

Article

The Effect of a Nature-Based Environmental Education Program on Children's Environmental Attitudes and Behaviors: A Randomized Experiment with Primary Schools

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Abstract: The evidence about the effects of nature-based instruction on pro-environmentalism is unconvincing, mainly due to a lack of controlled experiments. This hinders causal claims and the provision of intervention guidelines. We present an experiment examining the impact of a nature-based environmental education (NBEE) program included in the school curriculum on children's environmental attitudes (EA) and behaviors (EB). Children who followed the program through traditional instruction were used as a control group. Seven Spanish primary schools participated in the program and school classes were randomly assigned to the NBEE program (experimental group, $N = 516$) or the environmental education (EE) through traditional instruction (control group, $N = 218$). Our results indicate that children's EA increased more in the NBEE group than in the control group. On average, EB remained virtually the same in both groups of children across time. In light of our findings, we encourage the promotion of a nature-based pedagogy in formal education to enhance children's environmental attitudes.

Keywords: pro-environmentalism; contact with nature; experiences in nature; new ecological paradigm; pro-environmental behavior

1. Introduction

There is a growing awareness about the detrimental effects that human behavior has on the environment [1–3]. To counteract environmental issues, an understanding of the determinants of people's pro-environmentalism, i.e., pro-environmental attitudes (EA) and behaviors (EB), is required [4]. EA are understood as a "collection of beliefs, affect, and behavioral intentions a person holds regarding environmentally related activities or issues" [5], and EB refers to actions that contribute to the sustainability of nature [6].

Environmental education (EE) has been highlighted as a relevant tool to modify individuals' attitudes and behaviors towards more sustainable ones [7]. EE is usually seen as an effective tool to enhance people's EA and EB, surpassing the effects of extrinsic motivators, such as incentives and punishments [8]. EE has traditionally focused on providing knowledge of how and why we need to behave in a pro-environmental way [9,10]. Knowledge seems to be, however, relatively unimportant when predicting EB, and other factors such as emotional connection to nature [11–13] and pro-environmental beliefs [14,15] are more strongly related to acting in favor of the environment.

While knowledge can generally be taught both in and outside a classroom, EA and EB are more difficult to acquire indoors [16]. Hence, several researchers propose direct contact with nature as an effective way to enhance EA and EB [11,14,15,17], and encourage the inclusion of direct exposure to nature as part of EE programs [16]. Many of the studies conducted before now evaluate the impact that exposure to nature has on children's EA and EB but, unfortunately, they are retrospective and correlational, making it difficult to establish a causal link between time spent in nature and increased EA and EB. This also diminishes the possibility of providing specific guidelines to environmental educators and stakeholders. As a result, a call has recently been made for controlled experiments that will most likely help to shed some light on the effects that contact with nature has on children's pro-environmentalism [16,18]. As the first answer to this call, we present a randomized controlled trial or "true experiment" in which we examine the effects of a nature-based environmental education [NBEE; 13] program on primary school children's EA and EB. The NBEE program was designed to provide opportunities for direct contact with nature while following the standard school curriculum. Specifically, we aim to check the possible effect of a NBEE program included in the school science curriculum on children's EA and EB in comparison with the effects of following the same curriculum through traditional instruction (i.e., indoors and without contact with nature).

Studies examining the benefits of contact with nature for children have multiplied in the last few years [18]. Their collective findings suggest that exposure to nature improves children's mental [19] and physical [20] health, ameliorates their stress levels [21], improves self-discipline [22], increases students' motivation and engagement in school activities [23], enhances cooperative relations among peers [24] and academic learning [25], and fosters personal development, such as better critical thinking and problem solving [26]. Exposure to nature as a child is seen as one of the main correlates of pro-environmentalism, which is of interest to the current study. Retrospective studies have shown that adults devoted to taking care of the environment attribute their pro-environmentalism mainly to positive experiences in nature as children [27]. In line with these findings, a longitudinal study found that experiences in nature during childhood do indeed predict EA as adults [17]. Regarding children, direct contact with nature is associated with a stronger emotional affinity towards nature [12], connection to nature and interest towards nature [28], pro-ecological beliefs [15], awareness about the importance of nature for people's lives [29], and a sense of morality towards the environment [30].

Most of the benefits of nature exposure described above can be categorized as nature-based learning (NBL), defined as the "acquisition of knowledge, skills, values, attitudes, and behaviors in realms including, but not limited to, academic achievement, personal development, and environmental stewardship" [16]. One way in which children can learn through direct contact with nature is via EE programs that provide opportunities for nature exposure. There is empirical evidence showing that participation in EE programs promotes positive changes in children's EA [15,31], connectedness to nature [13], and environmental knowledge [32]. There has been some debate about whether EE interventions are more effective indoors or outdoors, with mixed results [33]. EA and EB appear to be more strongly enhanced when outdoor contact with nature is provided [32].

Regarding academic contexts, nature-based instruction has been proven to surpass traditional instruction in terms of personal development and academic learning [34]. However, the accumulated evidence about the impact of nature-based instruction on children's EA and EB is less robust [32]. Many have argued that combining the provision of information with direct experience with nature should have a stronger impact on pro-environmentalism than just providing information. There is some empirical evidence supporting this [13,32,35–38], but the strength of this evidence is impaired due to methodological limitations. These include not following a randomized experimental procedure, a lack of pre-intervention baseline data and/or control group, and small sample sizes. To fill this gap in the literature, the current study investigates the impact of a NBEE intervention, included in the school curriculum of primary school children, on EA and EB through an experiment with a large sample of children. Compared to one-time interventions, a program included in the school curriculum should be more inclusive, reaching children from families with varied socioeconomic status, as well as different

levels of EA and EB. The effect of the NBEE intervention will be compared to the effect of learning about the same content following traditional instruction (i.e., indoor EE without contact with nature).

2. Materials and Methods

2.1. Description of the Intervention

The EE intervention was designed by a national Spanish non-profit organization (hereafter Eco-organization) that aims at enhancing pro-environmentalism both in adults and children. It had two versions: EE program that followed traditional instruction (i.e., indoors and without contact with nature, which served as the control group) and NBEE program, which served as the experimental group. This NBEE program was motivated by previous studies suggesting that contact with nature can improve EA and EB [13,16,37,39] and, at the same time, serve as a learning tool [18]. With this in mind, the Eco-organization created a three-month-long program, which was designed so that its content matched that of the school curriculum and, at the same time, helped to mitigate children's diminishing contact with nature [40]. This was done with the idea that the NBEE program could, in the future, be implemented at a national level while following the educational standards established by the national government.

Both versions of the EE program were delivered by primary school teachers with the help of an environmental educator randomly designated to each school by the Eco-organization. Teachers had access to an online platform that included training in how to deliver the EE sessions. The program included three main topics, studied in three different and consecutive months: local flora and fauna, climate change, and endangered species. These topics aligned in content and time with the standard science curriculum and, therefore, were addressed within the same period in the control and experimental groups. The EE program had two phases. In the first phase, each topic was addressed in three in-class, 50-minute-long sessions (i.e., nine sessions in total). For children in the experimental group, the sessions were structured so that the students could understand the content proposed in the official science curricula while directly experiencing nature. For example, when learning about local flora and fauna, students were brought examples of plants, leaves, and branches to the classroom, which they could manipulate. Students in the control group learned about the same three topics following traditional instruction (mainly through the textbook). In the second phase, children in the experimental group participated in three nature-based EE sessions, one per topic (i.e., one per month). Each one had a duration of approximately 1 h and 30 min. The content of these sessions was directly linked to the content provided in the classroom during the month in which the outside session took place. The sessions were conducted in nearby natural areas and were designed while keeping in mind that students should explore their natural surroundings. For instance, children were asked to look for a specific plant previously seen in class and describe the plant and its habitat in their notebook. In this phase of the program, children in the control group conducted an indoor activity concerning the same topic. For example, they gathered in groups and created a poster about the local flora.

2.2. Study Design, Participants and Procedure

In this experiment, twenty state primary schools located in different geographical regions in Spain were approached by the Eco-organization to explore the possibility of participating in the NBEE program. As a consequence of the eligibility criteria (i.e., principal's and teachers' interest in the program and the accessibility of a nearby natural area), the list of schools narrowed to seven. The EE intervention was provided at the class level. Classes within each school were randomly assigned to the experimental group ($N = 516$, $M_{age} = 8.23$, $SD = 1.71$, 48% boys) or to the waitlist control group ($N = 218$, $M_{age} = 9.47$, $SD = 1.39$, 50% boys). Although it was important for the Eco-organization to empirically check whether their NBEE program affected children's EA and EB, their main aim was to reach as many children as possible from the very beginning of the program. The reason for this is that principals and teachers usually meet serving on the waitlist control group with opposition.

Thus, classes were randomly assigned to the experimental and control group using a ratio of 2:1. This ratio enhanced schools' commitment to the program while ensuring there was an appropriate number of children in the control group. The Eco-organization assigned a number to each school class and wrote it on a piece of paper. Numbers were introduced in an opaque box and extracted to be randomly assigned to the experimental or control group. This intervention could not be blinded because both the intervention providers and participants knew whether they were in contact with nature or not. Participants remained in their group until the end of the intervention (i.e., no switching). Classes included in the control group could participate in a similar NBEE program later on in the academic year (with different content, in line with the science curricula at that time).

Data collection was in accordance with the ethical standards of the third author's institution. The educational team within each school authorized children's participation in the research and child assent was obtained. Data were collected the day before starting the program (T0; Fall 2019) and the day after it finished (T1; Winter 2019) through a pen and pencil questionnaire. Child assent was obtained. Before data collection, two trained master's students pilot tested the procedures to identify possible comprehension problems. They were also trained by the authors of this paper to collect data following a standardized procedure, and were in charge of the data collection. Data included here are from children who completed both questionnaires (pre and post-intervention). About three percent of the children who completed the questionnaire at T0 did not complete it at T1. This was mainly due to children not going to school on the day of data collection due to feeling sick.

At the end of the program, teachers were given a document issued by the Eco-organization certifying the completion of the program. This was done in an attempt to enhance adherence to the program. Variability across classes and schools in the program implementation was minimized through the presence of an environmental educator from the Eco-organization while the program was delivered. Due to bad weather conditions, two on-site visits had to be postponed until the weather allowed conducting the outdoor activity (two and three days after the initial schedule day, respectively). This posed no relevant modification to the program and no major deviations from the intended intervention were detected. We are unaware of any adverse effects (e.g. accidents) of the NBEE program.

2.3. Measures

Environmental attitudes: Children's EA were registered using two different measures, one primarily designed to capture children's cognitive beliefs (i.e., the New Ecological Paradigm scale) and the other one aimed at capturing the affective side of children's EA (i.e., the Children's Environmental Perceptions Survey). This was done because previous studies have shown the importance of both affective and cognitive aspects of attitudes in people's pro-environmentalism [12,41]. The response format followed a Likert-like five-point scale: 1 = strongly disagree; 2 = disagree; 3 = not sure; 4 = agree; 5 = strongly agree.

(a) **New Ecological Paradigm (NEP) scale** [42]: We used the Spanish version of the NEP scale for children to assess their environmental beliefs [43]. It is formed of 11 items, for instance: "If things don't change, we will have a big environmental disaster soon".

(b) **Children's Environmental Perceptions Survey (CEPS, 29)**: It is formed of 16 items and registers children's affinity towards nature, interest for nature and awareness of nature's value (e.g., I like to spend time in places that have plants and animals). It has been previously used with Spanish children and showed good psychometric properties [44].

Self-reported pro-environmental behaviors (PEB): We used the Spanish version of the Children's Ecological Behavior (CEB) scale [45]. The CEB scale includes a diverse range of pro-environmental behaviors such as energy and water conservation, and recycling (e.g., I recycle). Responses were given in the following format: 1 = never; 2 = a few times; 3 = sometimes; 4 = quite often; 5 = always.

In line with previous studies, the three scales were used as unidimensional and they have a high internal consistency [43–45], as shown in Table 1.

Table 1. Internal consistency of the scales before and after the intervention.

Scales	Number of Items	Experimental Group (N = 516)		Control Group (N = 218)	
		Pre-intervention α^1 (ω)	Post-intervention α (ω)	Pre-intervention α (ω)	Post-intervention α (ω)
Children's Environmental Perceptions Survey	16	0.85 (0.88)	0.80 (0.84)	0.90 (0.92)	0.93 (0.95)
New Ecological Paradigm Scale	11	0.78 (0.83)	0.74 (0.80)	0.81 (0.84)	0.90 (0.92)
Children's Ecological Behavior Scale	11	0.74 (0.78)	0.71 (0.77)	0.74 (0.79)	0.69 (0.77)

¹ Cronbach's α is provided out of parentheses and Revelle's ω is provided between parentheses. Revelle's ω was calculated using the software R as described by McNeish [46].

2.4. Data Analysis

Data analysis was done using participants' mean scores in each outcome measure. We first checked the missing values (only one in the variable sex was identified) and examined descriptive statistics, including mean, standard deviation, and indicators of non-normality (i.e., skewness and kurtosis). Next, we assessed the possible differences in children's EA and EB between groups. In doing so, we conducted three stepwise regression analyses with IBM SPSS 21 [47], with each measure of EA and EB as dependent variables. In the first step of the analyses, the post-intervention outcome (e.g., NEP mean post-intervention) was added as the dependent variable and the variable group (coded as 1 = experimental and 2 = control) was added as the independent variable. This approach mirrors an independent samples t-test so that the regression coefficient is equal to the mean difference between the two groups. In the second step, the pre-intervention outcome (e.g., NEP mean pre-intervention) was added to the model. This second step mirrors an analysis of covariance [48]. We visually checked the plot of the second step of each regression (i.e., standardized predicted values in the x -axis and standardized residuals in the y -axis) and deemed that outliers and heteroscedasticity were not a concern [49]. We interpreted the effect estimates (i.e., regression coefficients and mean differences) and its confidence intervals [50,51]. As the change values from baseline to post-intervention for our dependent variables followed an approximately normal distribution, we conducted paired t-tests to assess the possible changes from T0 to T1 in each group [52].

3. Results

Descriptive statistics for our outcome measures at T0 and T1, for the experimental and the control group, are provided in Table 2. Children presented, on average, strong EA and reported high engagement on EBs.

The results of the three stepwise regression analyses (one for each dependent variable), performed to check the possible differences in the children's EA and EB by group, are exhibited in Table 3. Our findings show that the NBEE program (i.e., experimental group) was more effective than traditional instruction (i.e., control group) in enhancing children's EA, both measured with the NEP and the CEPS. The adjusted (by the pre-intervention mean) mean difference between the experimental and control group of the CEPS post-intervention was 0.24. Thus, the NBEE program increased children's EA, as registered by the CEPS, 6% more than following the curriculum through traditional instruction. Similarly, the adjusted (by the pre-intervention mean) mean difference between the experimental and control group of the NEP post-intervention was 0.32. Thus, participants in the NBEE program increased their EA, as registered by the NEP, 9% more than participants attending classes following traditional instruction. The difference in post-intervention self-reported EBs between the experimental and the control group was negligible, even after adjusting for baseline self-reported EBs.

Table 2. Mean (SD), skewness and kurtosis for the outcome measures pre- and post-intervention by groups (experimental: $N = 516$; and control: $N = 218$).

	Experimental Group			Control Group		
Pre-Intervention (T0)						
	Mean (SD)	Skewness	Kurtosis	Mean (SD)	Skewness	Kurtosis
CEPS ¹	4.07 (0.60)	−0.85	0.69	3.99 (0.64)	−0.91	0.65
NEP	3.71 (0.65)	−0.64	0.27	3.65 (0.59)	−0.48	0.34
CEP	3.91 (0.59)	−0.74	0.10	3.95 (0.52)	−0.59	0.66
Post-Intervention (T1)						
	Mean (SD)	Skewness	Kurtosis	Mean (SD)	Skewness	Kurtosis
CEPS	4.31 (0.48)	−0.84	1.25	4.05 (0.72)	−1.18	0.81
NEP	3.91 (0.58)	−0.68	0.42	3.58 (0.84)	−0.87	0.09
CEP	3.90 (0.61)	−0.65	0.16	3.91 (0.57)	−0.94	1.03

¹ CEPS = Children's Environmental Perceptions Survey; NEP = New Ecological Paradigm; CEP = Children's Ecological Behavior.

Table 3. Regression coefficient (CI), R^2 , t , p , and residual degrees of freedom (df) from stepwise regressions.

Post-Test	Regression Step ¹	Regression Coefficient (CI)	R^2	t	p	Residual df
CEPS mean	1	−0.26 (−0.35, −0.17)	0.04	−5.76	<0.001	732
	2	−0.24 (−0.32, −0.15)	0.16	−5.54	<0.001	731
NEP mean	1	−0.33 (−0.43, −0.22)	0.05	−6.08	<0.001	732
	2	−0.32 (−0.42, −0.21)	0.07	−5.94	<0.001	731
CEP mean	1	0.009 (−0.09, 0.11)	0.00	0.19	0.848	732
	2	0.001 (−0.09, 0.10)	0.04	0.03	0.978	731

In the first regression step, only the variable group (1 = experimental; 2 = comparison) was inserted as a predictor of each of our outcome variables. This first step mirrors an independent samples t -test. In the second regression step, the outcome pre-intervention mean was inserted in the regression model, controlling for possible baselines differences. This second step mirrors an analysis of covariance. The regression coefficient is equivalent to the difference between the groups' post-test outcome mean and relates to our group variable (i.e., experimental/control); R^2 , t , p , and residual degrees of freedom (df) relate to the model. CEPS = Children's Environmental Perceptions Survey; NEP = New Ecological Paradigm; CEP = Children's Ecological Behavior.

The paired t -tests showed that participation in the NBEE program enhanced children's EA, but had virtually no effect on children's EB. The mean change from T0 to T1 in children's EA as registered by the CEPS was 0.25 (i.e., a 6% gain), and EA, as registered by the NEP, increased by 0.20 (i.e., a 5% increase). No relevant effects were found in the control group for any of the dependent variables. Please see Table 4.

Table 4. Mean change from baseline to post-intervention (CI), *t*, *p*, degrees of freedom (*df*), and Hedges' g_{av} from paired *t*-tests of the experimental and control group outcomes.

Experimental Group					
Outcomes ¹	Mean Change from Baseline (CI)	<i>t</i>	<i>p</i>	<i>df</i>	g_{av}
CEPS	0.25 (0.20, 0.30)	9.36	<0.001	515	0.46
NEP	0.20 (0.13, 0.27)	5.72	<0.001	515	0.32
CEP	−0.01 (−0.08, 0.06)	−0.28	0.782	515	0.02
Control Group					
Outcomes	Mean Change from Baseline (CI)	<i>t</i>	<i>p</i>	<i>df</i>	g_{av}
CEPS	0.06 (−0.04, 0.17)	1.17	0.242	217	0.09
NEP	−0.06 (−0.19, 0.06)	−0.97	0.332	217	0.09
CEP	−0.04 (−0.12, 0.04)	−0.91	0.362	217	0.07

¹ CEPS = Children's Environmental Perceptions Survey; NEP = New Ecological Paradigm; CEP = Children's Ecological Behavior. Hedges' g_{av} was reported as recommended by [53] and calculated using the spreadsheet provided by the author.

4. Discussion

The findings of this study contribute to understanding the impact of exposure to nature through environmental education on children's pro-environmentalism. To the best of our knowledge, this is the first study to show, through a randomized controlled trial, the effect a NBEE program designed to follow the standard science curriculum has on children's EA and EB, and to compare these effects with a control group who had no provision of direct contact with nature. According to our results, a NBEE program that combined the provision of information with bringing nature to students' classrooms and nature-based EE activities had a greater positive effect on children's EA than traditional instruction. These results align with those of previous studies that found that participation in a NBEE program enhances children's emotional affinity toward nature [12], connectedness to nature [13], and environmental beliefs [15,42]. For example, Manoli et al. [42] found that children who attended a 5 day outdoor EE program showed stronger EA (registered by the NEP) after the program. In concordance with this study, Collado et al. [12] demonstrated that a two-week outdoor program that included EE activities increased both cognitive and affective aspects of children's EA. These results resemble those of a correlational study in which Otto and Pensini [13] concluded that participation in NBEE programs organized outside of the school (e.g., conservation centers) was positively related to children's connectedness to nature.

It should be noted that while we found significant positive effects of NBEE in children's EA, these are modest. Children in the experimental group increased their EA by 9% (as registered by the NEP), and by 6% (as registered by the CEPS) more than children in the control group, and no relevant effects were found on children's EB. Children who followed the curriculum through traditional instruction (i.e., control group) did not show any relevant increase in their EA and EB. Our findings are in concordance with those of previous researchers who found modest effects of NBEE interventions on children's pro-environmentalism [11,38]. For example, Evans et al. [15] concluded that attending a week-long nature education experience increased children's EA (as registered by the NEP), but had no effects on children's EB. This aligns with arguments that changing people's EB through environmental education is a difficult task [36]. We can only speculate why the program had no significant effects on EB. It might be that our participants' EB at baseline were already high, leaving small room for change. In line with this idea, previous studies have found that exposure to nature has a weaker association with EB for those children who already hold strong environmental attitudes [39,45]. Another possibility for the lack of effect of the NBEE program on children's EB might be the absence of correspondence between the content of the program and the actions included in the EB scale. The program was designed

so that children followed the school curriculum and did not include learning specific guidelines about how to behave in a pro-environmental way, or about how children's actions (e.g., failing to recycle) are linked to the topics covered within the program (e.g., the habitats of local flora and fauna). Hence, it was possibly too difficult for children to infer the relationship between what they learned in the EE program and the specific EB registered.

It is also interesting that, even though the content of the NBEE program was similar to the one delivered with a traditional methodology (i.e., without contact with nature), no changes in children's pro-environmentalism were found in the control group. This suggests that learning about environmental issues through traditional instruction is not enough to improve children's pro-environmentalism and that direct exposure to nature may be needed, especially when children already hold strong EA and EB. Based on previous studies [25], one could have expected an increased environmental knowledge for both groups of children. Unfortunately, the schools involved in the present study did not allow the examination of possible differences in acquired knowledge among children in the experimental and the control group, as they thought parents would meet this with opposition. Nevertheless, informal data provided by the teachers and the Eco-organization indicate that children in both groups did not differ in the scores obtained in the science exam.

So far, most studies examining the effects of nature exposure on children's pro-environmentalism followed a limited methodology [18], precluding making causal inferences. Extending from these previous findings, we base our results on a randomized controlled trial with a large sample of children. The fact that we registered children's EA and EB before and after the EE intervention together with our random assignment to experimental or control group provides valuable insight into the positive effects of NBEE on children's pro-environmentalism. The program took place during school hours. Thus, engagement with the intervention was not influenced by children's or their parents' pro-environmentalism as might have been the case in previous studies [12,32]. The random assignment of the classes to the intervention allows the assumption that there was not a systematic difference in possible confounders between groups. Additionally, the inclusion of a large sample of children from different Spanish regions enhances the study's external validity. Another relevant point is that the NBEE program followed the standard science curricula and hence it is feasible to be implemented in other primary schools with access to nearby natural environments, which ensures the practical relevance of the study.

Our study has some limitations that set the basis for future lines of research. Firstly, the NBEE program had a modest effect on children's pro-environmentalism, and we do not know how long this effect lasts. Future studies should check whether programs including more frequent contact with nature and/or longer nature exposure lead to stronger effects. This might be done through, for instance, greening the school ground [34] and the use of school gardens that provide opportunities for nature contact without leaving the school [54]. Additionally, the inclusion of information about how specific behaviors can be conducted by children and how these behaviors affect the global and local environment in the EE program might enhance children's EB [39]. Studies that include a follow-up period are needed to examine the possible lasting effects of NBEE programs conducted in the context of the school curriculum. It will also be useful to consider the possible effect that children's previous participation in nature-based activities, such as scouts or summer camp EE programs, has on children's pro-environmentalism before participating in the NBEE intervention [12].

Secondly, participating schools had a principal and teachers who thought it was relevant to provide opportunities for contact with nature within the school curriculum. The principal's and teachers' commitment to the program might reflect the importance that participating schools give to environmental education. This might explain why our participants showed high EA and EB at the baseline. Future studies could try to reach schools where principals and teachers are less committed to environmental education to check whether similar findings are obtained in a different context. Participation might be encouraged by, for instance, offering rewards to the schools and teachers, and creating nationwide school competitions that give visibility to the schools. Another way

of promoting participation is by providing schools with information about the synergistic benefits of contact with nature instead of focusing exclusively on the benefits for pro-environmentalism. Information about the psychological and physiological positive effects of contact with nature, such as renewed attentional capabilities [55], and greater physical activity [56], as well as the students' increased interest in the school in general [34] might enhance schools' and parents' interest in NBEE interventions.

Thirdly, we learned, through informal communications with the teachers, that the NBEE program was perceived as an extra activity by some of them, and that they felt too much time was needed to implement the program. Future studies should more systematically check teachers' perceptions of the program, and especially the barriers they see to following the science curriculum with a nature-based pedagogy.

5. Conclusions

To conclude, this empirical evaluation of a nature-based environmental education program designed to follow the school science curriculum demonstrates that learning through nature exposure surpasses traditional instruction in terms of environmental attitudes. This study constitutes a first step towards advancing research on the benefits of nature-based environmental education by using a robust design that favors causal conclusions. In light of our findings, we encourage the promotion of a nature-based pedagogy in formal education to enhance Spanish children's environmental attitudes. A more in-depth understanding of the effects that different doses of nature exposure have on children's pro-environmentalism, the impact of nature-based environmental education programs on other relevant outcomes, such as environmental knowledge and health-related outcomes, together with a close examination of the barriers to implementing these kinds of programs will certainly guide the development of more efficient nature-based environmental education initiatives.

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