



Article

Active Learning Affects Children's Intention to Act and Awareness of the Importance of Nature and Understanding Environmental Change

Carmella Granato, Marco Campera *  and Matthew Bulbert 

School of Biological and Medical Sciences, Oxford Brookes University, Oxford OX3 0BP, UK; carmellasoffia@hotmail.com (C.G.); mbulbert@brookes.ac.uk (M.B.)

* Correspondence: mcampera@brookes.ac.uk

Abstract: Guiding future awareness of and attitudes on the importance of nature and understanding environmental change is crucial for its future mitigation. A barrier to acting on issues such as climate change, however, is the time scale at which they occur and the lack of tangibility around key concepts such as the impact they have on phenotypic shifts in fauna and flora. Here, we assessed an environmental education intervention integrated into a mainstream curriculum that included cooperative learning and a practical environmental biology experiment. We aimed to understand if this intervention increased both the awareness of environmental change and intention to act in primary-school-aged children. We selected 150 students (5–11 years) from Oakhurst Community Primary School, UK, and assessed the intervention via the Draw-Our-Environment (DOE) test and an Environmental Perception Survey (EPS). We showed how a curriculum inclusive of more than tokenistic environmental education, developed through considering a combination of different active learning activities, favoured a clear increase in environmental awareness and intention to act. Via path analysis, we showed that an increase in environmental awareness (assessed via the DOE test) determined an increase in individual orientation on pro-environmental behaviours (assessed via the EPS). Experiential learning helps students to understand the physical processes of environmental change and increase awareness of environmental problems. This has the potential to alter perceptions of young people's attitudes on the importance of and willingness to act against environmental change.

Keywords: SDG 4; quality education; cooperative learning; pro-environmental behaviour; environmental awareness; environmental perception; environmental orientation; environmental attitudes; biophilia; climate change



Academic Editors: Jungho Baek and Manfred Max Bergman

Received: 30 December 2024

Revised: 15 March 2025

Accepted: 19 March 2025

Published: 21 March 2025

Citation: Granato, C.; Campera, M.; Bulbert, M. Active Learning Affects Children's Intention to Act and Awareness of the Importance of Nature and Understanding Environmental Change. *World* 2025, 6, 36. <https://doi.org/10.3390/world6020036>

Copyright: © 2025 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

1. Introduction

A challenge with increasing public contribution to address global environmental concerns is giving the public tangible information and clear pathways to implement change [1]. The lack of willingness in public participation in addressing climate change has been attributed to the public's lack of understanding and/or misunderstanding of physical processes (e.g., global warming, greenhouse gases, photosynthesis, phenotypic shifts) [2]. These terms are far removed from everyday activities and as such can be difficult for the public to reconcile into manageable actions [3].

The current youth are expected to overcome the legacies of environmental and climate inaction [4]. Several studies have indicated that young people's understanding of environmental change is limited in understanding the physical processes of environmental change

(i.e., phenotypic shifts) [5]. Simply educating students about environmental impacts can affect students' behaviour and attitudes towards environmental issues [6], but it does not necessarily lead to students fostering a sense of responsibility (i.e., attitude–behaviour gap; [7]). This can be attributed to a lack of tangible connection between classroom learning and real-world impacts, leading to a sense of detachment [8]. Other factors can also play a role in taking responsibility for improving environmental conditions, e.g., the predominance of cognitive activities over affective-based actions [9], the clash between climate change communication and individuals' sensitivity [10], and the discrepancy between the impact of individual actions versus collective effects [11].

Conservation education is a type of environmental education with the specific aim of influencing people's attitudes, knowledge, behaviour, and emotions about nature and wildlife [12]. Initiating behavioural change is the primary goal of conservation education projects, though many initiatives achieve only the first stage of the revised Bloom taxonomy of educational objectives (i.e., increase in knowledge) within the cognitive learning domain [12,13]. The cognitive domain has been the influence of curricular development and assessments worldwide [14]. Recently, it has been acknowledged that if there is any hope of ensuring the long-term goal of increasing the pro-environmental behaviours of the next generation, environmental education techniques need to adapt within the affective domain (i.e., values, attitudes, and interests) [15]. The affective domain's utilisation and international acceptance have been more subdued, highlighting the need for research into how it can be used to guide curricular development [16].

Active learning involves students taking an active role in learning with the educator being a facilitator of this process, and it is effective in teaching STEM disciplines [17]. Examples of active learning techniques are group discussion, hands-on field or laboratory experience, problem-based learning, role playing, and gamification [18]. Experimental activities, in particular, have been shown to increase knowledge and stimulate cognitive processes [19]. The active learning paradigm, which involves constructing personal meaning and building internal representations of knowledge, relies on direct experience [20]. Experiential learning—where individuals engage in practical activities that reinforce their understanding—plays a crucial role in shaping how they interpret information and develop attitudes [15].

Active learning produces students with higher levels of emotional intelligence, i.e., self-awareness, self-regulation, motivation, empathy, and social skills [21]. Highlighting the likelihood of an individual choosing to invest in future pro-environmental behaviours as an adult is framed by their own personal experience [22]. Experiencing firsthand the effects of a physical environmental process will produce a more inherent understanding of biological principles and individuals will thus gain a sense of urgency as it has been personally experienced [23]. For example, a programme combining digital photography and hands-on educational activities increased children's knowledge of, attitudes about, and intention to act about the social and scientific dimensions of environmental change [24]. Similarly, related studies also identified that environmental engagement activities resulted in changes in skills, attitudes, and knowledge related to enhancing ecological, social, and economic justice [25–27].

Active learning can be a way to support children's learning environments and promote an increase in awareness of and orientation on environmental issues such as climate change [24]. Environmental awareness refers to how students think about environmental issues in their lives and how they can make a difference in this world [25]. An increase in knowledge and understanding is the main element considered to achieve an increase in environmental awareness, but some authors include environmental perception as an element of environmental awareness (e.g., [25]). For this paper, however, we considered

environmental perception a separate element from awareness as it is not only children's ability to perceive environmental issues but also the way in which the environmental issue is interpreted [28], and we did not investigate environmental perceptions

This study aimed to assess whether integrating an environmental education intervention into a mainstream curriculum—combining cooperative learning with a hands-on experiment—could enhance primary-school children's awareness of environmental change and their intention to act. Ultimately, we sought to strengthen their connection with nature and foster a positive attitude toward the topic, particularly regarding the impact of environmental change on wildlife [29,30]. We hypothesised that the educational resource would deepen students' understanding of the relationship between temperature and the phenology of organisms, thereby increasing both awareness and intention to act. Additionally, we predicted that environmental awareness and environmental orientation scores would rise following the intervention and that improvements in various aspects of environmental awareness would have a significant positive effect on different elements of environmental orientation.

2. Materials and Methods

2.1. Site Selection and Test Subjects

One hundred and fifty students from Oakhurst Community Primary School in the United Kingdom partook in this case study. Students from six classes across three year groups, years one, two, and five, were eligible to participate. The ages of the participants (5–11 years) were selected based on Piaget's theory of cognitive development [31]. Focusing on the pre-operational and concrete operational stages, children begin using inductive logic or reasoning from specific information to form a general concept [32]. Individual classes were selected based on their prior engagement with the scientific module "Life Cycles" during the semester before this case study. This approach ensured a smooth transition for participating students while providing a foundational understanding of phenological processes.

2.2. Intervention

The environmental education strategy was integrated into the first week of term six and delivered in three elements: a workshop, the set-up of a practical experiment, and the monitoring and recording of the practical experiment. The workshop and set-up of the practical experiment were completed during the first visit and lasted around two hours per class (Table 1).

Table 1. Elements of the environmental education intervention delivered to Oakhurst Primary School (150 students) in Wiltshire, UK, with target revised Bloom's level.

Activity	Type	Revised Bloom's Level
Workshop	PowerPoint presentation with imagery and activities including active discussions between peers.	Remember, Understand.
Experiment set-up	Practical activity preparing live specimens, set-up of incubator, and making predictions.	Remember, Understand.
Experiment monitoring/recording	Practical experiment monitoring and recording phenological changes in <i>Vanessa cardui</i> larvae	Remember, Understand, Apply.

A simplified version of the baseline experiment described in Granato et al. [33] was used during the intervention. Larvae in this experiment were only exposed to low and high temperatures. Each of the 6 classes were supplied with one incubator and ten *Vanessa cardui* larvae. Greater replication was not required based on the baseline experiment and the

reliability of responses from previous studies [33]. Three of the classes' incubators were at the optimal temperature (28 °C) whilst the remaining enclosures were kept at room temperature (18.5 °C). Incubators were set up to the same standards as those of the baseline experiment. Students monitored the incubators over several weeks, documenting the pupation date and emergence date in a child-friendly way.

2.3. Evaluation

A mixed-methods approach for evaluating the outcomes of this study was used. More specifically, we used the "Draw-Our-Environment" test to measure environmental awareness and a survey to measure environmental orientation which were adapted versions of two existing environmental education (EE) evaluation instruments.

The first assessment method, an open-ended drawing prompt, was adapted from the Draw-An-Environment test [34] and the similar Schoolyard Habitat Drawing [35]. Previous studies suggest that environmental concepts and definitions can be evaluated using drawn images and written words [36]. Employing a similar approach, this study used a drawing exercise with a written prompt that asked participants to "Draw a Picture of our Environment" and an additional verbal prompt asking participants to "Draw and label what our environment means to you". The Draw-Our-Environment (DOE) test was designed to allow children to express their awareness of the word environment, allowing individuals creative scope when considering the words "Our" and "Environment" together, resulting in images that were personal but reflective of community [37]. For example, these included children's general depictions of habitat types across an anthropogenic-to-natural spectrum (i.e., indoor habitats, back-garden habitats, natural outdoor habitats). Additionally, any changes or interactions between them provided a coarse measure of eco-affinity and eco-awareness or the extent to which the children demonstrated a personal interest in and attitudes to an array of environmental settings. To assess this, the scoring rubric from Moseley et al. [34] was used to facilitate a reliable evaluation of children's drawings among multiple scorers (Table A1). Participants were anonymised prior to this study; a code was given to each student which was used for the individual consistently throughout data collection (Tables A2–A4). Participants' drawings were evaluated independently on three occasions by C.G. and two educators at Oakhurst Community Primary School. To remove bias from the evaluation, individuals from different departments with no personal and/or professional connection to the participants were asked to partake in the evaluation process.

The second assessment method, a paper survey, was an adapted version of the Children's Environmental Perception Scale (CEPS). The original CEPS from Larson et al. [38] included 16 Likert-type statements and proved to be a valid and reliable method for evaluating children's orientations, eco-affinity, and eco-awareness. This method is not suitable to assess environmental perceptions despite the name of the survey, but it is still an established method to assess environmental orientation and intention to act, similarly to what was conducted by Bergman [39] and Collado et al. [40]. This study used the original 16 Likert-type statements from the CEPS with the inclusion of 8 additional Likert-type statements focused specifically on climate change. The adjustments made allowed for insight into the children's orientation towards current environmental changes. The children responded by circling one of five responses (from one = "strongly disagree" to five = "strongly agree") (Table A5).

2.4. Data Analysis

For the ease of analysis, individual scores from each assessor were combined to create an overall score for each response variable of the DOE test (human, living, abiotic, and human-built) (i.e., scorer 1 = 3; scorer 2 = 3; scorer 3 = 2; total score = 8). The responses from

the Likert-type statements for the EPS were converted to a series of numbers so that calculations could be made for each response variable (climate change, eco-affinity, eco-awareness) (i.e., strongly disagree = -2; disagree = -1; unsure = 0; agree = 1; strongly agree = 2). Generalised Linear Mixed Models via R software v 4.3.1 were used for both strategies. Package instalments included glmmTMB [41], DHARMA [42], and emmeans [43]. To ensure the best fit, a variety of family models were tested for each response variable. The select models for each response variable were as follows: Type-One Negative Binominal Distribution in Zero-Inflated Negative Binominal (nbinom1) = H; Generalised Poisson Distribution (genpois) = L; Type-Two Negative Binominal Distribution in Zero-Inflated Negative Binominal (nbinom2) = A; nbinom1 = Hb; nbinom1 = total [41]; and climate change, eco-affinity, and eco-awareness = Gaussian [41]. A structural equation model in the form of a pathway analysis was conducted to evaluate the covariance of the DOE test in response to the EPS. The package used was Latent Variable Analysis (Lavaan) [44]. The model fit was checked based on the Comparative Fit Index ($0.97 \leq \text{CFI} \leq 1.00$ was considered a good model fit; [45]), the Adjusted Goodness of Fit ($90 \leq \text{AGFI} \leq 1.00$ was considered a good model fit; [45]), the Standardised Root Mean Square Residual ($0 \leq \text{SRMR} \leq 0.05$ was considered a good model fit; [45]), and the Root Mean Square Error of Approximation ($0 \leq \text{RMSEA} \leq 0.05$ was considered a good model fit; [45]).

3. Results

3.1. Environmental Awareness (DOE Test)

The overall score for the DOE test increased in each stage with the most substantial increase occurring post-experiment. The overall scores for each stage were 440.4 (24.4%, pre-intervention), 536.6 (29.8%, post-workshop), and 737 (40.94%, post-experiment), with a slight increase of 5.4% post-workshop and 16.5% post-experiment. This positive impact was consistent and significant in all the response categories of the DOE tests that made up for the overall score. The individual response variable scores increased by 1.8% (H), 25.5% (L), 31.4% (A), and 7.4% (Hb) from pre-intervention to post-experiment, demonstrating that the overall emphasis of environmental awareness was greater in those of the living and abiotic response variables when compared to those of the human and human-built response variables (Figure 1; Table A6).

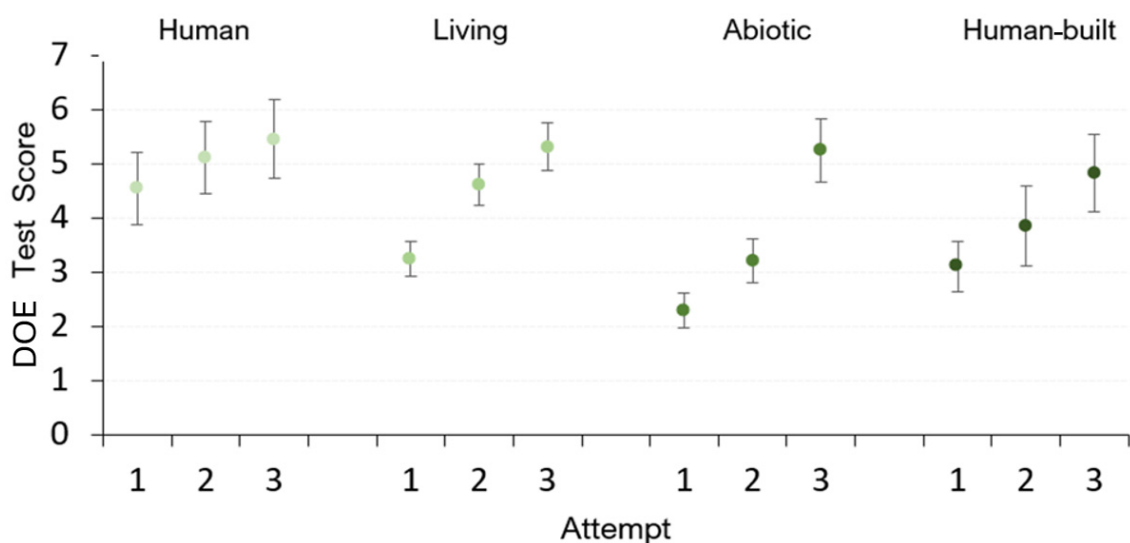


Figure 1. Mean score and standard error for each attempt (pre-intervention, post-workshop, post-experiment) for all response variables (human, living, abiotic, human-built) of Draw-Our-Environment test for environmental awareness. Data are from 150 children from Oakhurst Community Primary School, UK.

3.2. Environmental Orientation (EPS)

There was an increase in EPS scores (i.e., “strongly agree”, SA) over the three stages. The SA selection score was 1330 pre-intervention (46.8%), 1642 post-workshop (57%), and 1770 post-experiment (61.4%), demonstrating a consecutive increase of 10.8% post-workshop and 15.2% post-experiment. The response variables eco-affinity (EA), eco-awareness (EAw), and climate change (CC) were all positively associated with the environmental education strategies with significant relationships displayed in all variables. Each response variable displayed an increase in SA from pre-intervention to post-experiment (4.9% for EA, 4% for EAw, and 6.4% for CC).

The responses of individual statements varied within the response variable categories. The statements that required action from the participant within the EA category received on average higher scores of SA than those of statements which simply stated a view, e.g., for #20, “I would give some of my pocket money to help protect wild animals”, 76 students (71%) selected SA post-experiment in comparison to for #3, “I like to read about plants and animals”, where 65 students (60.7%) selected SA, a trend that was consistent throughout the EA response variable.

The EAw response variable category showed that the statements which implied a negative impact towards the individual or community scored higher in the SA response, e.g., for #15, “if there were no trees everyone’s life would change”, 99 students (92.5%) selected SA post-experiment. This was closely followed by statements which invoked a negative feeling towards the individual; for example, for #6, “building homes where plants and animals use to be upsets me”, 75 students (70%) selected SA in comparison to for impersonal statements such as #8, “nature is easily destroyed”, where 68 students (63.5%) selected SA post-experiment.

The CC response variable received the highest overall increase; however, it also displayed the highest level of uncertainty post-experiment, demonstrated by the statement response “unsure” being chosen by 13.5% of children in comparison to EA (11.2%) and EAw (7.6%). Additionally, like the other response variable categories, it also displayed variation in responses to individual statements. However, unlike the EA category, a statement which required action from the participants received the lowest SA selection, i.e., for #23, “I would help in projects that are trying to reverse the effects of climate change”, 65 students (60.7%) selected SA in comparison to for statements which expressed importance, such as #24, “It is important to learn about the effects of climate change on plants and animals”, where 79 students (73.8%) selected SA (Figure 2; Table A7).

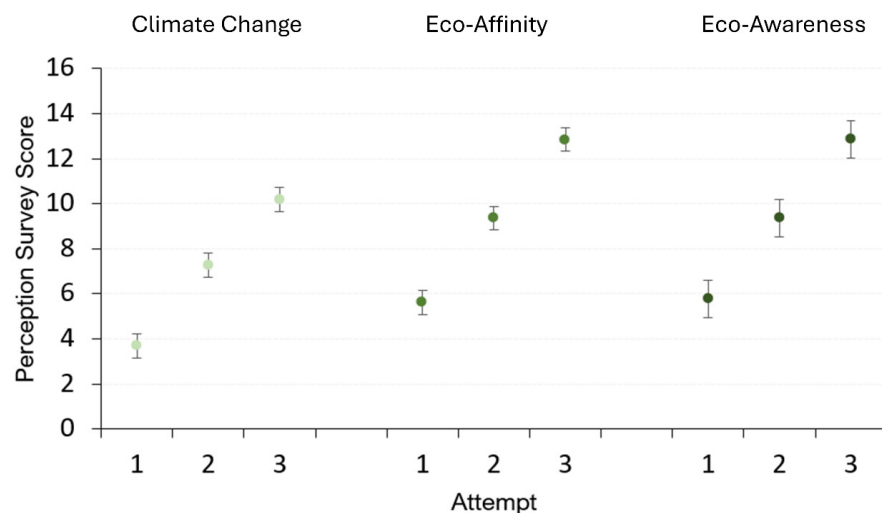


Figure 2. Mean score and standard error for each attempt for all response variables of Environmental Perception Survey (climate change, eco-affinity, eco-awareness) for environmental orientation. Data are from 150 children from Oakhurst Community Primary School, UK.

3.3. Relationship Between Environmental Awareness and Environmental Orientation

Each variable of the DOE test (human, living, abiotic, human-built) showed a positive impact on each variable of the EPS variables (climate change, eco-affinity, eco-awareness). The responses of individual variables varied; however, they all displayed a significant impact. A positive correlation was also displayed within the EPS variables (Figure 3; Table A8). The model fit parameters were CFI = 1.0; AGFI = 1.0; SRMR = 3.3×10^{-8} ; and RMSEA = 0.0.

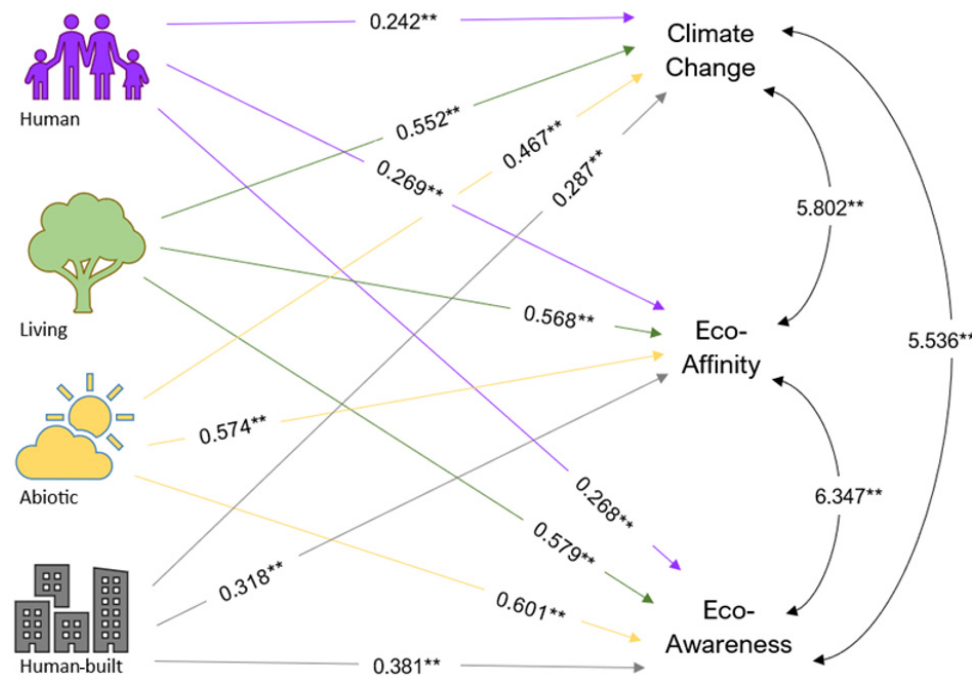


Figure 3. Estimates for the response variables for the Draw-Our-Environment test for environmental awareness (human, living, abiotic, human-built) in relation to the Environmental Perception Survey response variables (climate change, eco-affinity, eco-awareness) for environmental orientation. Double arrows indicate covariances between the Environmental Perception Survey variables. The data are from 150 children from Oakhurst Community Primary School, UK. ** $p < 0.01$.

4. Discussion

4.1. Curriculum Design and Active Learning

Here, we demonstrated how a curriculum that went beyond tokenistic environmental education—designed by integrating various active learning activities—significantly enhanced environmental awareness and intention to act among primary school students in Wiltshire, UK. Alongside the environmental biology experiment, a key factor in enhancing students' retention of concepts about climate change and understanding of its environmental impact was a series of activities that encouraged active peer discussions during the workshop stage. The activity was guided by the concept that knowledge cannot be simply transmitted through passively absorbing it but can rather be constructed through mental activity [46]. The active discussion component enabled learners to construct their own meaning and develop internal, personal representations of knowledge [47], fostering higher-order skills and attitudes that extended beyond discipline-specific knowledge. These higher-order skills included transferable abilities such as empathy for real-life situations and self-evaluation [20]. Despite its increasing positive traction, active discussion between young students can often lead to misconception, due to the lack of understanding or knowledge of the revised topic [48]. Similarly, as Giles [49] states, to achieve higher-level discussions, children need to be taught how to construct dialogue in groups if they are

to effectively learn the skills to enhance environmental learning. Yannier et al. [50] state that active, student-focused discussions give students time to reflect not only on their own thoughts but also on those of their peers. Gaining knowledge through participation and contribution often fosters problem-solving and collaborative thinking skills, which are especially valuable when applied to real-world challenges such as environmental change.

Collaborative thinking or cooperative learning is not simply a synonym for students working in groups but rather refers to specific conditions that include the following elements: positive interdependence, individual accountability, face-to-face promotive interaction, the appropriate use of collaborative skills, and group processing [51]. Successful in the practical set-up stage of this study design, it enforced the notion that cooperative learning promoted understanding of the impacts of environmental issues and influenced orientation on behaviours for it to comply with pro-environmental behaviours. As shown by Yavuz [52], responsible environmental behaviours are associated with positive early childhood experiences in education, focusing specifically on environmental awareness. Although, it is suggested that cooperative learning in environmental education cannot be effective and thrive without considering students' needs and preferences [53]. Consequently, it is important to determine attitudes, group composition, and social skills when implementing cooperative learning [54]. More recently, studies have indicated that collaborative learning is inclusive of individual needs as it not only engages cognitive abilities but also encompasses motivation, self-awareness, empathy, personal experience, and social skills. Thus, this produces students with higher levels of emotional intelligence to pragmatically deal with future problems, e.g., environmental issues [15,20,21]. Additionally, a greater depth of understanding of students' needs can only be achieved when environmental education is present in more than tokenistic forms [55].

One of the most important aims of environmental education is bringing up individuals who have sensitivity towards the environment [25]. Affective learning using prolonged environmental education activities, like that of the practical element of this design, allows students the time to establish personal connections to the environmental activities. In performing so, it generates a sense of responsibility for the outcome, developing a deeper sense of environmental awareness and understanding. In agreement, Littledeyke [56] states that environmental education inclusive of the affective domain enforces a sense of a relationship and is essential for environmental care and responsibility, which in turn leads to pro-environmental action. Similarly, a study with a practical design element of learning in open spaces showed a significant positive effect on students' awareness of the local environment [57]. Claims have also been made that environmental education theory and research have overlooked the children who are the subjects of environmental education, and no research has been conducted that places student experiences at the centre of attention [58]. More recently, research findings have shown substantial evidence-based, child-focused studies on affective learning and its positive effects on environmental education [25–27]. The current concern is, rather, that the formation of attitudes and affective skills have not been fully implemented into curricula [59].

Capturing young children's environmental perception is particularly challenging; approaches to environmental education assessment strategies should therefore consider both cognitive and affective aspects of child–nature relationships [36]. Introducing active assessment strategies in science education allows students' construction of mental representation, fostering the concept of meaningful learning outcomes [60]. This enables students to experience learning, where students transition from a passive position to the position of "doing and experiencing" [61]. Such assessment strategies are considered an alternative method and not widely implemented in teaching practises [62]. However, active assessment strategies used in the context of ethnoecological research open a general interaction

space between science and society [63]. It is suggested that understanding one's immediate societal surroundings creates an awareness where change becomes a possible action [21]. Environmental assessment strategies which focus on changing attitudes rather than simply transferring information have had success in influencing pro-environmental behaviours of students [64].

4.2. Teaching the Concept of Environmental Change in Schools

Teaching the concept of environmental change within schools can encourage students to make connections between the general depiction of global environmental concern and the environmental representations of environmental change in the local community [25]. The issue is not identifying the effectiveness of teaching strategies but rather their application and delivery [65]. Limited research providing a comprehensive description of environmental education programmes and projects that are part of curricula developed and implemented in primary and secondary schools, combined with a lack of knowledge, results in curricula developed without a cohesive strategy to guide students to competently, successfully cope with environmental matters [66]. Environmental education present in curricula as more than in a tokenistic form is required, but evidence suggests that until curriculum politics, planning, and implementation can be reworked, environmental education will continue to be characterised as loose in organisation with little sense of direction [66].

It is recognised throughout the current literature and curriculum documents that increasing emphasis is placed on promoting positive attitudes towards the environment [67]. Many teachers agree that it is important to integrate environmental education in the learning process of students, but this does not dismiss several apparent constraints [68]. The issue that educators currently face is producing the effective delivery of a subject that requires such magnitude. Shortages of time and resources are, in part, one of the major concerns when teaching in environmental education [69]. In turn, limited resources coupled with the unfamiliarity of environmental learning creates an environment where educators lack confidence, support, and knowledge to deliver effective environmental education sessions [48].

A new initiative in designing green spaces on school grounds has been adopted by several academic institutes. This method of teaching enables students to connect with nature and create an environment where children can actively engage with their surroundings, producing students who are environmentally conscious [26,30,70,71]. However, green schoolyards as learning environments remain mostly unintegrated in teachers' educational practises [72], potentially due to teachers lacking hands-on experience with outdoor environments and knowledge of local biodiversity [73,74]. There is a substantial divergence between current teachers' ability and the espoused aims of environmental education, suggesting that, unless curriculum developers take into account teachers' unfamiliarity in designing new curricular materials, those materials are unlikely to be implemented in their intended format [48].

If integrating environmental education into mainstream curricula is successful, it can enhance personal growth as well as shape a future community where pro-environmental behaviours are instinctive [75]. In recent years, emphasis has been placed on the connection between children's social-emotional learning (SEL) and nature [76], a process in which individuals obtain and apply knowledge, skills, and attitudes to manage emotions, show empathy, develop healthy identities, establish and uphold supportive relationships, achieve collective and personal goals, and make accountable decisions [77]. Enhancing SEL skills in young children through curriculum-based SEL interventions has resulted in outcomes positively associated with affinity with nature [76].

The concept of eco-affinity has recently generated great interest and empirical research. Simply being environmentally literate is not enough to effectively predict pro-environmental behaviours [7]; by adopting the notion that environmental attributes such as land are seen as part of the community in which we belong, we may begin to use these behaviours with love and respect [78]. Using human relationships as an example, when relationship closeness increases, so does empathy and willingness to help; expanding one's sense of self to include another does lead to more empathetic and protective behaviour, a concept which can be extended to human–environment relationships [78]. In designing curricula, educators should use particular care in using a biophilic approach (i.e., to support children's affinity towards nature [29,30]). Biophilia is considered an innate human need and tendency to connect with life, but there is strong support that it is learned and experiential [29]. With individuals' inability to change their lifestyle choices and limiting factors in responding to environmental change, environmental educators are more important than ever [29]. Environmental education can foster attitudes, motivation, and commitments to create a future generation where change is possible [28].

5. Conclusions

We found that a significant relationship was present between active learning in the form of cooperative and experiential learning and increasing intention to act and environmental awareness in primary-school-aged children. Peer discussions enabled learners to foster attitudes and empathy for real-life situations, as well as problem-solving and collaborative thinking skills, which are especially valuable when applied to real-world challenges such as environmental change. Experiential learning to create connectedness with nature helps students to understand the physical processes of environmental change and increase awareness of environmental problems. This has the potential to alter perceptions of young people's attitudes on the importance of and willingness to act against environmental change.

Author Contributions: Conceptualization, C.G. and M.B.; methodology, C.G. and M.C.; software, C.G. and M.C.; validation, C.G., M.C. and M.B.; formal analysis, C.G. and M.C.; investigation, C.G.; resources, C.G., M.C. and M.B.; data curation, C.G. and M.C.; writing—original draft preparation, C.G.; writing—review and editing, M.C. and M.B.; visualisation, C.G. and M.C.; supervision, M.C. and M.B.; project administration, C.G. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of Oxford Brookes University (protocol code HLS/2023/JR/134, May 2023).

Informed Consent Statement: Informed consent was obtained from all subjects involved in this study.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors on request.

Acknowledgments: We would like to thank Joshua Spurr for assistance with incubator design and construction and the staff and students of Oakhurst Community Primary School who enthusiastically participated in the activity, with special acknowledgement of Chloe Dunne who facilitated the workshop and provided invaluable assistance with classroom practicalities and curriculum interpretation.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. Rubric used for scoring Draw-Our-Environment (DOE) test (adapted from Moseley et al. [34]).

Factor	Present	Interaction with Other Factors	System Interactions Made Explicit	
	0 points	1 point	2 points	3 points
Human	Drawing does not contain pictures of humans	Human(s) drawn without any apparent interactions with other factors	Human(s) drawn interacting with other humans and/or another factor (e.g., a human fishing or walking on a bridge) but without special emphasis placed on the influence of the interaction on the environment	Humans drawn with obvious deliberate emphasis on interaction with one or more factors and the influence of that interaction on the environment using special indicators such as conceptual labels and/or arrows
Living	Drawing does not contain pictures of living organisms	Living organisms (e.g., plants and animals) drawn without any apparent interactions with other factors	Living organisms drawn interacting with other living organisms and/or another factor (e.g., animals grazing) but without special emphasis placed on the influence of the interaction on the environment	Living organisms drawn with obvious deliberate emphasis on interaction with one or more factors and the influence of that interaction on the environment using special indicators such as conceptual labels and/or arrows
Abiotic	Drawing does not contain pictures of abiotic factors	Abiotic items (e.g., mountains, rivers, the sun, or clouds) drawn without any apparent interactions with other factors	Abiotic items drawn interacting with other abiotic items and/or another factor (e.g., wind blowing down a tree) but without special emphasis placed on the influence of the interaction on the environment	Abiotic items drawn with obvious deliberate emphasis on interaction with one or more factors and the influence of that interaction on the environment using special indicators such as conceptual labels and/or arrows
Human-built or -designed	Drawing does not contain pictures of human-built factors	Human-built or -designed items (e.g., buildings, automobiles, and bridges) drawn without any apparent interactions with other factors	Human-built items drawn interacting with other human-built items and/or another factor (e.g., a smokestack emitting smoke into the air) but without special emphasis placed on the influence of the interaction on the environment	Human-built items drawn with obvious deliberate emphasis on interaction with one or more factors and the influence of that interaction on the environment using special indicators such as conceptual labels and/or arrows

Table A2. Student 150's first attempt (pre-intervention) at the DOE test (female, aged ten); a score of one was received from all examiners for the living, abiotic, and human-built components. It is shown in the form of flowers, the sky, and a brick wall.


Participant DOT Example	No. 150	Factor	Score 1	Score 2	Score 3	Average Score
		Human	0	0	0	0
		Living	1	1	1	1
		Abiotic	1	1	1	1
		Human-Built	1	1	1	1
		Total	3	3	3	3

Table A3. Student 93's second attempt (post-workshop) at the DOE test (male, aged seven); a score of two was received from all examiners for the living component, due to the image showing the living component interacting with other components; for example, the mole is digging and the spider is climbing a tree. The examiners also unanimously scored one for the abiotic component and a score of zero for both the human and human-built components. An abiotic score of one was given due to the body of water being present.


Participant DOE Test Example	No. 93	Factor	Score 1	Score 2	Score 3	Average Score
		Human	0	0	0	0
		Living	2	2	2	2
		Abiotic	1	1	1	1
		Human-Built	0	0	0	0
		Total	3	3	3	3

Table A4. Student 101's third attempt (post-experiment) at the DOE test (female, aged 9). The examiners unanimously scored three across the board for the living, abiotic, and human-built components. This was due to the interactions in the image being clearly labelled, such as "high sea" and "dump sea", with an image of rising water and plastic pollution, and "petrol cars" and "to much" with images of a car emitting toxic fumes and high-rise buildings.

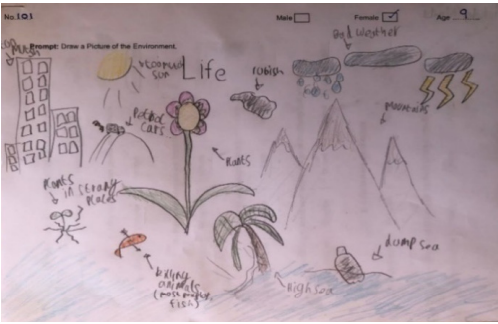
Participant DOE Test Example	No. 101	Factor	Score 1	Score 2	Score 3	Average Score
		Human	0	0	0	0
		Living	3	3	3	3
		Abiotic	3	3	3	3
		Human-Built	3	3	3	3
		Total	9	9	9	9

Table A5. The 24 Likert-type statements used in the Children's Environmental Perception Survey (CEPS).

Eco-Affinity
#1 I like to learn about plants and animals
#3 I like to read about plants and animals.
#5 I like to learn about nature.
#10 I would help clean up green areas in my area.
#12 I am interested in learning new ways to help protect plants and animals.
#16 I would spend time after school helping to fix problems in nature.
#20 I would give some of my pocket money to help protect wild animals.
#22 I like to spend time in nature reserves.

Table A5. *Cont.*

Eco-Awareness
#2 plants and animals are important to the planet.
#6 building homes where plants and animals use to be upsets me.
#7 If there were no plants or animals my life would change.
#8 nature is easily destroyed
#11 plants and animals are easily harmed by people.
#13 people need plants to survive.
#15 If there were no trees everyone's life would change.
#18 everyone needs to take better care of nature.
Climate Change Affinity and Awareness
#4 changes to the environment are good for plants and animals.
#9 climate change effects animals.
#14 climate change is bad for nature.
#17 climate change effects plants.
#19 habitats change because of climate change.
#21 climate change effects life cycles of plants and animals.
#23 I would help in projects that are trying to reverse the effects of climate change.
#24 It is important to learn about the effects of climate change on plants and animals.

Table A6. The results of the Generalised Linear Mixed Model for each response variable for each attempt (pre-intervention, post-workshop, post-experiment) of the Draw-Our-Environment test. The test was given to 150 students between five and ten years of age. * $p < 0.05$; *** $p < 0.001$.

Response Variable	Predictor	Estimate	Std. Error	z-Value	p-Value
Human	Intercept	1.516	0.065	23.216	<0.001 ***
	Attempt 2	0.116	0.083	1.389	0.164
	Attempt 3	0.182	0.083	2.182	0.029 *
Living	Intercept	1.178	0.043	27.392	<0.001 ***
	Attempt 2	0.351	0.044	7.991	<0.001 ***
	Attempt 3	0.494	0.043	11.305	<0.001 ***
Abiotic	Intercept	0.834	0.063	13.129	<0.001 ***
	Attempt 2	0.336	0.072	4.652	0.001 ***
	Attempt 3	0.824	0.066	12.390	<0.001 ***
Human-built	Intercept	1.138	0.067	16.991	<0.001 ***
	Attempt 2	0.213	0.064	3.307	0.045 *
	Attempt 3	0.438	0.090	4.822	<0.001
Total	Intercept	2.119	0.039	53.60	<0.001 ***
	Attempt 2	0.327	0.037	8.71	<0.001 ***
	Attempt 3	0.586	0.035	16.40	<0.001 ***

Table A7. The results of the Generalised Linear Mixed Models with the response to the Environmental Perception Survey. The survey was given to 107 students between seven and ten years of age. *** $p < 0.001$.

Response Variable	Predictor	Estimate	Std. Error	z-Value	p-Value
Climate Change	Intercept	3.688	0.218	16.85	<0.001 ***
	Attempt 2	3.579	0.246	14.55	<0.001 ***
	Attempt 3	6.504	0.246	26.44	<0.001 ***
Eco-Affinity	Intercept	5.607	0.218	25.69	<0.001 ***
	Attempt 2	3.747	0.252	14.83	<0.001 ***
	Attempt 3	7.243	0.252	28.67	<0.001 ***
Eco-Awareness	Intercept	5.776	0.340	16.94	<0.001 ***
	Attempt 2	3.607	0.244	14.76	<0.001 ***
	Attempt 3	7.084	0.244	28.98	<0.001 ***

Table A8. The results of the path analysis, a structural equation model with the responses to the perception survey and Draw-Our-Environment test.

Response Variables	Estimate	Std. Error	z-Value	p-Value
Climate change				
Human	0.242	0.059	4.076	0.0001
Living	0.552	0.087	6.350	0.0001
Abiotic	0.467	0.069	6.787	0.0001
Human-built	0.287	0.060	4.786	0.0001
Eco-Affinity				
Human	0.269	0.063	4.278	0.0001
Living	0.568	0.092	6.156	0.0001
Abiotic	0.574	0.073	7.866	0.0001
Human-built	0.318	0.064	4.997	0.0001
Eco-Awareness				
Human	0.268	0.060	4.486	0.0001
Living	0.579	0.088	6.618	0.0001
Abiotic	0.601	0.069	8.689	0.0001
Human-built	0.381	0.060	6.320	0.0001

References

1. Takacs-Santa, A. Barriers to environmental concern. *Hum. Ecol. Rev.* **2007**, *14*, 26–38.
2. Fu, L.; Sun, Z.; Zha, L.; Liu, F.; He, L.; Sun, X.; Jing, X. Environmental awareness and pro-environmental behaviour within Chinas road freight transportation industry: Moderating role of perceived policy effectiveness. *J. Clean. Prod.* **2020**, *252*, 119796. [[CrossRef](#)]
3. Bamberg, S. How does environmental concern influence specific environmentally related behaviours? A new answer to an old question. *J. Environ. Psychol.* **2003**, *23*, 21–32. [[CrossRef](#)]
4. Cutter-Mackenzie, A.; Rousell, D. Education for what? Shaping the field of climate change education with children and young people as co-researchers. *Child. Geogr.* **2018**, *17*, 90–104.
5. Rousell, D.; Knowles, A. A systematic review of climate change education: Giving children and young people a “voice” and “hand” in redressing climate change. *Child. Geogr.* **2020**, *18*, 191–208.
6. Eilam, E. Climate change education: The problem with walking away from disciplines. *Stud. Sci. Educ.* **2021**, *58*, 231–264.
7. Redondo, I.; Puelles, M. The connection between environmental attitude–behavior gap and other individual inconsistencies: A call for strengthening self-control. *Int. Res. Geogr. Environ. Educ.* **2017**, *26*, 107–120.

8. Sinan, O.; Usak, M.; Sinan, Y. Environmental problems and education in last five years. *Aquademia* **2022**, *6*, ep22006.
9. Farid, T.; Iqbal, S.; Khan, A.; Ma, J.; Khattak, A.; Naseer Ud Din, M. The impact of authentic leadership on organizational citizenship behaviors: The mediating role of affective-and cognitive-based trust. *Front. Psychol.* **2020**, *11*, 1975.
10. Ágoston, C.; Csaba, B.; Nagy, B.; Kóváry, Z.; Dúll, A.; Rácz, J.; Demetrovics, Z. Identifying types of eco-anxiety, eco-guilt, eco-grief, and eco-coping in a climate-sensitive population: A qualitative study. *Int. J. Environ. Res. Public Health* **2022**, *19*, 2461. [[CrossRef](#)]
11. Klöckner, C.A.; Brenner-Fliesser, M.; Carrus, G.; De Gregorio, E.; Erica, L.; Luketina, R.; Niemi, A.; Pihkola, H.; Schwarzinger, S.; Similä, L.; et al. Climate actions on the neighbourhood level—Individual, collective, cultural, and socio-structural factors. *PLoS Clim.* **2024**, *3*, e0000424. [[CrossRef](#)]
12. Van der Ploeg, J.; Cauilan-Cureg, M.; Van Weerd, M.; De Groot, W.T. Assessing the effectiveness of environmental education: Mobilizing public support for Philippine crocodile conservation. *Conserv. Lett.* **2011**, *4*, 313–323. [[CrossRef](#)]
13. Bloom, B.S.; Engelhart, M.D.; Furst, E.J.; Hill, W.H.; Krathwohl, D.R. Taxonomy of educational objectives: The classification of educational goals. In *Handbook 1: Cognitive Domain*; Longman: New York, NY, USA, 1956; pp. 1103–1133.
14. Kostova, Z.; Atasoy, E. Methods of successful learning in environmental education. *J. Theory Pract. Educ.* **2008**, *4*, 49–78.
15. Gano-Phillips, S. Affective learning in general education. *Spec. Top. Assess. Univ. Gen. Educ. Program* **2009**, *6*, 1–44.
16. Teraoka, E.; Ferreira, H.; Kirk, D.; Bardid, F. Affective learning in physical education: A systematic review. *J. Teach. Phys. Educ.* **2020**, *40*, 460–473. [[CrossRef](#)]
17. Freeman, S.; Eddy, S.L.; McDonough, M.; Smith, M.K.; Okoroafor, N.; Jordt, H.; Wenderoth, M.P. Active learning increases student performance in science, engineering, and mathematics. *Proc. Natl. Acad. Sci. USA* **2014**, *111*, 8410–8415. [[CrossRef](#)]
18. Felder, R.M.; Brent, R. Active learning: An introduction. *ASQ High. Educ. Brief* **2009**, *2*, 1–5.
19. Naujoks, N.; Göllitz, D.; Tellesch-Bülrow, C.; Händel, M.; Schubert, J.C. Students' motivation during experimental activities: An empirical study with GeoBoxes in Germany. *Int. Res. Geogr. Environ. Educ.* **2022**, *31*, 320–336. [[CrossRef](#)]
20. Jones, R.; Bursens, P. The effects of active learning environments: How simulations trigger affective learning. *Eur. Political Sci.* **2015**, *14*, 254–265. [[CrossRef](#)]
21. Marleny, L.; Aloysius, C.; Hadi, S. Emotional intelligence among auditory, reading, and kinaesthetic learning styles of elementary school students in Ambon-Indonesia. *Int. Electron. J. Elem. Educ.* **2017**, *10*, 83–91.
22. Gifford, R.; Nilsson, A. Personal and social factors that influence pro-environmental concern and behaviour: A review. *Int. J. Psychol.* **2014**, *49*, 141–157. [[PubMed](#)]
23. Balestri, M.; Campera, M.; Budiadi, B.; Imron, M.A.; Nekariz, K.A.I. Active learning increases knowledge and understanding of wildlife friendly farming in middle school students in Java, Indonesia. *Knowledge* **2023**, *3*, 401–413. [[CrossRef](#)]
24. Trott, C.D. Reshaping our world: Collaborating with children for community-based climate change action. *Action Res.* **2019**, *17*, 42–62.
25. Trott, C. Childrens constructive climate change engagement: Empowering awareness, agency, and action. *Environ. Educ. Res.* **2020**, *26*, 532–554.
26. Baker, C.; Clayton, S.; Bragg, E. Educating for resilience: Parent and teacher perceptions of children's emotional needs in response to climate change. *Environ. Educ. Res.* **2021**, *27*, 687–705.
27. Cordero, E.; Todd, A.; Abellera, D. Climate change education and the ecological footprint. *Bull. Am. Meteorol. Soc.* **2008**, *89*, 865–872.
28. Zube, E.H. Environmental perception. In *Environmental Geology. Encyclopedia of Earth Science*; Springer: Dordrecht, The Netherlands, 1999.
29. Simaika, J.P.; Samways, M.J. Biophilia as a Universal Ethic for Conserving Biodiversity. *Conserv. Biol.* **2010**, *24*, 903–906.
30. Küpeli, K.; Bayındır, D. Preschool outdoor education environment quality predicts children's environmental attitude, awareness and affinity towards nature (biophilia). *Early Years* **2025**. [[CrossRef](#)]
31. Sanghvi, P. Piaget's theory of cognitive development: A review. *Indian J. Ment. Health* **2020**, *7*, 91–96. [[CrossRef](#)]
32. Babakr, Z.; Mohamedamin, P.; Kakamad, P. Piaget's cognitive development theory: Critical review. *Educ. Q. Rev.* **2019**, *2*, 5–14.
33. Granato, C.; Campera, M.; Bulbert, M. Sensitivity of *Vanessa cardui* to temperature variations: A cost-effective experiment for environmental education. *Insects* **2024**, *15*, 221. [[CrossRef](#)] [[PubMed](#)]
34. Moseley, C.; Desjean-Perrotta, B.; Utley, J. The Draw-An-Environment Test Rubric (DAET-R): Exploring pre-service teachers' mental models of the environment. *Environ. Educ. Res.* **2010**, *16*, 189–208.
35. Cronin-Jones, L. Using drawings to assess student perceptions of schoolyard habitats: A case study of reform-based research in the United States. *Can. J. Environ. Educ.* **2005**, *10*, 225–240.
36. Flowers, A.; Carroll, J.; Green, G.; Larson, L. Using are to assess environmental education outcomes. *Environ. Educ. Res.* **2015**, *21*, 846–864.
37. Berry, R. Inclusion, power, and community: Teachers and students interpret the language of community in an inclusion classroom. *Am. Educ. Res. J.* **2006**, *43*, 77–83.

38. Larson, L.R.; Green, G.T.; Castleberry, S.B. Construction and validation of an instrument to measure environmental orientations in a diverse group of children. *Environ. Behav.* **2011**, *43*, 72–89.
39. Bergman, B.G. Assessing impacts of locally designed environmental education projects on students' environmental attitudes, awareness, and intention to act. *Environ. Educ. Res.* **2016**, *22*, 480–503.
40. Collado, S.; Rosa, C.D.; Corraliza, J.A. The Effect of a Nature-Based Environmental Education Program on Children's Environmental Attitudes and Behaviors: A Randomized Experiment with Primary Schools. *Sustainability* **2020**, *12*, 6817. [CrossRef]
41. Brookes, M.E.; Kristensen, K.; Van Benthem, K.J.; Magnusson, A.; Berg, C.W.; Nielsen, A.; Skaug, H.J.; Maechler, M.; Bolker, B.M. glmmTMB balances speed and flexibility among packages for zero-inflated generalized linear mixed modelling. *R J.* **2017**, *9*, 378–400.
42. Hartig, F.; Lohse, L. Residual Diagnostics for Hierarchical (Multi-Level/Mixed Regression Models). Available online: <https://cran.r-project.org/web/packages/DHARMA/index.html> (accessed on 30 December 2024).
43. Lenth, V.R.; Bolker, B.; Buerkner, P.; Gine-Vazquez, I.; Herve, M.; Jung, M.; Love, J.; Miguez, F.; Riebl, H.; Singmann, H. Emmeans: Estimated Marginal Means, aka Least-Squares Means. Available online: <https://cran.r-project.org/web/packages/emmeans/index.html> (accessed on 30 December 2024).
44. Rosseel, Y. lavann: An R Package for Structural Equation Modelling. *J. Stat. Softw.* **2012**, *48*, 1–36.
45. Schermelleh-Engel, K.; Moosbrugger, H.; Müller, H. Evaluating the fit of structural equation models: Tests of significance and descriptive goodness-of-fit measures. *Methods Psychol. Res. Online* **2003**, *8*, 23–74.
46. Michael, J. Where's the evidence that active learning works? *Adv. Physiol. Educ.* **2006**, *30*, 159–167. [CrossRef] [PubMed]
47. Vermetten, Y.; Vermunt, J.; Lodewijks, H. Powerful learning environments? How university students differ in their response to instructional measures. *Learn. Instr.* **2002**, *12*, 263–284. [CrossRef]
48. Van Dijk-Wesselius, J.; van den Berg, A.; Mass, J.; Hovinga, D. Green schoolyards as outdoor learning environments: Barriers and solutions as experienced by primary school teachers. *Environ. Psychol.* **2019**, *10*, 2919. [CrossRef]
49. Giles, R. *Cooperative Learning*; SAGE: Queensland, Australia, 2007.
50. Yannier, N.; Hudson, S.; Koedinger, K.; Hirsh-Pasek, K.; Golinkoff, R.; Munakata, Y.; Doebel, S.; Schwartz, D.; Deslauriers, L.; McCarthy, L.; et al. Active learning: "Hands on" meets "minds on". *Science* **2021**, *374*, 26–30. [CrossRef]
51. Felder, R.M.; Brent, R. Cooperative learning. Active learning: Models from the analytical sciences. *ACS Symp. Ser.* **2007**, *970*, 34–53.
52. Yavuz, M. An Investigation of Burn-Out Levels of Teachers Working in Elementary and Secondary Educational Institutions and Their Attitudes to Classroom Management. *Educ. Res. Rev.* **2009**, *4*, 642–649.
53. Ballantyne, R.; Fien, J.; Packer, J. Program effectiveness in facilitating influence intergenerational environmental education: Lessons from the field. *J. Environ. Educ.* **2001**, *32*, 8–15. [CrossRef]
54. Gillies, R.M.; Boyle, M. Teachers' reflections on cooperative learning: Issues of implementation. *Teach. Teach. Educ.* **2010**, *26*, 933–940. [CrossRef]
55. Nekaris, K.A.I.; Rickets, H.; Campera, M.; Bukit, W.L.; Imron, M.A. The impact of teaching method and learning style on student engagement: A formative assessment of a primate education programme. *Folia Primatol.* **2025**. [CrossRef]
56. Littlelyke, M. Science education for environmental awareness: Approaches to integrating cognitive and affective domains. *Environ. Educ. Res.* **2008**, *14*, 1–17.
57. Fisman, L. The effects of local learning on environmental awareness in children: An empirical investigation. *J. Environ. Educ.* **2010**, *36*, 39–50.
58. Payne, P. Children's conceptions of nature. *Aust. J. Environ. Educ.* **1998**, *14*, 19–26. [CrossRef]
59. Wijoyo, H.; Santamoko, R.; Muliensyah, D.; Yonata, H.; Handoko, A. The development of affective learning model to improve emotional quotient. *J. Crit. Rev.* **2020**, *7*, 2–7.
60. Chang, D.; Hwang, G.J.; Chang, S.C.; Wang, S.Y. Promoting students' cross-disciplinary performance and higher order thinking: A peer assessment-facilitated STEM approach in a mathematics course. *Educ. Technol. Res. Dev.* **2021**, *69*, 3281–3306. [CrossRef]
61. Alkan, H.; Orgurlu, I. Changes in the environmental perception, attitude and behaviour of participants at the end of nature training projects. *Environ. Eng. Manag. J.* **2014**, *13*, 419–428.
62. Sofi, H.; Chandra, A.; Nanang, W. Enhancing students creativity through STEM projects-based learning. *J. Sci.* **2019**, *2*, 50–57.
63. Fache, E.; Sabinot, C.; Pauwels, S.; Riera, L.; Breckwoldt, A.; David, G.; Matairakula, U.; Carriere, S. Encouraging drawing in research with children on marine environments: Methodological and epistemological considerations. *Hum. Ecol.* **2022**, *50*, 739–760.
64. Korkmaz, S.; Cetin-Dindar, A.; Oner, F.K. Impact of educational game development on students' achievement and attitudes toward science. *J. Educ. Res.* **2023**, *116*, 268–279.
65. Ramsey, J.; Hungerford, H.; Volk, T. Environmental education in the K-12 curriculum: Finding a niche. *J. Environ. Educ.* **2010**, *23*, 35–45.

66. Hungerford, H.; Peyton, R.; Wilke, R. Goals for curriculum developed in environmental education. *J. Environ. Educ.* **2010**, *11*, 42–47.
67. Reid, A. *Curriculum and Environmental Education: Perspectives, Priorities and Challenges*; Taylor & Francis: London, UK, 2018.
68. Sukma, E.; Ramadhan, S.; Indriyani, V. Integration of environmental education in elementary schools. *J. Phys. Conf. Ser.* **2019**, *1481*, 012136.
69. Edwards-Jones, A.; Waite, S.; Passy, R. Falling into LINE: School strategies for overcoming challenges associated with learning in natural environments. *Education* **2022**, *46*, 49–63.
70. Cetken-Aktas, S.; Sevimli-Celik, S. Play Preferences of Preschoolers According to the Design of Outdoor Play Areas. *Early Child. Educ. J.* **2023**, *51*, 955–970.
71. Kiewra, C.; Veselack, E. Playing with Nature: Supporting Preschoolers' Creativity in Natural Outdoor Classrooms. *Int. J. Early Child. Environ. Educ.* **2016**, *4*, 70–95.
72. Maynard, T.; Waters, J. Learning in the outdoor environment: A missed opportunity? *Early Years* **2007**, *27*, 255–265.
73. Dymont, J.E. Green school grounds as sites for outdoor learning: Barriers and opportunities. *Int. Res. Geogr. Environ. Educ.* **2005**, *14*, 28–45.
74. Balestri, M.; Campera, M.; Nekar, K.A.I.; Donati, G. Assessment of long-term retention of environmental education lessons given to teachers in rural areas of Madagascar. *Appl. Environ. Educ. Commun.* **2017**, *16*, 298–311. [[CrossRef](#)]
75. Grill, T. The benefits of children engaging in nature: A systematic literature review. *Child. Youth Environ.* **2014**, *24*, 10–34.
76. Bakir-Demir, T.; Berument, S.K.; Sahin-Acar, B. The relationship between greenery and self-regulation of children: The mediation role of nature connectedness. *J. Environ. Psychol.* **2019**, *65*, 101327.
77. Lanza, K.; Alcazer, M.; Chen, B.; Kohl, H. Connection to nature is associated with social-emotional learning of children. *Curr. Res. Ecol. Soc. Psychol.* **2023**, *4*, 100083.
78. Frantz, C.; Mayer, F. The importance of connection to nature in assessing environmental education programs. *Stud. Educ. Eval.* **2014**, *41*, 85–89. [[CrossRef](#)]

Disclaimer/Publisher's Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.