 weeks later (*T*3).

Descriptive Statistics

A 87 pupils (30.7% of the sample) had not participated in any environmental program in the past, while 196 (69.3%) had participated in at least one when attending lower grades. Furthermore, the majority of pupils, 167 (59.0%) have never participated in any outdoor environmental program before.

Figure 2 shows the students' comparison of INS scores in the three phases (*T*1–*T*2–*T*3). Only 1.4% (*T*1) and 0.8% (*T*2) of pupils feel no connection with nature (INS scale 1) while 2.8% (*T*1) and 1.7% (*T*3) little connection (INS scale 2). It is worth mentioning that 4 weeks after the intervention (in *T*3), there were no answers in these categories. The highest percentages in all three tests appear in number 6 of the INS scale, which means that the majority of pupils feel a great connection to nature. Responses in each stage differ statistically significantly according to the Friedman test ($\chi^2 = 29.971$, $p < .001$), while *T*2 responses are higher compared to *T*1 ($z = 2.049$, $p = .04$). *T*3 responses are also higher compared to *T*1 ($z = 5.706$, $p < .001$) and *T*3 responses are higher compared to *T*2 ($z = 2.983$, $p = .003$) according to the Wilcoxon signed-rank test.

Regarding the responses to the knowledge evaluation questions, pupils responded correctly 98.3%, 84.0%, and 90.7% for Q1, Q2, and Q3, respectively just after the intervention and 90.2%, 82.0%, and 76.7% for Q1, Q2, and Q3, respectively 4 weeks later. The wrong responses per question just after the intervention (*T*2) and 4 weeks later (*T*3) are presented in Figure 3. We observe some loss of the obtained knowledge mainly for Q1 and Q3. There is also an increasing gap in loss of the obtained knowledge 4 weeks after the intervention for Q2 compared to Q1 and for Q3 compared to Q2, in line with the increased difficulty of the questions.

Statistical Comparisons

The type of the requested data and distribution of the responses indicate the use of non-parametric tests. Median group comparisons with non-parametric tests do not require the same sample size for each group. We investigated the negative sign of the new "Knowledge loss" variable that indicates the assimilation of the program's knowledge. Other studies (Otto et al., 2021) have found that specific groups of people (like humanitarians or environmentalists) might have increased nature connectedness. We also search if gender or age affects the connectedness of nature, but we found no statistically significant results (gender: $\chi^2 = 0.281$, $p = .335$ and age: $z = 0.319$, $p = .750$). The number of programs attended, however, was statistically significant in retaining the knowledge from the program ($z = 3.702$, $p < .001$). This finding shows that the greater the involvement of the students in outdoor programs, the more probable it was that the knowledge would be retained. We can infer from this finding that lower values of the second self-evaluation (just after the intervention), are (marginally) correlated with the negative responses given (with $p < .10$). *T*2 self-estimation is the one just after the intervention, so it can be considered to be the most representative and reliable in terms of self-evaluation.

We compared the INS (*T*1 and *T*2) scores of pupils with no experience in environmental programs and those who attended at least one or more programs running the Mann-Whitney *U* test. The results showed that those having participated in other programs in the past stated more connected to nature before ($p < .005$) and after ($p < .005$) the intervention, compared to the others. Figure 4 represents the correlation of pupils' INS (purple figures) scores with their parents (light blue figures) both after the intervention (left part of the figure) and 4 weeks later (right part of the figure).

We found no statistically significant relations for INS scores among pupils' versus parents' gender INS, or

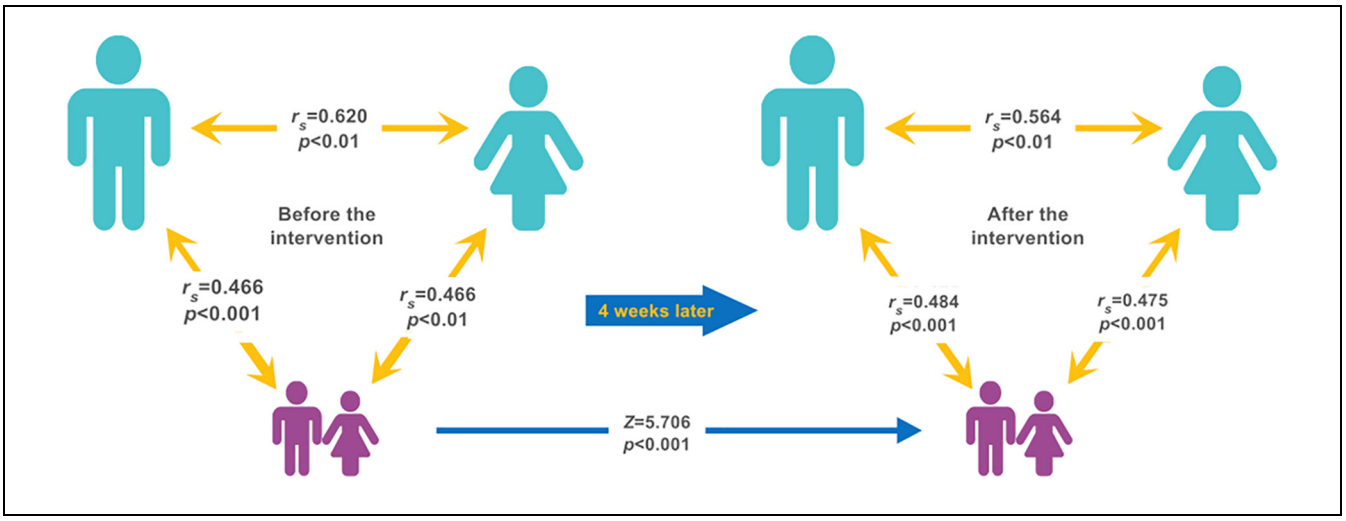

Figure 4. Correlations of INS scores among pupils and their parents after the intervention and 4 weeks later.

pupil's gender versus parent's gender INS. Also, non-parametric tests for parents' INS, as perceived by their children, before and after the intervention showed an increase but not statistically significant for fathers ($z = 0.901$, $p = .367$) and mothers ($z = 1.344$, $p = .179$) as shown in Figure 4. Pupils' scores about their fathers have slightly improved: 69 ties, 84 negative, and 89 positive ranks. On the other hand, pupils' scores about their mothers improved slightly more: 79 ties, 70 negative, and 91 positive ranks.

Discussion

This study contributes to the field by examining how a 1-day environmental education program affects children's connection with nature. Our INS analysis demonstrated that the majority of pupils feel quite connected with nature, especially after the intervention, confirming the positive effect of outdoor environmental education on nature connectedness (Sellmann-Risse & Bogner, 2013). Even after a month, pupils seem to maintain the perceived connectedness with nature, which is in line with Liefländer et al. (2013) results, which showed an increased inclusion in connectedness 4 weeks after the environmental education program mostly in young participants (9–10 years). Knowledge and self-estimation connectedness with nature was found to be higher and statistically significant immediately after the intervention. It is worth mentioning that studies based on self-reporting of children need to take into consideration social desirability in their results (Oerke & Bogner, 2011). Consequently, we must consider that INS pupils' results are likely to have been affected by social desirability, especially in younger participants. Nevertheless, we found no statistically significant differences in nature connectedness between children's age and gender.

Several studies have indicated that children interact with parents (Keramitsoglou & Tsagarakis, 2011) by actively participating and promoting environmental values, rather than passively (Chamberlain & Patterson, 1995; Donenberg & Baker, 1993; Pardini, 2008). Moreover, a literature review has shown that the nature familiarity of parents influences the nature connectedness of their children (Louv, 2005). Additionally, Racz and McMahon (2011) showed that parents' and children's behavior is influenced in a reciprocal way. In our study, children evaluate their mothers as being slightly more connected with nature after the intervention in comparison to their fathers, which is also supported by the literature (Tsagarakis et al., 2011; Tziakis et al., 2009) but this needs a larger sample size to be statistically verified.

The results of the "Knowledge" part of the study indicate no age and gender differences in knowledge assimilation; in contrast to the previous participation in environmental programs, which is statistically significant. This is in line with our finding that the children with previous experience in environmental programs tended to feel more connected with nature after the intervention, suggesting that the repetition of environmental programs not only enriched but also enhanced the pupils' existing knowledge and reinforced their connectedness to nature. The pupils with experience in outdoor activities also stated similar positive attitudes toward nature which is in line with previous studies, namely, the frequency of time spent in nature and outdoor experiences reinforce nature connectedness (Clayton, 2003; Kaiser et al., 2008; Liefländer et al., 2013; Mayer & Frantz, 2004; Müller et al., 2009; Nisbet et al., 2009; Raudsepp, 2005; Schultz & Tabanico, 2007). However, in Greece, according to the curriculum, primary students can participate in full-day outdoor field programs, at the

most, twice a year (Ministerial Descision, 2019). We hope education policymakers will benefit from the findings of this work when updating the Greek primary school curriculum.

Nevertheless, our study bears some limitations. One concerns the use of Schultz's INS scale since there are also other established measures and scales (Ernst & Theimer, 2011). Future research could focus on cross-studies, adjusting each measuring tool to the pupils' grades. Furthermore, our study focused on pupils aged 8 to 12 years old (primary education). The inclusion of students of different academic levels may reveal further insights, which will help future educators design environmental programs that can positively influence nature connectedness. Although our sample represented all the possible socio-cultural variations, it was limited to only one region. In addition, parents' direct involvement in self-evaluating their own connection with nature may give additional insights, complementary to their children's evaluation.

Conclusions

This study contributes to the field of outdoor environmental education. The finding of the 1-day outdoor environmental program showed the positive impact of pupils' nature connectedness and highlights the repetition benefit. Educators or teachers have to take into account the frequency, the duration, and also the pupils' age when they design environmental educational programs. Moreover, these programs should be created in order to (i) establish the pupils' connectedness with nature, (ii) develop their awareness and interest in nature and environmental issues, and (iii) reinforce their knowledge. Additional and follow up learning activities in nature at the right age can lead to more responsible adults and consequently to a more sustainable future. Children can also act as educational agents for their families. Our findings suggest that if the limitation of the two outdoor programs per year, set by the ministry, is waived or increased, this will benefit pupils' connectedness with nature. Further insights could be gained by expanding the sample in terms of participants' age, program duration, and parents' involvement, as well as by expanding to other regions or countries.

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