

Ecological behavior in children is linked to environmental knowledge and “a sense of connection to nature”

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Abstract

“An important part of environmental education is to promote environmental knowledge,” even if it has little effect on natural behavior. Learning about the environment and cultivating an emotional connection with nature are two components of nature-based education, a comprehensive approach to environmental behavior. This article examines “the effects of nature-based environmental education on students in grades 3 through 6,” with a sample size of 260. “Nature-based environmental education was related with improved ecological behavior,” as predicted, “and this association was mediated by improvements in environmental knowledge and a greater sense of connection to the natural world.” Even though both traits were linked to “participation in nature-based environmental education,” the correlation between “ecological conduct and environmental knowledge was just 3 percent.” While theoretical assumptions backed up by literature may be relied upon to establish the causality of these correlations, our data design does not support this causality. However, “nature-based environmental education, as an auspicious way to cultivating environmentally driven persons,” should be investigated further for its value in “creating environmental knowledge and Connection to nature as complementing drivers of ecological behavior.”

Keywords: “Environmental education, Ecological awareness, Ecological conduct, and Environmental knowledge.”

1.

Introduction

“It is commonly acknowledged that existing human activity has negative consequences for the planet's ecology;” hence, avenues for better understanding and, eventually, improved individual ecological behavior are necessary. As it tries to achieve the objective of environmental preservation and conservation, environmental education may be a valuable instrument in combating environmental issues (Ardoin et al., 2020). Environmental education attempts to influence not just “a person's internal representations and understandings of the

environment,” “but also to naturally encourage them to engage in acceptable real-life activities (Varela-Candamio et al., 2018).” To achieve sustainable development, education is a must (Chan et al., 2018). When it comes to extrinsic motives (e.g., rewards, penalties), they are typically greeted with resistance and have only short-term impacts, as shown by (Zhang and colleagues, 2019). As explained by (Zhang et al., 2019), reducing humanity's negative impact on the world requires an intrinsic desire to act environmentally (Turrini et al., 2018). As a result, to effectively ameliorate anthropogenic environmental concerns, cultivating an inherent

desire to serve the environment is critical (Leal Filho et al., 2018). Numerous academics have emphasized that environmental education should include intrinsic motivation and proper knowledge (Vicente-Molina et al., 2018). Because the incentive to be environmentally friendly is created in childhood and is likely to last a lifetime (Chuvieco et al., 2018), “environmental education for children is especially crucial.”

“This research examines the impact on the environmental behavior of children’s involvement in nature-based environmental education.” “The competency model of environmental education” (Zolnikov et al., 2018) is investigated in this way. To genuinely create ecological behavior, this concept posits that developing an internal drive through a sense of connection to nature, along with the acquisition of environmental information, is essential. “Nature-based environmental education, such as that given by forest schools or conservation centers, teaches environmental information while also fostering a sense of connection to nature.” This research will show that “children’s visits to nature-based environmental education institutions are connected to ecological behavior via the acquisition of environmental knowledge and a strong connection to nature.”

1.1 “Environmental knowledge.”

Individuals who want to engage in ecological behavior must thoroughly understand their surroundings to determine what steps to take. As a result, to develop ecological behavior, one must first understand the environment. No matter how beneficial it is to learn about the environment, “the link between environmental knowledge and ecological behavior has been debated,” and motivating variables such as personal values and attitudes may have a role. Researchers have discovered little evidence that environmental knowledge affects ecological behavior (Dong et al., 2020). However, it appears that promoting a specific ecological behavior, even based on a single piece of information, has the lowest impact. Motivating factors are absent from knowledge methods, not merely environmental behavior.

1.2 Education’s motivating component

A growing number of education-related areas have recently acknowledged the significance of student motivation in the learning process. Education for sustainable development and global learning, on the other hand, regards knowledge as just one component. Both knowledge and inspiration are considered necessary in “science technology, engineering, mathematics (STEM), and this is especially true in the case of STEM fields” (Swami et al., 2020). Global learning focuses on the development of motivation and ethical standards (Liu et al., 2019). According to this logic, there is a need for “greater learning and education for sustainable development since holistic vision and the capacity to handle contradictory kinds of information are essential to sustainable development and ecological conduct.” Environmental and sustainability concerns and issues need deep learning, enabling students to grasp better what they’re reading. In addition, students engaged in the more in-depth study are less concerned with merely passing an exam and instead have a sincere desire to learn. Because of this, an educational environment must be provided that encourages students to acquire a strong sense of personal responsibility for sustaining their communities (Krettenauer et al., 2020). For environmental education, we now know that it must have a motivating element as well as environmental information; thus, “we propose a competency model that includes both environmental knowledge and an element of motivational connection to nature.”

1.3 Connection to nature

“People who have a deep connection to nature are more inclined to participate in environmentally-friendly activities (Fränkel et al., 2019).” Connection to nature is, in fact, the strongest indicator of ecological behavior (or at least has the strongest correlation with it). It has been found that up to 60% of the variance in connectivity to nature and ecological behavior is shared across many research and measurements. While other variables, such as moral and normative concern, may explain some variance in

environmental behavior, models like the "norm activation model" do not account for the connection to nature when trying to promote ecological behavior. Therefore, the strength of this connection is critical when trying to promote environmental behavior. Connection to nature and environmentally responsible conduct appear to be intertwined at every stage of life, from childhood through adolescence to adulthood (Moreton et al., 2019). An ecological activity needs a connection to nature (Sato et al., 2021). It's a great incentive to live a greener lifestyle since, when one is more in tune with nature, harming the environment has a more significant impact on one's wellbeing. In the same way, other relationships may be strengthened via touch and exposure. A person's sense of connection to nature signifies how close they are to each other (Martin et al., 2020). Exposure to nature rather than an urban setting, regular trips to natural areas, and having personality close at hand are all positively associated with "a sense of connection to nature."

1.4 Environmental knowledge and "a sense of connection to nature" are two separate but related concepts.

Individuals' ecological behavior is influenced by a mix of environmental knowledge and "a sense of connection to nature." Due to the interconnected nature of these notions, learning about the natural environment's functioning may

expose people to the interconnectedness of all life, therefore altering their relationship with nature. Connection to nature may also lead to an increase in environmental understanding. "Individuals who have a deep connection to nature may be more interested in learning about and protecting the natural environment." According to research, there is only "a weak link between environmental literacy and a sense of connectedness to the natural world (Sobko et al., 2020)." Due to the lack of environmental awareness in the sample, this is most likely the reason. In another study, environmental awareness was shown to be low, as was the case in this one. People's emotional attachment explains a third of ecological behavior to nature, "which is a considerably more powerful predictor of ecological behavior than environmental knowledge" ever could have been on its own.

There is barely a 3 percent correlation between environmental knowledge and a sense of connection with nature, even though both are important in encouraging ecological behavior. Furthermore, it is unclear which, if either, of the two, arrives first. While their tenuous link implies that they have some mutual influence on each other depending on "an individual's background, we think that in a nature-based environmental educational setting, these two components are addressed simultaneously, and their impact on one another cannot be quantified."

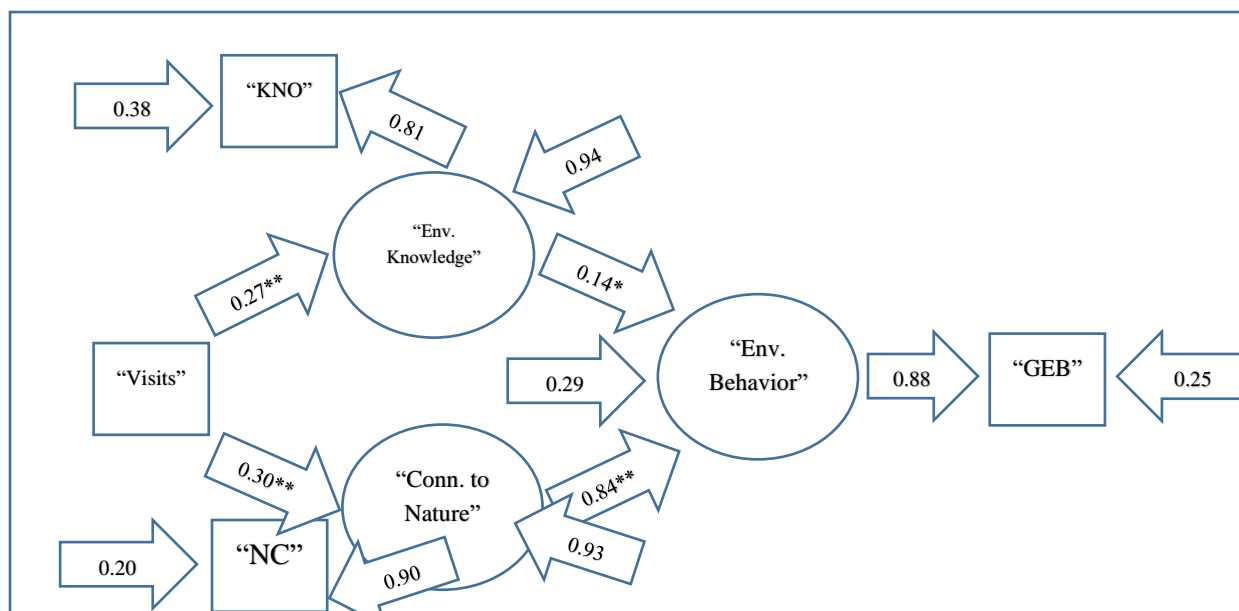


Figure 1. “Visits to nature-based environmental education influence environmental understanding and connection to nature.”

Note. Error variances are represented by arrows with no sources, while proportions of unexplained variations are shown by arrows having origins. Except for the number of visitors, all observable variables have boxes to reflect their known reliabilities. There are numerical numbers at each of the dashed lines representing the factor loadings. There are three circles for each of the three components of “the environmental competence model (latent variables).” Normalized multiple regression coefficients are a numerical value that is statistically significant for the remaining arrows with origins. $N = 260$. * $p < .06$. ** $p < .02$.

1.5 Encouraging ecological literacy through nature-based education

According to the environmental competency model, ecological behavior can be influenced by environmental knowledge and a sense of connection to nature (Schmitt et al., 2018). Even though environmental information is a regular part of environmental education, encouraging pupils to interact with nature is less common in educational settings. These educational settings are located in nature, which allows students to learn more about the environment and have a direct connection to nature. Some examples of these environments include: “farms; urban gardening initiatives, such as community gardens on defunct allotments; botanical gardens; zoos; and forest schools, which include inclusive gardening-schooling” ideals as well as traditional conservation concepts. In a nature-based setting, kids may learn about the environment while also developing a feeling of connection to nature.

Through personal experiences, nature-based environmental education fosters students' emotional connection to nature, awareness of ecological challenges, and social ties. Nature experiences bolstered students' self-esteem and sense of security, and as a result, they were more eager to partake in such outdoor activities in the future. There seems to be a substantial connection

between students who participated in outdoor activities and those who did not. A similar effect is shown in students' attitudes about the environment and their desire and conduct in those areas while studying in a natural setting. The ecological consequences of human activity are a vital component of nature-based environmental education. As a result, nature will take on unique meanings for each pupil.

According to research, higher rates of eco-friendly behavior are linked to “people's sense of connection to nature.” “Connection to nature” has correlations as high as .46, .62, and .47 with variables such as biospheric values, environmentalism, and ecological behaviors. As a result, there is a strong empirical link between environmental-related variables (e.g., environmental concern, environmental behavior) and a connection to nature.

Environmental education programs that are longer or more regularly administered have a more significant impact on ecological behavior than shorter or less frequently performed programs. More extended environmental education programs have been shown to have a substantial and favorable effect on students' ability to form meaningful connections with nature. In light of this, researchers have concluded that “repeated or long-term adoption may guarantee permanent effects that eventually may continue for life.” According to the results, people who participate in “environmental education programs in the setting of the natural environment are more likely to adopt environmentally friendly behaviors.”

There are many ways to learn about the natural world, but the most effective one is to know about it in the context of nature. Learning about the environment and its place is more accessible when students are immersed in natural surroundings. Or, to put it another way: the connection to nature and environmental knowledge fostered in these educational

environments cannot be separated in time. Ecological behavior is influenced by environmental expertise and a link to nature. The two components are assumed to act as a mediating force between environmental education grounded in nature and changes in ecological behavior. Knowledge and connection to nature are impacted simultaneously by nature-based environmental education, making it impossible to investigate the association between them. For these and other reasons, we will omit our model's correlation between environmental knowledge and a strong sense of connection to nature (see Figure 1).

1.6 Research objective

Participation in nature-based education and environmental behavior are examined in this research. Nature-based education aims to influence students' attitudes about the environment positively. A connection to nature may be fostered, and environmental information can be acquired conceptually if the educational setting is integrated with or adjacent to nature. "Nature-based environmental education is expected to have a good influence on environmental knowledge and a positive connection to nature." The link to nature and environmental knowledge is expected to mediate environmental education and ecological behavior based on nature (Gao et al., 2019).

2. Method

2.1 Those involved and the process

More than 260 children from five universities in grades 3 through 6 participated in our research project. "Only after gaining official consent from the Senate Office of Education, Youth, and Science, university presidents, and parents of the students were it agreed to continue." Parents at the five schools were asked how frequently they attended nature-based educational facilities or activities, and 260 students answered the essential question. More than 260 pupils, or 40% of 3rd to 6th graders from five of those schools, were included in the study. Students were invited to fill out a questionnaire in class to obtain data. The same researcher was in charge of these processes, and they offered a consistent

introduction and explanation of the survey and the written instructions.

2.2 Measures

"The frequency of visits to a nature-based environmental education facility was utilized to assess student engagement." Describe your experience at one of the following types of environmental education facilities: outdoor labs, Eco Works, conservation centers, or forest schools. "Never" or "Once" were the most common responses when asked whether they'd ever gone to such an establishment. As part of the questionnaire, a researcher explained the term "nature-based environmental education centers" in considerable detail. These include outdoor labs and Eco works; botanical gardens and forest schools; as well as a variety of conservation centers and educational programs. We used "(a) an ecological behavior scale for children," "(b) a Connection to nature scale for children," and "(c) an environmental knowledge measure for children" to gauge the various aspects of our study's environmental competency model.

According to the field of eco-behavior, the degree to which people adopt an environmentally-friendly lifestyle is examined. Focusing on a single behavioral area and neglecting others misses the reality that individuals execute a wide range of actions, influencing the environment. An individual's overall environmental effect may not be accurately assessed "without a similarly comprehensive approach to rating ecological behavior." It is also necessary to consider that youngsters have only a limited number of behavioral options when evaluating their environmental behavior (Frankenhuis et al., 2019). "Energy conservation, mobility and transportation, waste avoidance, recycling, consumerism, and vicarious conservation were among the six categories addressed by a behavior-based environmental attitude scale," which was used to discover and modify 25 behavioral items. Examples include "I turn off the lights when I leave a room," "I keep present wrapping paper for future use," and "When I leave a room, I turn off the lights." Reverse coding was used for five out of the 25 behaviors that were unecological. On a scale of 1 (not at all) to 5 (completely), the subjects answered each

question (absolutely). By reducing 1, 2, and 3 into a un ecological tendency and merging 5 and 4, “the answers to the polytomous self-report questions were recoded into a dichotomous format.”

These findings were based on a “shorter version of the Disposition to Connect with Nature Scale (DCN-S).” As contrasted to “other measures of connection to nature,” “such as the Environmental Identity Scale or the Connection to Nature Scale,” DCN examines unique bonding behaviors that show how close one is to the natural world. As a result, it is a good choice for youngsters. “DCN has a higher incremental validity than other measures of nature connection,” although other measures are typically converging on the DCN scale. Based on their difficulty distribution, things were chosen to create a scale with the same range of items. I like seeing animals and the sound of insects, although these are only two examples (reversed). “The polytomous self-report questions were recoded into a dichotomous format,” and the unconnected and linked tendencies were consolidated into one. Every one of the “25 questions were answered on a five-point scale from 1 (not at all) to 5.”

People's environmental knowledge is frequently gauged by how well they can complete exercises tailored to the participants' ages. “Individuals within a wide range of a certain ability may be distinguished using differentially challenging tasks,” “which can be investigated using the Rasch model to construct an in-transitive scale (Taufique and Vaithianathan, 2018).” As well as correctly separating trash, this measure includes information on the environmental system and how to increase its performance. To create a collection of questions that matched the “theoretical approach of Rasch-based measurements,” we chose and adjusted items that were appropriate for 3rd to 6th graders. Environmental knowledge was examined using eight questions, three of which may be answered incorrectly or adequately, and five could be answered incorrectly, partially correct, or entirely correct (Maravilha and Martins., 2019). Questions that were left unanswered were given an erroneous grade. Biological knowledge,

environmental systems knowledge, and environmental action knowledge are all represented in this collection. Socially valued reactions may influence ecological behaviors and a connection to nature. Social desirability was not included in our study. There was no significant effect on a measure of environmental behavior in prior research on social desirability. Since our environmental conduct and our sense of connection to nature are generated from the exact behavioral-based mechanism, we argue that social desirability does not affect either.

3. Results

Ecological behavior, connection to nature, and understanding of the environment are all examined in this section. Structural equation model findings, which we utilized to test whether our hypothesis that was frequenting nature-based environmental education institutions had a positive influence on ecological behavior is valid, will be discussed next (Meng et al., 2019). The item's fit for all three-measuring equipment was within the recommended range. The findings of using a “weighted MS value to assess how well the item response data matched the model” are presented in this picture. Values below one suggest overfitting, while those above indicate underfitting for an item's MS, which has an ideal weight of 1. For example, an MS score of 1.3 implies 18 percent excess variance (underfit), whereas 9 shows 25 percent less variation (overfit). According to academics, several ranges of acceptable model fit are provided as recommendations and rules-of-thumb. One of the most typical rules of thumb is to utilize an MS of .8 to 1.4. We used the overall mean of the item estimates to anchor the logit scale, which is a typical practice in Rasch modeling (e.). MS values ranged from .82 to 1.32 as a measure of ecological behavior, “and the mean (MS) of all MS values was M.97,” indicating that the items were well-matched. The research discovered that just “3% of children had a statistically significant poor fit,” much less than the recommended 6%. $R = .76$ is regarded as excellent in terms of separation reliability (the proportion of person variation not attributable to error). An environmentally minded person would have a mean score of .13 ($SD = 1.19$) on this test, which

is near the item mean and indicates that the item difficulty and the desire to act ecologically are well-matched. For the connection to nature measure, “MS values varied from .83 to 1.32,” “with an overall mean of $M(MS) = 0.98$ ($SD = 12$), and just 3% of the children's response patterns did not match the model” which is within the suggested MS value range. Separation reliability was also deemed suitable at $r = .82$ (Abbas and Sasan, 2019). There was practically a perfect match between the difficulty of the scale with the typical person's connection to nature, with $M = .03$ ($SD = 1.31$). Only 3% of children showed a statistically significant poor fit on the “environmental knowledge measure,” “MS values ranged from .64 to 1.17, with a mean of $M(MS) = .91$ ($SD = .19$).” The separation reliability was satisfactory, $r = .65$, despite the scale's short length. The “children's mean score for environmental awareness was $M = .77$ ($SD = 1.27$) and hence more than 0” in this category.

Because of this, in every knowledge exam involving multiple-choice questions, the participants' assessed scores will always be higher. “It is assumed that a student knows the knowledge assessed by the question if the item's response probability exceeds $p = .64$.” “In our sample, the response probability was close to $p = .63$, with an average of $p = .68$.” The unmodified theoretical model-implied figures and observed numbers “($\chi^2 = 2.33$, $df=2$, $p=.32$)” are a good match in our structural equation model test. All four of theorists' predicted routes proved to be necessary. Students' environmental awareness and connection to nature improved after attending nature-based environmental education programs, with effects of $=.26$ ($p = .001$) and $=.29$ ($p = .001$). There was a significant correlation between ecological activity and a person's level of connection to nature ($r = .83$) and their level of environmental awareness ($r = .14$; $p = .036$; Figure 1) ($p = .001$). Ecological behavior may be described by connection to nature to the tune of 70% and by environmental knowledge to the tune of 3%. There was also an association ($r = .16$) between environmental awareness and nature connection scores ($p = .06$).

4. Discussion

“This study aims to examine the impact of environmental education on ecological behavior.” “We think our research is the first to show a substantial influence of nature-based environmental education on ecological behavior mediated by both links to nature and knowledge of the natural world.” “(Carducci and colleagues, 2020)” This effect is dependent on environmental education that is grounded in nature. According to our competency model (Trivedi et al., 2018), “connections to nature and environmental knowledge have a significant impact on ecological behavior, and the size of these effects is within the range predicted.” Connection to the natural world had a more significant impact on ecological behavior than environmental knowledge ($= 0.14$; $p = .036$), which had a minor effect ($= 0.84$). Only 3% of the variety in ecological behavior can be explained by knowledge of the natural world. Environmental knowledge significantly impacted environmental behavior, although it was not as strong as previous research (Bertz et al., 2018). This effect may have occurred because of a mismatch between environmental information and the difficulty of questions. However, this was not the case in our investigation. As a result, “the relationship between environmental knowledge and ecological behavior remained relatively modest at $r = .20$ (p less than 0.02).”

Our research also found a slight correlation between environmental awareness and a sense of connectedness to nature, with $r = .14$ ($p = .06$), which is in line with prior findings (Liu et al., 2020). Despite this, we did not include trips to nature-based environmental education facilities in our structural equation model since we believed that such visits had a direct and simultaneous impact on “environmental knowledge and a connection to nature.” For this experiment, “the good fit of our model on all fit indices supports this omission in favor of our more frugal model in Fig 1.” Still, before we can generalize to all such situations, our method must first be tested in other regions and institutions. In Larsson and colleagues' (2018) work, It is possible to compare and enhance the efficacy of diverse educational settings. Before wide-scale implementation, new educational ideas based on our technique might be created and assessed. As

a result, empirical assessment of “environmental education programs will help environmental education theory as well as practice.” Children who participate in “nature-based environmental education are more likely to understand better the environment and a stronger connection to nature,” which leads to better ecological behavior. (Bhagat and colleagues, 2021) Many questions remain unanswered, such as how much time and how often one should spend in nature to reap the most significant long-term benefits. “In the future, it may be useful to study these traits over time to understand better how nature-based environmental education might be most successful.”

Furthermore, we can only deduce our hypothesis's inherent causality from the literature; no actual proof has been provided. As a consequence, “more research into the causal direction would strengthen the scientific basis for the benefits of nature-based environmental education.” “It is also possible to test the validity of our findings by replacing or substituting the independent variable (i.e., recall of the frequency of visits to nature-based environmental educational institutions) with other indicators.” Furthermore, “retrospective monitoring, particularly for the chosen age group, is a conflicting approach (Arfi et al., 2018).” Learning about nature and having an “emotional connection to it has been shown to have a positive impact on environmental behavior (Choi and Johnson, 2019).” An environmental education program using nature-based activities has been shown to influence ecological behavior positively. This suggests that “nature-based environmental education is an extremely successful strategy for encouraging a sustainable way of living that has a broad impact on ecological behavior.” “Nature-based environmental education's impacts on environmental knowledge and the development of a strong sense of connection to nature were about comparable.” However, when it comes to influencing ecological behavior, connection to nature beats environmental knowledge.

In addition, “nature-based environmental education may affect environmental knowledge and behavior via other means.” A student's

motivation for learning is influenced by their classroom's environmental attitudes and attitudes toward understanding (Jaiswal and Kant, 2018). “If information acquisition is not the major aim of nature-based environmental education, and only the motivational component is addressed,” an increase in motivation is likely to encourage knowledge acquisition in other contexts, as well.

The stability of educational influences on knowledge and behavior is another critical factor, which is most likely controlled by the frequency and length of the program (Turnhout et al., 2020). Even after a “one-day environmental education intervention in an ecological-botanical garden, at least part of the positive effects may last for six weeks (Cerri et al., 2018).” “As a result of these results, long-term environmental education programs are more likely to influence participants’ attitudes and actions. Ecological behavior and a deep connection to nature are linked strongly by nature-based environmental education in our study.

Increasing ecological behavior without the use of external motivators like monetary or social gain appears to be a potential goal of “nature-based environmental education.” “It is predicted that (Latulippe and Klenk, 2020).” However, the type of “nature-based environmental education that has this effect is still unclear.” Further research is needed to confirm this effect's causation in long-term investigations. “Comparing environmental education units with and without nature exposure would be the next obvious step to evaluate whether there was an additional advantage.” As a result of “nature-based education's fostering of a connection to nature, it provides a long-term” approach to environmental behavior.

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