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Climate Superheroes: Impact of a STEAM Camp on Preschool Children's Ideas about Climate-Friendly Actions

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ABSTRACT

Climate change is an urgent global environmental crisis that requires widespread action and an educated, motivated citizenry. This study explored the impacts of a Climate Superheroes STEAM camp on preschool children's ideas about climate-friendly actions. The research employed a mixed methods experimental design approach including a quantitative pre/post-test, qualitative activity prompts, field notes, and a post-camp parent survey. The sample included 27 children aged 3 to 6 years and 11 of their parents. Preschool children made significant gains on their understanding of climate-friendly actions, using reusable materials, turning off lights when not in use, and gardening. Children demonstrated many correct ideas about how and why climate-friendly actions helped the Earth and some common misconceptions as well. Children gained knowledge of accessible climate actions, and qualitative results show some increase in agency for taking climate action. Implications for early childhood education and environmental education related to climate change are explored.

Keywords**:** climate change, climate change education, early childhood education, informal education, early childhood environmental education

Anthropogenic climate change is an urgent environmental concern occurring on a global scale (Intergovernmental Panel on Climate Change [IPCC], 2022). The extensive impacts of climate change affect ecosystems, humans, society, and infrastructure (IPCC, 2022). Climate extremes have already caused extensive global damage and some irreversible impacts. Climate vulnerability is not uniform across the Earth but can significantly differ between regions. Collective actions that limit global warming to 1.5 degrees Celsius would largely reduce future impacts and losses (IPCC, 2022). Hence, education that includes mitigation and adaptation actions is essential (Krasny & DuBois, 2016; Stevenson et al., 2017). Students must become engaged citizens who are willing to take collective actions to reduce fossil fuel use and practice sustainable policies (Stevenson et al., 2017). Finally, climate change education should begin in the early years so students can develop a deep understanding of climate change (Boylan, 2008), and become empowered to take action (Gambino et al., 2009).

Young Children and Climate Change Education

Environmental literacy is the ability to make and act on informed environmental decisions, and it requires environmental knowledge, dispositions, skills, and behavioral strategies (Hollweg et al., 2011). Environmental educators have postulated that environmental literacy is achieved by moving up the environmental literacy ladder, a model with increasingly complex environmental literacy components such as awareness, knowledge, attitudes, skills, and eventually action (Elder, 2003). Elliott and Davis (2009) assert that educators must not underestimate

young children by assuming that they have too little science content knowledge to understand climate change or should be sheltered from this worrisome topic. In fact, climate change instruction can and should be addressed in early childhood for several reasons. First, young children have demonstrated their sophisticated reasoning about environmental problems (Palmer & Suggate, 2004) and pro-environmental solutions (Kos et al., 2016). Second, when environmental issues are taught in grade-appropriate ways, young children feel empowered to be a part of environmental solutions (Gambino et al., 2009). Third, compared to adults, young children are going to be both more impacted by climate change consequences and required to take adaptation actions (Hahn, 2021). Thus, young children's climate literacy, a component of environmental literacy, is particularly important. Fourth, compared to adolescents, young children have more pro-environmental attitudes (Otto et al., 2019) and willingness to take action (Lee et al., 2020) and are thus potentially more receptive to climate instruction (Lieflander & Bogner, 2014).

Elementary children have some understanding of climate change. When asked about the impacts of climate change on polar creatures, very young (four-year-old) children provided only short-term effects, but 90% of ten-year-olds offered reasonable long-term effects (Palmer & Suggate, 2004). In fact, in a review of youth perceptions of climate change, most children accurately understand climate change impacts as including rising temperatures, melting ice caps, and ecosystem changes (Lee et al., 2020). Children recognize that climate change results from human activities but hold common misconceptions about the causes including pollution, a hole in the ozone layer, the sun getting nearer to the Earth, and seasonal change (Lee et al., 2020; Palmer & Suggate, 2004). Previous research has indicated that preschool children do not necessarily understand language related to sustainability (Engdahl & Rabusicova, 2011; Honig & Mennerich, 2013) but do have knowledge about the environment and views about humans' responsibilities toward the environment (Engdahl & Rabusicova, 2011). Preschool children have some understanding of recycling (Honig & Mennerich, 2013), plant and animal interactions (Madden & Liang, 2017), and flora and fauna (Fraijo-Sing et al., 2020). Indeed, a primary grades curriculum in Greece accomplished climate change education for sustainable development by addressing topics such as food, water, education, health, gender equality, and a clean environment as basic needs and human rights (Gkotzos, 2017).

Interventions that include direct engaging experiences that emphasize the impact of human activities on the environment show the most promise for increasing children's understandings of the natural world (McClain & Vandermaas-Peeler, 2016; Kos et al., 2016). Children ranging from ages 4 to 6 have improved environmental knowledge (Gambino et al., 2009), environmental attitudes (Gambino et al., 2009; Samur, 2018), and an awareness of how they as humans influence the environment (Kos et al., 2016; Samur, 2018). Furthermore, elementary-level interventions may find a particularly receptive audience given that children's environmental attitudes begin to form around 7, increase until 10, plateau until 14, and then decrease until adulthood (Otto et al., 2019) and that age is a negative predictor of pro-environmental behaviors from children ranging in age from 6 to 12 (Collado et al., 2015).

As children become aware of climate change, they experience many emotions. In a survey of Australian parents and teachers, even young children reported feeling low to moderate stress about climate change (Baker et al., 2021). When asked how climate change makes them feel, Canadian children aged 8 to 12 most frequently described sadness, followed by anger, fear, and stress (Leger-Goodes et al., 2023). These children's sadness centered on the suffering of humans and other animals, demonstrating a strong empathy toward animals (Leger-Goodes et al., 2023). In a study of nine- and ten-year-old children from England engaged in climate change education, children experienced anger, sadness, and helplessness (Jones & Whitehouse, 2021). These children demonstrated more hope during an activity focused on who or what could help those impacted by climate change (Jones & Whitehouse, 2021).

Ojala (2012) identified coping strategies that young people employ to deal with climate worry: problem-focused strategies that entail taking individual or collective action; emotion-focused strategies that may involve de-emphasizing the threat of climate change, distancing, seeking social support, and hyperactivation; and meaning-focused coping that includes reframing climate change positively, employing general positive thinking, and putting trust in other sources. In studies of younger children, children mostly employ emotion-focused coping (distancing), problem-focused coping (individual action), and meaning-focused coping (trusting others) (Leger-Goodes et al., 2023; Ojala, 2012).

In reviews of research about climate change education in Turkey and Korea, researchers are finding that most studies investigate children's awareness, knowledge, and attitudes without an explicit attention to eco-friendly behaviors (Ozturk, 2023; Park et al., 2020), essentially never reaching the top rungs of the environmental literacy ladder (Elder, 2003). Furthermore, when expert environmental educators from around the world were asked about their students, most teachers expressed that their environmental education instruction did not include pro-environmental actions (Huoponen, 2023). Yet, given the urgency of climate change, many primary and secondary teachers in England sought action-oriented climate change instruction (Howard-Jones et al., 2021). These educators indicated that action-oriented climate instruction for primary school grades should include mitigation projects like conservation, tree-planting, and family advocacy (Howard-Jones et al., 2021). This form of climate action instruction, combined with efforts to promote climate awareness, knowledge, and attitudes, is essential for achieving environmental and climate literacy (Elder, 2003).

Given this prior research, the current study seeks to advance this literature by examining children's pro-environmental behaviors at a younger age in the context of a climate change STEAM camp that employs several research-based methods including: (1) direct experience, (2) opportunities to investigate human impacts on the environment, and (3) opportunities to investigate the impacts of pro-environmental actions. This study was guided by the following research questions:

(1) What are preschool children's ideas/feelings about climate change and climate-friendly actions?
(2) To what extent can preschool children explain reasons for climate-friendly actions?
(3) How do preschool children's ideas of climate-friendly actions change following an action-orientated climate change camp?
(4) Following an action-oriented climate change camp, what actions do preschool children tell their parents about?

METHODS

This study used a mixed methods case study approach (Creswell & Plano Clark, 2018) that included semi-structured qualitative protocols for student work, open-ended questions from a parent/guardian survey, a quantitative pre-/post-assessment of children's ideas of climate-friendly actions, and a quantitative parent/guardian survey of climate actions mentioned by children and performed at home. The Kent State University Institutional Review Board approved this research project (IRB #815).

Intervention

This camp was designed based on environmental education literature about theories of pro-environmental behavior and environmental topics and activities that have been successfully used with young children. The intervention was guided by the value-belief norm theory (Stern et al., 2000). The value-belief norm theory (Stern et al., 2000) posits that one's value orientations (egoistic, altruistic, and biospheric) influence one's beliefs including their ecological worldview, awareness of adverse consequences of their behavior for the environment, and their beliefs about their ability to reduce threats to the environment. These beliefs shape one's moral obligation for pro-environmental behavior and ultimately their personal norms. These pro-environmental behaviors may take the form of activism, nonactivist public-sphere actions, private-sphere actions, and behavior in organizations. The camp was also built around a problem-focused coping strategy (Ojala, 2012) for coping with climate anxiety. This strategy emphasizes learning more about climate change and climate-friendly actions and actually engaging in those actions mitigate worry about climate change (Ojala, 2012). Specific topics for this camp were selected because previous literature showed promise for young learners engaging with this content. This content centered around human actions that contribute to climate change and human actions that can help mitigate climate change. For example, Gkotzos (2017) identified the topics of food and water as appropriate contexts for teaching primary grades students about sustainability, and Honig & Mennerich (2013) found that preschool children can understand recycling. The camp also employed the tooth-brushing water conservation experiment utilized successfully by Kos et al. (2016). The camp did not address scientific mechanisms that explain climate change but did address common misconceptions about

climate change from the literature including how climate change is different than pollution and seasonal change (Lee et al., 2020; Palmer & Suggate, 2004).

The week-long "Climate Superheroes" intervention was part of a larger 10-week STEAM summer camp for children aged three through six. The camp targeted 10 climate-friendly actions (Table 1). The authors planned the instructional activities, worked with the lead teachers in the Older and Younger classrooms to lead the activities, and observed each of the five instructional days. The Day 1 children's book, *Coco's Fire* by Jeremy D. Wortzel & Lena K. Champlin, served as a foundational text for the camp. In the story, a squirrel named Coco learns about climate change using an analogy of the Earth being overly warmed by putting blankets around it, and these blankets were the result of various human activities. In the story, Coco experiences climate anxiety, talks to her parent and other experts, and learns to cope with climate anxiety by doing various individual and collective climate actions. The first author and children referred back to this story and these blankets several times throughout the week.

During the weeklong intervention, children were guided through several investigations highlighting climate-friendly actions (Table 1). The overall goal of the camp was to empower children to take climate actions, and the concept of superheroes was presented as a means by which children could exert agency in the face of environmental challenges. As an embodiment of this superhero concept, children were given fleece capes and earned a badge each day that was affixed to their capes. Children earned badges for saving energy, saving water, reducing/reusing/recycling, and saving food. Each day opened with a morning meeting during which the first author introduced the day's superhero badge, described and discussed the importance of that climate action and some of the ways "we" could be superheroes in that regard, and included a climate change and/or pro-environmental action children's book that the first author read. During the book reading, the first author sought to solicit children's ideas about climate change and the climate actions featured for the day's badge. At the end of the morning meeting, the authors described the various choice activities (Table 1) that children could do for the remaining hour. Then, children freely chose between three and five options, at least two of which were staffed by the first and second authors.

Table 1. Summary of Intervention

Day	Theme	Targeted Actions	Activities
1	Energy	● Turn off lights/ appliances ● Walk/bike/ride bus ● *Use solar, wind energy*	Superhero cape construction, green city diorama, windmill craft, lights out signs
2	Water	● Turn off water when brushing teeth, bath etc. ● *Collect rainwater for re-use*	Superhero masks, toothbrush water experiment, rain gauge construction, cloud water conservation craft
3	Materials	● Recycle items ● Reuse water bottles, bags, & clothes ● Reduce: Buy less, use old	Windsock craft, decorate reusable bags, ocean clean-up recycling sort
4	Food	● Earth-friendly food choices ● Garden ● Reduce food waste & compost	Climate-friendly picnic, compost bin exploration, decorate herb pots and plant
5	Collective Action	● Work with others to improve the climate	Climate signs, bird feeder construction, polar bear animal habitat, Earth Sun catcher

Note. Italicized actions did not appear on the 10-item pre/post-test.

Sample

The sample of participants was drawn from 3- to 6-year-olds attending this week-long "Climate Superheroes" camp. Children's parents/guardians were given the recruitment letter and consent form at the beginning of camp and invited to participate in the study. In total, 27 children (14 in the Older Class and 13 in the Younger Class) had parental/guardian consent to participate in the study. Because the project also included a post-camp Parent/Guardian Survey inquiring about children's experiences and what they learned from the camp, the

parents/guardians are adult members of the study sample as well. In total, 11 parents/guardians responded to the parent survey. These parents' children included one 3-year-old, six 4-year-olds, three 5-year-olds, and one 6-year-old.

Data Sources

The data sources included researcher field notes, collected student work including a pre/post-test, and a post-camp parent/guardian survey described below:

- **Researcher field notes of classroom observations.** Field notes were taken by the second author following guidelines from Bogdan and Biklen (2007). Field notes were recorded on a laptop each of the five days during carpet time when the first author was introducing the theme of the day, reading a new science picture book, and asking the children follow-up questions. The descriptive field notes included what the researcher heard, saw, and experienced while observing both preschool classrooms.
- **Pre-/Post-test.** On Day 1 and Day 5, children worked with a teacher in small groups to provide responses on a pre- and post-test. This test asked children to make dichotomous choices about which of two pictured activities were better for the Earth. The pre-test was piloted with a 3-year-old not involved in the study to determine if the pre-test items were sensible. Based on this initial feedback, two images were modified (by adding carrots on a plate and worms in the compost) to better clarify these actions.
- **Collected student work.** Children had free choice to rotate to various activity tables. At most of the tables, a researcher helped the child with the investigation and recorded children's ideas to various pre-planned questions associated with the activities. Because of the free choice, not all children participated in each assessment task. Table 2 shows the number of participants in each activity for both classes.

Table 2. Data Sources

Day	Assessment Task	N	Actions
1	10-item Pre-test	25	All 10
1	Green City Diorama	9	Renewable energy, biking, riding a bus
1	Windmill Craft	10	Renewable energy, pro-environmental actions
1	Lights Out Sign	8	Turning off lights, energy conservation
2	Toothbrush Water Experiment	7	Turning off water
2	Rain Gauge Making	16	Water conservation
2	Water Conservation	7	Home water conservation
3	Reusable Bags	13	Feelings about warming earth, taking action
3	Windsock Craft	12	Reusing
3	Ocean Clean-up	8	Recycling, Reducing
4	Earth-Friendly Picnic	12	Earth-friendly foods
4	Compost Exploration	6	Composting
5	Bird Feeder	13	Actions for helping animals
5	Polar Bear Habitats	11	Actions for helping animals impacted by climate
5	Earth Sun Catcher	13	Feelings about warming earth, taking action
5	10-item Post-test	24	All 10

- **Post-camp Qualtrics Parent/Guardian Survey.** This online survey was developed to understand what pro-environmental actions the child mentioned during the camp. Because re-using is closely linked to reducing, these two actions were combined in the parent survey. The Qualtrics survey was sent at the conclusion of the camp and consisted of four sections covering:
    - Nine items asking how often their child mentioned the nine targeted actions in the past week

- Two open-ended questions asking parents/guardians to explain what children talked about and any actions they took in connection to the camp and any additional comments about their child's experience with the camp

Data Analysis

Data analysis first entailed scoring participants pre- and post-tests for consistency with instruction for the 10 actions. First, descriptive statistics were used to characterize the pre/post scores and test assumptions of normality. The Kolmogorov-Smirnov test revealed that the pretest scores were normal, but the posttest scores were not (skewed toward maximum score). Consequently, a non-parametric related-samples Wilcoxon signed rank test was used to test the null hypothesis that there is no difference between pre- and post- scores. To characterize children's ideas about climate-friendly actions expressed to their parents, we conducted a descriptive statistics analysis of the parent/guardian survey.

Qualitative analysis of researcher table work, explanations provided during the pre- and post-tests, field notes, and open-ended parent survey data were analyzed using first-cycle descriptive coding (Saldana, 2021) to characterize children's ideas about climate change and climate-friendly actions and reasoning about climate-friendly actions. Both authors independently open-coded a set of children's qualitative responses, met to discuss the open codes, and developed and characterized three broad codes (correct ideas, misconceptions, and reasons). The authors independently coded the remainder of the transcripts and met to discuss and achieve consensus on those three broad codes. Then, based on this discussion, preliminary subcodes for the three broad codes were developed. The authors then independently coded the transcripts for these subcodes and again met to discuss and achieve consensus. These subcodes, their descriptions, exemplars, and frequencies are presented in Tables 3, 4, and 5. Second-cycle pattern coding (Saldana, 2021) was then used to interconnect descriptive codes in order to develop assertions about how young children learn about climate-friendly actions.

Results

The quantitative and qualitative findings are integrated in the sections below to answer each research question.

RQ1: Children's Ideas and Feelings about Climate Change and Climate-Friendly Actions

Throughout the daily activities, children shared many ideas about climate-friendly actions that were consistent with instruction. Table 3 highlights the most common correct conceptions about climate change and climate actions. The most commonly articulated correct conception about climate-friendly actions was the need to help animals in species-appropriate ways such as protecting animal habitats. In the Day 4 morning meeting (Field Notes), children explained why we should re-use items. One child (C6, age 5) explained, "don't throw plastic into the ocean because it hurts the fish." Another child suggested reusing a balloon because "something might eat it" (C3, age 6). Several children recognized fossil fuel-reduction actions and actions to save energy. For example, C6 (age 5) said, "I helped the Earth by riding my bike. I don't want it to have any more blankets" (Green City Activity). Similarly, C18 (age 4) explained how turning off lights when not in use helped the Earth because leaving lights on "wastes energy" (Turn Off Lights Activity).

Some children demonstrated misconceptions about climate-friendly actions as shown in Table 4. A common misconception was that any action that made an individual healthy was also helpful for the Earth. For example, C9 (age 4) suggested that eating "apples" would be good for the Earth "because they are good for you" (Picnic Activity). Similarly, during the morning meeting on Day 4, a child said, "burgers are better because they have meat," suggesting that meat is healthy for one's body (Field Notes, Day 4). Children also demonstrated another misconception: humans can help all wild animals by feeding them. For example, when asked how humans can help animals affected by climate change during a bird feeder activity, C22 (age 4) said "feed every animal" (Bird Feeder Activity). C21 (age 5) also conveyed this misconception (age 5) by suggesting "we could care for the polar bears and give them food" in order to help an animal endangered by climate change (Polar Bear Habitat).

Table 3. Correct Conceptions about Climate Change and Climate Friendly Action

Sub-code	Description	Exemplar	Frequency N=170
Animals	Help animals in species-appropriate ways in terms of providing/protecting food/habitat	"Help them, make them a home" (C36, age 4, Polar Bear Habitat Day 5)	22.4%
Water	Turn off water when not in use; Collect rainwater	"Turn off water when done washing hands" (C12, age 6, Cloud Day 2)	21.2%
Energy	Turn off lights/appliances; Walk/bike/ride bus; Use solar or wind energy	"Wind makes you have power because it has energy. We need wind energy to help us." (C8, age 4, Windmill Day 1)	18.2%
Food	Make Earth-friendly food choices; Grow own food; Reduce food waste and compost	"They're going to turn into dirt" (C18, age 4, Compost Day 4)	16.5%
Reduce/Reuse/ Recycle	Recycle items; Reuse water bottles, bags, & clothes; Reduce by buying/consuming less	"Reuse- so we can make something else" (C19, age 5, Windsock Day 3)	15.3%
Can Help	General indication that we can help the Earth and/or climate change without more elaboration	(Asked if there are things they can do to help our warming Earth) "Yes" (C28, age 3, Reusable Day 3)	5.3%
Together	Help make changes together	"Help with friends" (C7, age 5, Post 1)	1.2%

Table 4. Children's Misconceptions about Climate Change and Climate-Friendly Actions

Sub-code	Description	Exemplar	Frequency N=49
Irrelevant	Provides a response that is disconnected from the question	"Strawberry the size of a watermelon" (C38, age 3, Picnic Day 4)	32.7%
Human Health	Anything that makes me/humans healthy is good for the Earth	"Carrot because everyone needs to be strong" (C36, age 4, Picnic Day 4)	20.4%
Help the Earth	Suggests that any pro-environmental action is also a climate-friendly action	"Yes - something when I eat and my bag is empty it goes in the trash" (C27, age 4, Windsock Day 3)	14.3%
Using Resources	Suggests that using a resource is somehow saving it or helping the Earth in some way.	(Asked what they can do to help save water) "We could drink water. I love water" (C27, age 4, Rain Collector Day 2)	14.3%
Feed Animals	Suggests feeding wild animals that should not be fed as helping the Earth	"Fox/bear - get a string and put food for them" (C5, age 5, Birdfeeder Day 5)	8.2%
Wind is Helpful	Suggests that wind is helpful for breathing (not related to energy generation)	(Asked if wind energy is good for the Earth) "Yes because it helps give the	6.1%

		Earth more air" (C13, age 4, Windmill Day 1)	
Can't Help	Indicates that people cannot help the warming Earth	(Asked if there are things they can do to help our warming Earth) "Not that much" (C7, age 5, Reusable Day 3)	4.1%

Children were asked on Day 3 and Day 5 to express how they feel about our Earth getting warmer. On Day 3, three children responded, "I don't know", three indicated anger (e.g., C34 (age 3), "so so angry"), and the majority (n=8) indicated sadness (e.g., C5 (age 5), "bad and sad.") By Day 5, twelve children indicated sadness, three children indicated anger, and two children indicated a desire for action. As examples, C5 (age 5), said, "bad but we can fix it."

RQ2: Children's Reasoning about Climate-Friendly Actions

Qualitative data were analyzed from 27 preschool children to explain their reasons for taking climate-friendly actions. Table 5 shows the six reasons that emerged for why children choose to take climate-friendly actions. Children frequently mentioned conserving resources and helping humans or animals as reasons for taking climate-friendly actions. Regarding conserving resources, children discussed saving water, electricity, and materials. For instance, when asked, "Do you think it is better to reuse these materials or throw them away? Why?" C19 (age 5) answered, "Reuse, so we can make something new" (Windsock Activity). Regarding helping humans or animals, children discussed making healthy choices for themselves and making choices to help animals. For example, when asked, "What food is good for the Earth? Why?" C22 (age 4) explained, "Carrots, because it keeps everyone healthy" (Picnic Activity). Least often, children discussed reasons related to combating global climate change. C6 (age 5) shared that they do not want Earth to "have any more blankets." This statement was made after reading the children's book *Coco's Fire*, in which the book explains climate change to children by comparing the warming of the Earth to adding blankets around the Earth.

Table 5. Children's Reasons for Climate-Friendly Actions

Sub-code	Description	Exemplars	Frequency N = 82
Conserve Resources	References conservation of resources including energy, water, food, etc.	"Turn off the lights so they don't run out of battery" (C5, age 5, Reusable Day 3)	35.9%
Helping People & Animals	References helping animals or humans, the action helps the organism in some way	"So that every animal that lives in the water can stay living there and no pollution" (C17, age 6, Cloud Day 2)	26.8%
General	Explains that the action is good for Earth without much explanation, or the alternative action is bad for Earth	"Helps the Earth" (C19, age 5, Pre-test Day 1)	17.1%
Irrelevant	Child mentions a "because…" that makes no sense	"I got a pink bike" (C34, age 3, Pre-test Day 1)	13.4%
Clean the Earth	Action helps keep the Earth clean or cleans the environment	"Because it is not littering the ground" (C18, age 4, Picnic Day 4)	6.1 %
Adult Influence	References an adult asking them about the action or telling them to do the action	"My mom told me" (C34, age 3, Pre-test Day 1)	2.4 %
Combat Climate Change	Clearly references climate change, earth heating, or adding blankets (Coco's book)	"I don't want it to have any more blankets" (C6, age 5, Green City Day 1)	1.2%

RQ3: Change in Children's Ideas

Table 6 shows the descriptive statistics for the overall pre- and post-tests. Because the post-test scores were skewed toward the maximum score, a non-parametric related sample Wilcoxon Signed Ranks Test was used compare pre/post scores for the 17 students with complete data. This test produced a Z-statistic of -2.347 ($p<0.05$) indicating a significant gain from pre- to post-scores. Table 7 shows that most post-test item scores were quite high (above 63% correct). An examination of the item-level gain statistics (Table 7) reveals that children made the most gains on using re-usable water bottles, turning lights off when not in use, and growing garden vegetables instead of buying them. However, these gain findings must be contextualized given that several pre-test item scores, especially for collective action, eating vegetables instead of meat, and brushing teeth with water off, were quite high and afforded little opportunity to show gains.

Table 6. Descriptive Statistics Comparing Pre/Post Tests

	N	Minimum	Maximum	Mean	S.D.
Pre-Test	25	4	10	6.88	1.69
Post-Test	19	5	10	8.37	1.64

Table 7. Item-Level Gain Statistics

Item	Action	N	Pre Mean	Pre SD	Post Mean	Post SD	Mean Gain	Gain S.D.
5	Using re-usable water bottle	18	0.61	0.50	0.94	0.24	+0.33	0.48
1	Turning lights off	20	0.55	0.51	0.85	0.37	+0.30	0.57
8	Growing garden vegetables	18	0.61	0.50	0.89	0.322	+0.28	0.46
4	Re-using old coats	19	0.42	0.51	0.63	0.50	+0.21	0.63
7	Recycling paper	18	0.67	0.49	0.83	0.38	+0.17	0.38
9	Composting instead of trash	18	0.78	0.43	0.89	0.32	+0.11	0.47
3	Brushing teeth with water off	20	0.85	0.37	0.90	0.31	+0.05	0.39
6	Eating vegetables instead of meat	17	0.88	0.33	0.76	0.44	-0.12	0.33
2	Riding bike instead of car	20	0.75	0.44	0.70	0.47	-0.05	0.60
10	Collective action instead of individual	18	1.00	0	0.83	0.38	-0.17	0.38

RQ4: Children's Ideas about Climate-Friendly Actions from Parents

Survey data from 11 parents were used to determine Earth friendly actions children discuss at home and what actions the family takes. The first section of the survey asked parents to share the frequency in which their child mentions nine actions at home to help our warming Earth. As shown in Table 8, children were most likely to discuss working with others to help the Earth, recycling, and turning off the lights when not in use. Children were least likely to discuss using a refillable water bottle, eating more fruits and vegetables and less meat, and composting food scraps. The second section of the survey asked parents to share the frequency in which their household takes the same nine actions to help our warming Earth. The families were most likely to recycle, use a refillable water bottle, turn off the lights when not in use, and turn off the water when brushing teeth. The families were least likely to ride a bike or walk instead of using a car, grow food in a garden, and compost food scraps.

At the end of the parent survey, parents were asked to share what their child talked about and what actions they took in connection to the camp. These qualitative results help explain how "working with others to help the Earth" was the frequently mentioned action during the week. Multiple parents described how the superheroes camp positioned children as working with fellow superheroes for the climate. The parent of C8 (age 4) quoted her child as

saying, "'Me and 'X' were superheroes today. We're still in training, but we're going to save the world and that's how we help it.'" Similarly, the parent of C22 (age 4) quoted her child as saying 'we "all have to work together to save the earth."' Parents also described how the superhero theme supported their child's agency for climate action. The parent of C16 (age 5) said, "He really loved his cape and badges and I think especially loved feeling empowered to make changes that HE could do without an adult (or without waiting for an adult to take action first)."

Table 8. Frequency of Children's Mentions of Climate Action from Parent Survey

Action	Average	Standard Deviation
Working with others to help the Earth	3.27	1.49
Recycling	2.91	1.14
Turning lights off when not in use	2.45	1.21
Growing food in a garden	2.18	1.17
Riding a bike or walking instead of using a car	2.09	1.20
Turning water off when brushing teeth	2.09	0.94
Using a refillable water bottle	2.00	1.55
Eating more fruits and vegetables and less meat	2.00	1.61
Composting food scraps	1.82	0.87

Discussion

Findings from this project can contribute to the teaching and learning of science in several ways. First, these findings demonstrate that climate-friendly actions can successfully be taught to children in the 3-6 years age group. Second, this work identifies particular action topics and activities that may be more and less successful for early childhood curricula.

Overall Findings

The findings from this study indicate that young children are capable of learning about climate change and are not too vulnerable of an audience (Elliott & Davis, 2009). Further, young children can play a role by choosing climate-friendly actions (Stevenson et al., 2017). We discuss the main findings below:

Correct Conceptions and Gains

Conserving energy, especially by turning off lights when they are not needed, was an action that was frequently cited in daily work, mentioned by parents in the survey, and showed large gains from pre- to post-test. Several reasons may explain why this action was readily learned by the preschool children. First, this action was addressed on Day 1 and was revisited each following day. Second, one of the table activities allowed the children to make a reminder sign to hang near their light switch at home. Qualitative findings from the parent surveys indicated that several children took these signs home and used them. Additionally, this "turning off the lights" is an action that is readily accessible to children.

Children also frequently mentioned conserving water in their daily work. Conserving water by turning off the water during teeth-brushing showed little gain from pre- to post-test, but the vast majority of students already selected this pro-environmental action on the pre-test, presenting little opportunity for growth.

On the daily work, children offered many responses related to reusing and recycling materials. These findings support literature that has demonstrated that young children have some understanding of recycling (Honig & Mennerich, 2013). On the survey, parents also indicated that many children talked to them about recycling as a result of the camp. Additionally, children more readily supported reusing water bottles than reusing old coats. Some

children commented on the pre-test that "new" was better than "old." This preference for new materials should be further explored in sustainability instruction.

Conceptions Inconsistent with Instruction

Based on the pre- post-tests, children demonstrated a loss on their view that collective action is better for dealing with the warming Earth than working alone. This finding may be explained by at least three possibilities. First, every child who completed this item on the pre-test selected collective action, and consequently post-test item scores could not improve. However, the percentage of students selecting collective action did decrease in the post-test. Another possible explanation is that collective action was addressed only on Day 5, and the children had less opportunities to engage with this concept either through direct instruction or learning stations. Although collective action was addressed in one of the books, only one learning station (making climate signs) addressed it on Day 5. Finally, the camp's instruction positioned each child as a climate superhero who could engage in climate action. The instruction provided several individual actions that children could take themselves in their daily lives, and this emphasis on actions doable for preschool children may have over-emphasized individual actions at the expense of collective action. Surprisingly, working with others to address climate change was one of the most frequently selected actions on the parent survey. Parents may have been interpreting their children's accounts of what "we" did at camp each day as collective rather than individual action.

Several children expressed the idea that any pro-environmental action necessarily also helped to mitigate the warming Earth. This conflation suggests that children are not understanding how climate change is different from other environmental issues. The camp did not address scientific mechanisms associated with climate change such as the greenhouse effect beyond the analogy from the children's book in which human actions are akin to wrapping blankets around the Earth, thus trapping heat. More age-appropriate instruction is needed to support students in making more direct connections to climate actions that generate greenhouse gases and *how* these actions mitigate climate change by reducing greenhouse gas emissions.

Even though young children had several correct notions of Earth-friendly actions, they also had several misconceptions. One of the most frequent misconceptions discussed by young children included the inappropriate feeding of wild animals to help the Earth. For example, young children expressed the misconceptions of feeding a bear by putting out food on a string or feeding raccoons in the backyard. The backyard bird feeder activity may have contributed to young children's misconceptions by suggesting that feeding backyard birds is akin to feeding any wild animal. This distinction between feeding animals that are already habituated to human civilization and those that are not may be too confusing for young children to understand.

Several children conveyed the idea that any food that contributed to their health was necessarily good for the environment and climate change. This finding may be explained in at least two ways. First, this thinking may reflect an egocentric stage of development for these young preschool children. Second, children may have conflated their own health with the health of the Earth, and more careful characterizations about the actions intended to mitigate climate change could have helped children understand this distinction.

Feelings and Motivations to Take Action

Young children expressed multiple valid reasons for taking climate-friendly actions, including conserving resources, helping animals, and cleaning the Earth. The desire to take action to help animals is consistent with previous studies that have identified children's strong empathy for animals (Leger-Goodes et al., 2023). A few children described their reasonings related to adult influence such as a parent telling a child to recycle. This finding makes sense given the important roles that parents play in modeling pro-environmental behaviors (Leger-Goodes et al., 2023). The young children (aged 3-5) from our camp may not have the autonomy to make choices on their own. For instance, they may not be able to choose if their family recycles or composts. However, they can still choose some actions, such as turning off their bedroom light when they leave the room or turning off the water when they brush their teeth. To avoid parental influence, future interventions could focus exclusively on actions that young children are able to take individually.

Even though our camp was designed to teach young children about climate change, only one student (C6, age 5) discussed reasons related to combating climate change. This student referenced the book *Coco's Fire* and explained that they do not want the Earth to have any more blankets as a reason for taking action. This low frequency suggests that more time and resources may be needed to teach young children about climate change. Yet, there are a limited number of children's storybooks that explain the human impacts of climate change (Benevento, 2023).

Children's emotional response to climate change primarily included sadness and anger as in previous studies (Leger-Goodes et al., 2023). From the Day 3 to Day 5 assessments of children's emotional state, children offered fewer "I don't know" responses and least two agency-coded responses that entailed a turn to action. The overall framing of the intervention was built around a problem-focused coping strategy for dealing with climate anxiety (Ojala, 2012), and at least some of the participants demonstrated this strategy. Further early childhood interventions that attend to children's emotions and foster hope through agency should be developed and researched to help identify best practices for countering children's climate anxiety.

Limitations

The findings of this study must be understood in the context of the limitations of this study. First, the pre-post gains were assessed using an author-designed instrument with no further validity/reliability data to support it. Furthermore, some children on the pre-test and more children on the post-test obtained the maximum score of ten, indicating the need to include "difficult to endorse" climate action choices. Second, the intervention itself was relatively short in duration, and learning about pro-environmental actions and changing one's willingness to engage in those actions likely takes more time. Third, the camp took place in a university-affiliated child development center that primarily serves the children of faculty and graduate students. Thus, the sample is likely biased toward children with higher income parents and parents with higher levels of formal education. For this reason, gains demonstrated by this sample may be larger than in preschools more broadly.

Implications

Our results support calls for sustainability education for preschool children (Ginsberg & Audley, 2020). Findings from this study have implications for both formal and informal environmental educators. First, the children in this study had a difficult time explaining climate change and instead discussed climate change very generally and abstractly. One way for young children to get a better understanding of climate change is through place-based learning (Orr, 2013; Smith, 2002). Orr (2013) advocated for the integration of place into education to afford opportunities for connection, direct observation and experimentation, and learning "the art of living well where they are" (Orr, 2013, p. 186). This place-based pedagogy may particularly help young children understand local climate impacts, capitalize on their natural care for their own surroundings, and engage in climate actions that are locally meaningful. For instance, educators can connect climate change to the place-based theme of nature studies by examining local species that are impacted due to climate change. Educators can also invite children to investigate timely, local changes to the climate that students can observe and relate to such as phenological shifts in leafing, budding, and migration; flooding; fires; and increased pests and their visible impacts. In addition, making climate change relevant to children can help increase agency (Littrell et al., 2020) as children explore strategies for "living well where they are" (p. 186).

Children in this study faced misconceptions related to feeding individual species. Children had difficulty understanding which individual species safely benefit from human feeding and dangers associated with feeding other species. Further, scientific research regarding climate change suggests an ecosystem-based approach to conservation to support both biodiversity and resource management (Munang et al., 2013). Therefore, young children can alternatively be taught the importance of caring for and conserving ecosystems instead of being taught to help or feed individual species. An ecosystem approach to conservation could help avoid feeding misconceptions while also helping species impacted by climate change by supporting a larger variety of biodiversity. Furthermore, instruction about dangers associated with wild animals becoming dependent on humans can be included. In future versions of this camp, more emphasis will be placed on how animals meet their needs within their habitats.

Children's conflation of climate-friendly actions with *any* pro-environmental action represents a special challenge for early childhood climate change education. Very few children seemed to understand the greenhouse effect analogy (blankets) included in the book, and the camp did not otherwise address scientific mechanisms associated with climate change. Children may need to have more opportunities to explore heat, how heat is generated, and how heat can be trapped. This would allow children to make more direct connections to climate actions that generate greenhouse gases and *how* these actions can help mitigate climate change. Analogous situations such as being inside a warm car on a sunny day can be used to connect to children's experiences. Future iterations of this camp will build on the Coco's Fire analogy of putting blankets on the Earth by physically demonstrating blankets being placed on a model Earth.

Future interventions must consist of a balance of collective and individual actions. Our focus on individual actions was intended to empower children who may have no means to participate in collective action. Yet, interventions must have opportunities to help students become aware of collective actions. Future interventions could include organizing a climate march/walk on school grounds or writing a letter from the class about climate action improvements for the school. The extent to which climate education can foster hope by modeling collective action also warrants further curriculum development and efficacy research.

Findings of this study also have implications for future research about early climate change education. The assessment used for this study should be improved. Several children received the maximum score on both the pre- and post-tests, indicating that the assessment was not able to discriminate children's understandings at the high end. More dichotomous action choices with higher difficulty should be added to increase the person separation for this instrument.

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Moving Toward Nature: Teacher Candidates' Experiences with Nature-Based Learning in a Nature Reserve Field Setting

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ABSTRACT

Nature-based early childhood education programs and nature-based learning initiatives have deep roots in historically documented European nature education and the American Nature Study Movement. Education experiences in nature are designed to capitalize on the curiosity and natural explorational tendencies of young children to support quality and health-conscious early childhood learning experiences. While significant documentation exists that education in nature is beneficial for early childhood students, there are significantly fewer opportunities to explore the impact of putting teacher candidates into these unique placements or how implementing a field course at a nature reserve might affect a teacher candidate's attitude, skill development, and confidence toward educational experiences in natural environments. The lack of research begs a need for more exploration of field partnerships in nature-based preschools or in programs which contain elements of nature-based learning to attempt to find patterns in the development of teacher candidates who participate in these unique settings. This article is a qualitative study of a year-long field partnership between an early childhood teacher preparation program and a local nature reserve. The local nature reserve became a field site opportunity for candidates to be introduced to nature-based learning initiatives. Areas for research included the examination of reflections and focus group interview data related to participant prior knowledge, definitions, attitudes, and skill development.

***Keywords*:** early childhood, teacher preparation, nature-based learning, field experience in nature

Nature programming initiatives in early childhood education settings have a long history in the United States with significant documented growth over the last five years (North American Association for Environmental Education, 2020). Programs set in nature are a popular and fast-growing portion of the programming choices available to families through both school (nature-based education initiatives, outdoor schools, and forest schools) and public (nature sites, museums, parks, etc.) educational settings. Teacher education has lagged in meeting the need for highly qualified professionals to serve in these unique program types. With the types of programming for early childhood educators varying greatly between teacher education programs (Born, 2021), more research is needed to understand how infusing field components in nature could impact teacher candidate development. The aim of this study is to contribute to the existing educational research about the experiences of teacher candidates exposed to the principles of nature-based learning.

Literature Review

In the United States, there is a long and well-documented history that pairs nature-based education and quality early childhood programming. The movement toward more nature-based initiatives have been rooted in both outdoor classroom initiatives and the forest school initiatives of many European countries (Forest School Foundation, 2020). Roots of nature-based education are discussed as early as the late 1800s with the dawning of the American Nature

Study Movement encouraging learning from nature and not just books (Armitage, 2009). The Forest School Foundation (2020) also describes significant examples of the first forest school in Denmark in 1952, the "rain or shine schools" in Sweden in the 1980s, and the forest schools of 1960s Germany as historical evidence of the beginnings of these popular programs with even more models existing today worldwide. In the United States, the first forest school concept occurred in Laona, Wisconsin in 1927 based on a tree-planting project that had been observed in Australia (Forest School Foundation, 2020).

As of 2020, there were 585 nature schools (nature-based preschools, forest kindergartens, and outdoor schools) in the United States (North American Association for Environmental Education (NAAEE), 2020). This number is only representative of nature-based schools and does not include numbers of educational programs for young children that exist in public educational settings such as parks (state, local, and national), museums, historic sites, zoos, nature reserves and others. Statistics from the Natural Start Alliance, an organization concerned with improving educational access to nature, indicates by their membership numbers and maps that the growth of nature-based programs is likely much higher when considering non-school places that provide outdoor environmental early childhood programming (Natural Start Alliance, 2019). These statistics serve as evidence of a growing need for well-trained and highly qualified professionals to serve in all types of early childhood educational placements that have a nature setting or are by definition, nature-based.

An initial definition of nature-based education in the literature is described as "children's active learning in the natural world in which children are afforded regular opportunities to interact with nature" (Meier & Sisk-Hilton, 2013; Prochner, 2021, Defining Nature-Based Education section, para. 1.). While this definition does describe what nature-based educational opportunities are, it does not fully demonstrate the theory, mindsets, and pedagogies that are required of professionals working in early childhood educational settings where nature is either the main conduit of all experiences or a supplementary experience for students. In the last ten years, there have been more extensive discussions of quality program pedagogy. Larimore (2019) describes an emergent and purposeful pedagogical model where students spend at least a third of their time outdoors. Teachers of nature-based schools employ play-centric styles of early childhood education infused with environmental stewardship, an interdisciplinary approach, and a strong psychological and theoretical framework based in the physical, social, emotional, and cognitive developmental benefits of nature for early childhood students (Cree & Robb, 2021; NAAEE, 2016; Sobel, 2015).

Very little literature exists exploring strong teacher preparation program elements to prepare candidates for nature-based settings or nature-based learning and there is a deficit in the research understanding the elements that could assist with providing quality teachers for these specialized early childhood programs. Born (2021) surveyed programs in an attempt to identify sources of training and development for nature-based teachers. The survey provided awareness that program elements and the value to develop programs for nature-based education vary greatly from state to state and institution to institution. As an example, a review of the standards for early childhood in the state where the research took place (Pennsylvania) revealed significant references to ecological nature topics and encouragement for nature observations in the early childhood standards, but there was very little guidance on *how* those topics should be taught (Office of Child Development and Early Learning, 2014, 2016). When comparing the early learning standards to the early childhood program framework required for teacher preparation programs (2016), evidence shows that the framework also includes specific language requiring that programs prepare candidates with knowledge of ecological early childhood standards. Again, there is no specific guidance for strong ecological teaching practices recommended in the framework. Best practices for introducing candidates to quality ecological and nature learning is left up to the individual program and professionals who teach in each institution. In the United States, individual state departments of education determine standards for early learning as well as the frameworks for teacher preparation programs which are likely a major source of the variance between preparation programs.

Purpose

With the steady growth of nature-based educational programming (at preschools and forest schools) and outdoor educational initiatives (at nature reserves, national and public parks, museums, etc.) further research is needed to determine how nature-based or environmental education program components or field sites may contribute to the

overall development of teacher candidates and their readiness to teach in specialized nature settings. This study aimed to examine how teacher candidates in an upper-level early childhood field course developed through the integration of programming in a nature reserve field site. The researcher was concerned with finding any patterns among participants to help identify what unique outcomes might occur through participation in a field experience specifically structured to be outdoors and focused on nature-based learning. Of additional interest was how candidates changed any definitions or developed skills after learning more about nature-based learning while participating at the nature reserve site. Also of concern were their individual perceptions of the value of educating children in nature and how it might have contributed to their overall teacher development following their participation in the nature reserve field opportunity. Therefore, this qualitative research focused on the following research questions:

1. How do early childhood teacher candidates' definitions of nature-based education change after participating in a nature reserve field placement program as part of an upper-level field placement?
2. What patterns of skill development exist among candidates who participate in a nature reserve field placement?
3. How do the attitudes of candidates change through participation in a nature-based learning field component?

Examining the perceptions of the teacher candidates within the unique partnership between the teacher preparation program and the nature reserve site was most conducive to qualitative design using focus group interviews. Interviewing the candidates was distinguished as the appropriate means of inquiry as cited in Creswell and Poth (2025). Brinkmann and Kvale (2015) describe interviewing as an attempt "to understand the work from the subjects' point of view, to unfold the meaning of their experiences, to uncover their lived world" (p.3). Understanding candidates' perceptions of nature-based learning therefore could help the research understand the impact of participating in a nature-based learning program.

Research Setting

This study took place in an upper-level field course at a small liberal arts college in Pennsylvania. The college maintains an ongoing partnership with a nature reserve site within a short distance from the campus. The college education department offers early childhood (Pre-K -4) certification as well as various subject-specific certifications in the middle grades (4-8), secondary grades (7-12), and additional K-12 certification areas including physical education, art, and Spanish. The nature enrichment program where this research was conducted was planned as part of an upper-level field course for early childhood teacher candidates. The course is offered each semester, but a registration cap is set at 10-11 teacher candidates to allow for small class size and close supervision of candidates' experiences by the professor of record. Enrollment varies by semester and is not cohort-based. The main goal of the course is to give early childhood candidates strong experiences with preschool-aged children in both a traditional school and a separate, nature-reserve environment. The preschool-aged nature enrichment program that the teacher candidates run is a free public program the reserve and field instructor initially started as an alternative field experience opportunity for candidates when the COVID-19 pandemic closed schools in the area. The nature enrichment program allowed early childhood teacher candidates to work with preschool-aged students in an outdoor and less transmissible environment. When COVID-19 restrictions were lifted, the nature enrichment program continued and became a coexisting opportunity to the traditional classroom field placement which existed prior to pandemic restrictions.

Course Structure

The course where the study was situated is an upper-level early childhood field course that takes place during a semester in a teacher candidate's junior or senior year. The course precedes the 5-day-a-week student teaching experience by 1-3 semesters and is required of any candidate seeking Early Childhood (Pre-K-4) certification. The course is taken after the teacher candidate has taken two or more subject-specific pedagogical methods courses (i.e., the teaching of reading, mathematics, science, etc.). The upper-level field class is a 15-week course that meets 1 day a week for three hours. Students spend approximately 6-7 visits at the school site placement which is a

preschool class located within an elementary school a short driving distance from the campus. No data was collected from the school-based portion of the course because of its lack of components related to nature-based learning. Data was only collected based on the 5-week placement in the nature reserve field site. The first week at the nature reserve served as an orientation to the facilities and programming of the site as well as an overview of nature-based learning initiative characteristics. During the other four visits, candidates conducted hour-long family nature-based learning activities open to approximately 20-30 registered preschoolers between the ages of three and five years old and their supervising adult(s). Once registration capped for the program, a waitlist was generated. Twenty to thirty children registered and could potentially attend all four weeks of the program. If there was a parent call-off because a child was ill or unable to attend, then a person on the waitlist was invited to participate in their absence. While many children participated every week of the program, others were invited to "fill in" when one of the registered participants reported off.

Program Structure

Program registration was offered via social media link for no fee. Registration was required to keep student numbers manageable for the number of teacher candidates enrolled in the course that semester. The program had weekly themes selected by the reserve's Environmental Education Coordinator and usually were representative of seasonal thematic topics that could be explored at the site (i.e., pollinators, hibernation, seeds, nests, etc.).

The program format included a thematic environmental children's literature read-aloud. After the read-aloud, preschoolers and their supervising adult(s) broke into groups and rotated through four, 10-minute stations connected to the nature theme. Stations were brief and varied for student attention and interest. Supervising adults interacted with their students in various ways. Some adults chose to participate alongside their child while others stayed back and allowed the child to participate independently. The stations were given categories to allow students to keep them separate and individualized. Categories of stations include art, music and movement, outdoor, and wild card stations. Station one, Art, included a creative art activity. The expectation set during orientation was that candidates must use natural and/or recycled materials as much as possible with emphasis placed on the center having an environmental purpose (i.e., insect hotel, backyard nesting ball, etc.). The second station, Music and Movement, was focused on teaching environmental concepts through song, dance, exercise, obstacle course, group movement task or other similar activity (i.e., bird yoga, pollinator song and dance, group task to build a large insect, etc.). Station 3, Outdoor Station, involved (as the name implies) an outdoor activity and unstructured exposure to nature. The outdoor station often included a walk to explore or complete an activity in a specific area of the reserve such as the pond, wetlands, butterfly garden, or other site that connected to the literature-based theme. Station four, Wild Card, was a free-choice station that was structurally different from the other three. Teacher candidates received the opportunity to be creative to contrast their peers' stations. This station commonly included a game, STEM activity, experiment, or other activity unique from the other three stations.

Teacher candidates received station rotation assignments during orientation week and had the opportunity for mentored and coached planning with access to the nature reserve's library of resources. Knowledge and experience with nature and environmental content varied per participant so candidates were supported as requested and offered models and suggestions if there was a struggle to choose a learning activity for a station. Teacher candidates submitted station lesson plans to the professor via a learning management system five days before the station was taught. Initial feedback was given by both the professor from the education department as well as the Environmental Education Coordinator from the reserve three days before the lesson was taught. The candidates made final station adjustments based on feedback and prepared for student materials prior to the program date. Following the program, feedback was given within one week. The structure of the course was scheduled so that the next session occurred at least two weeks later to allow time for response to feedback. In the "off" weeks of the planning/teaching cycle, the students were individually responsible for planning lessons for their assigned groups of learners at their school-based site.

Program Limitations

The program that was used for this research had characteristics that could be considered limitations or challenges for the study of how teacher candidates develop concepts in a nature field site. It was important to identify these factors so that the researcher could be cognizant of how the limitations might intervene with the participants' experiences in the program. First, it is recognized that the nature enrichment program design only covers a short time of the field course and does not meet full criteria of a nature-based program as defined by Larimore (2019). The structured environmental program contained some emergent and discovery elements held outdoors in nature where students could explore a site and interact with the candidates, but it also contained more structured environmental education activities which mirrored lessons from more traditional early childhood settings and public educational programming. Since Larimore (2019) describes that programs shifting toward nature-based education often exist on a spectrum of implementation, the enrichment program was still used to provide a basic introduction to principles of learning in nature to expose candidates to this mindset even though the program does not meet the full definition of a nature-based early childhood education program. The program did contain consistent infusion of natural materials when building and crafting, outdoor observation opportunities, nature play at reserve locations (gardens, ponds, bird stations, trails, etc.) exploration of nature materials when indoors (specimens of nest, hives, persevered animals, and interaction with live animal ambassadors) to lay the foundation for candidates to understand basic ways to infuse nature-based learning and environmental stewardship into early childhood teaching (Powers & Ridge, 2019).

A second program limitation included the location and existing partnerships with the reserve. Because of the close and multifaceted partnership between the reserve and the college, the candidates may have had exposure volunteering or working at the reserve prior to the study. A pre/post reflection was used to establish current levels of knowledge and past experiences with nature. Defining these past experiences allowed the researcher to identify prior knowledge and how that knowledge might have changed by the end of the field experience. This research was a small qualitative study, and the ideas of the study will only be transferable to other programs of similar size, function, and design. Because there are only small amounts of research about a nature field site used in teacher preparation, the study still potentially offers valuable information about how candidates develop in a nature field site.

Methodology

Prior to conducting any research, the methodological procedures for this study were approved by the Institutional Review Board (IRB) at the college where the research took place. Qualitative research was the most appropriate form of research for the study. Qualitative research is most suited when endeavoring to "study things in their natural settings, attempting to make sense of or interpret phenomena in terms of the meanings people bring to them" (Denzin & Lincoln, 2018, p. 10).

Participants

There were 11 teacher candidates enrolled in the course during the academic year when the study was completed. Four teacher candidates were enrolled during the fall semester, and seven teacher candidates were enrolled during the spring semester. Of the 11 potential teacher candidates who took the course, four candidates elected to participate in the study (two spring, two fall). All participants were either juniors or seniors and in their 20s. All participants were majoring in early childhood education (grades PreK-4). The candidates who participated were a mixture of both male and female. Exact ratios of male to female participants are omitted to protect the identities of the male participants since the early childhood program at the college experiences disproportionate numbers of male and female candidates. All participants were seeking their initial certifications. Two of the participants were also seeking dual certification in special education (K-12). The course where the field experience took place is designated as a student's third of five specific field courses (Field I-Field V). The field courses are designed to be taken individually, but in unique cases, a student may be registered for two adjacent field classes at the same time due to scheduling hardships. This co-registration scenario happened with one participant who was taking both the

third field course at the same time as the fourth field course. The fourth field course is designated as pre-student teaching—a 7.5 hour-a-day, 1 day-a- week, 15-week field placement course.

Course Procedures

The field experience was planned as a part of a one-credit undergraduate field course required of all early childhood candidates at the college. It is a part of a regiment of field courses which range from basic observations and novice, small-group, teaching tasks (Field I) to full-time student teaching (Field V). The course has both a school-based component at an elementary school and the nature reserve component. The researcher was the professor of record for the academic year that the study took place. Because the researcher was the professor of record, special attention was paid toward sources of bias when conducting the course and data collection procedures. To account for this bias, the value or quality of the specific program elements was not the emphasis of the study. The type of program was not viewed as an intervention or specific format for teaching nature-based education initiatives to candidates. Rather, the participants' thoughts and reflections were the focus of the data. While the structure of the program is pertinent to help bound the program and site used in the study, it is acknowledged that there are many formats, programs, and opportunities where candidates could participate in nature-based learning. The sources of data that were used from the program/course are a regular part of the course routines.

At the time when the program was conducted, teacher candidates were not aware that the professor would ask them to participate in a study at the end of the semester. The informed consent and focus group interview invitation was sent following the grade deadline for the college to ensure that students could participate/or not participate without fear that their grades could be affected. The informed consent asked permission for class assignments to be used as a source of data. Since the researcher was the professor of record, the assignments from all participants who gave consent were downloaded from the learning management system and printed as a paper record.

Field Procedures

The field experience at the nature reserve was constructed to be five (5) weeks of the 15-week field course. The first week of class, candidates were notified that they would be participating in a field experience at the site during a general orientation to the field course. Basic information about the program was explained, but limited to the location of the site, recommendations for options of how to travel to the site as well as a general introduction to themes that would be used for the weekly courses. The pre-reflection was assigned at the first class meeting so that students' background knowledge and questions could be used to plan an orientation about the nature reserve.

Pre-reflection. Very little information about the mission of the nature reserve or the different components and structures of the program were given initially to allow candidates the opportunity to report their prior knowledge of nature-based learning accurately without influence. Pre-reflections were reviewed by the professor of record and the Environmental Education Coordinator from the field site to plan an orientation session to the program. Students were given an assignment sheet with open-ended questions to prompt them in reflecting on past experiences with nature. The following are the questions that were included on the pre-reflection assignment sheet. Students were permitted to add additional thoughts or to not answer specific questions based on their preferences.

Pre-reflection assignment prompts included:

1. How do you currently define nature-based education? Prior to this course, have you ever volunteered, worked, or observed in a nature-based educational situation? Please provide details

2. What are the most significant field experiences you have had leading up to this course? What do you believe made them so significant to your current teaching style or development?

3. How confident would you label yourself as a teacher of content knowledge about nature or the environment?

4. Did you ever participate in educational activities in nature as a child (i.e Camps, field trips, family travel, organizations that promoted time in nature, etc.)?

5. What are your current career goals as a teacher candidate? Does integrating nature into education play any part in these goals? Feel free to be honest.

6. What questions do you currently have about nature-based education?

7. Do you have any expectations for the orientation or ideas of what you would like to see/do at orientation to become more familiar with the site or to support you in providing strong educational experiences?

Nature Orientation. *A*fter the pre-reflection was due and an orientation constructed, the students participated in the orientation to the nature reserve and its nature enrichment programming. The orientation included an introduction to nature-based learning and a review of the site's mission, programs, and resources. The orientation also included a tour of the different animal ambassador stations and locations to explore on the reserve. Candidates were introduced to the themes and matching literature selections. They were assigned one of the four possible stations for the first week (outdoor, music and movement, art, or wild card station). Purposeful time was left open at the end of the orientation to allow candidates time to answer questions and access the resource library at the reserve. Each week the candidates would plan a different ten-minute, station lesson to work with the group of children registered to attend. Candidates were encouraged to get feedback by emailing the professor of record or the environmental education coordinator before constructing a lesson plan.

Teacher Feedback/Teaching in Nature. Once the initial lesson plans were submitted, the Environmental Education Coordinator and the professor of record worked together to review the plans and provide feedback. Revisions were completed if needed. If a revision occurred, it was most often related to aligning to the program expectations (i.e., using natural materials, having environmental purposes for activities, etc.). Other minor adjustment included management of supplies, management of students, or movement of groups between stations. This rotation occurred each week for the three remaining weeks of the program. Each week of the course had a different nature theme and each week, teacher candidates would be responsible for a different station. In the fall, each of the four enrolled candidates had a chance to run each station once. In the spring semester, candidates were assigned a team-teaching partnership due to higher enrollment. There was one teacher candidate who volunteered to work alone. Again, each candidate team had an opportunity to plan and teach each station once during the 4-week program rotation.

Post-reflection. Following the final program session, the candidates were assigned a post-reflection narrative to allow them to reflect on how participating affected them. The assignment was given immediately following the completion of the 4^{th} week of the preschool nature enrichment program. The assignment sheet was again constructed to have prompting questions for candidates to answer but was a flexible assignment. Candidates were free to identify any information they did/did not want to write about.

Post-reflection assignment prompts included:

1. How do you currently define nature-based education? Has that definition changed since the beginning of the semester?

2. How did this experience align with or differ from past experiences you had in nature prior to this semester?

3. Using the subdomains of Danielson (2022), what domains were you able to grow in or practice during this specific field placement?

4. What are the most significant experiences you had during this placement? What were you most confident in teaching?

5. How confident would you label yourself as a teacher of content knowledge about nature or the environment?

6. Following this nature placement, does nature-based education play any future role in your teaching? Would you consider implementing a nature-based curriculum or experiences into your future practice? How confident would you feel?

7. What questions do you currently have about nature-based education?

8. What recommendations do you have for the professor about this experience in the future?

Focus Group Interviews. Following the grade deadline in the spring and fall semesters, candidates were sent an informed consent which asked them to participate in the study by joining in a focus group interview and allowing the professor to pull their pre- and post-reflections and lessons from their semester of participation in the nature enrichment program. Candidates sent an email indicating an affirmative response to participate. Negative response emails or no email responses were both considered as nonparticipants whose artifacts were not included with the recorded data. Interviews were held online at a time convenient for all participants for that semester (arranged by email). Prior to the interview the candidates were sent the focus group interview procedures and questions for review. Like the pre- and post-reflections, candidates were notified that they were free to speak candidly and add additional comments that did not pertain to the questions to encourage candid speech.

Possible Focus Group Question for Discussion:

1 How has your definition of nature-based education changed (or not changed) since the beginning of the semester? What led to this change (or lack of change)?
2) What benefits did you experience from participating in a nature field experience?
3) Were there characteristics of the experiences that you believed were not beneficial to your development?
4) How did this experience compare to other field experiences you have experienced in more traditional settings?
5) What specific teaching skill domains (planning and preparation, classroom environment, instruction, professional responsibilities) did you utilize most while participating in this placement?
6) What skills, if any, did you believe grew as a part of participating in this placement?
7) Of the teaching skills that you utilized were there ones you believe you could/could not transfer to other field placements?
8) Has participating in a nature early childhood field experience changed how you plan to teach?
9) What importance do you place on nature field experiences being included in early childhood teacher preparation programs?
10) What importance do you place on nature-based education placements for early childhood students?

[Note: Participants were welcome to discuss any issue or topic related to the study not included on this list during the focus group Zoom meeting.]

Both sets of participants completed their interviews a few weeks after each semester was over to allow some separation between when the program ended, when the post-reflection was completed, and when the interview was conducted. All interviews were completed using video conferencing software (Zoom) and were recorded for the purpose of creating an interview transcript for data. To transcribe the participants' responses a cell phone with a Google Doc application with dictation feature was used to record each response initially. An inclusive timestamp was recorded for a response, and a color of font assigned for each different participant. After using the dictation feature to initially record the response, the researcher would then review (several times) each specific response by its inclusive time stamps and make corrections to the dictation of the response so that it reflected the exact words of the participant. This process was repeated until a transcript of the interviews was finalized for each semester. Then, each video was reviewed in its entirety with the finalized script to ensure accuracy of the data overall.

Data Collection

There were two main sources of data for this study. The first source of data came from document analysis of the pre-reflections and post-reflections of the participants. Pre/post reflection data were chosen because of the opportunity to document prior knowledge of the participant before participating at the nature reserve site and the opportunity to conceptualize growth or change after completing the nature reserve field placement. These reflections were completed in the participants' free time outside of class using a semi-structured format that allowed them to choose questions to answer (questions described in pre-reflection and post-reflection sections), but participants were also offered flexibility to discuss any additional thoughts or opinions they wished to share. These reflections (as described in the methodology) were also used to help plan orientation experiences at the nature reserve so that the orientation presentation might address differences in nature-based learning methods and answer questions/concerns of the teacher candidates before they were expected to teach independently in the program. Understanding the ideas and reflections of a participant both before and after program participation helped to develop descriptive context for what participants experienced during program participation.

The second source of data for this study came from the participant responses during the focus group interviews following each semester's end. These interviews were used to allow the participants both space and time from the completion of the program to support that a candidate might be more willing to speak freely about their reflections of the experience. A permissive environment was cultivated to reassure the participants that they could speak freely and offer opinions about the experience without the researcher being affected. They were reassured that the specific quality of the program was not being researched and that the main concern was their beliefs and perceptions of having a nature reserve site as part of a field experience. As a part of the informed consent, additional artifacts obtained included lesson plans and feedback in case of a need to provide context of the candidate's lessons and activities as reported in their post-reflection or their focus group interview responses.

Data Analysis

Data analysis procedures for the qualitative case study were determined using procedures and recommendations for qualitative data analysis from Merriam and Tisdell's (2016) book on the design and analysis of qualitative research. The authors describe data analysis as a simultaneous event with data collection. Thus, conceptualization of the data patterns began to faintly take shape with the turning in of the pre-reflection documents and the planning of orientation. The initial review of the pre-reflections helped to shape course experiences and helped to identify patterns in prior experience among candidates in the course. Only the data of consenting participants is included with this analysis. Despite this, the non-participant candidates' reflections had impact on the structure of the orientation and the experiences in the course.

Once consent was obtained following the grade deadline, the researcher first reviewed a candidate's individual data to identify unique features of each person's experience within the course. Notes were made to identify those unique features. Each participant's data was then examined based on individual types of artifacts to identify possible consistent patterns or themes among the participants' experiences. For example, all pre-reflections were compared for patterns, all the post reflections were compared for patterns, etc. Participants were assigned a number disregarding if they took the course in the spring or fall semester. Because the data were multifaceted based on each person's unique experience and because participants had the choice of what to focus on in interviews and reflections, the decision was made to focus on thematic categories that were consistently comparable between all participants. In some cases, individuals reported on a topic that others did not. For example. In the post-reflection, not all participants made recommendations to the professor about the nature-site field component. One student mentioned not having partners in future courses, while another one made a recommendation of the setup of the school calendar for the traditional and nature sites. There was not enough consistency between answers to visualize and compare them. These types of responses were not disregarded, but because they were not the focus of the research questions, they are not the main focus of the discussion.

The following thematic categories were present and comparable in each participant's data:

1. Pre-definitions and post-definitions
2. Prior nature experience
3. Skills utilized
4. Value of nature field for candidates
5. Value of nature-based education for students

Once the common thematic categories among participants were identified, pre-reflections, post-reflections and focus group interview scripts were read multiple times to identify the similarities and differences among participants in these categories. Categories were given a color code and kept consistent among each thematic category for all sources. The data from each category were then used to visualize and identify findings that matched the themes of the research questions (definitions, skills, attitudes). Using the data that was common among participants and classifying them back to the research questions allowed for better reduction of the data for significance. It was helpful to create graphic organizers to better compare the common responses in some categories.

Results

The results of each of the common thematic categories are assembled in this section. The significance of these data to the research questions are explained in the discussion section.

Pre-Definitions

All participants provided a basic definition that showed some awareness and pre-knowledge of nature-based educational settings and nature being used as a tool for learning. Table 1 is a visualization of the features of each candidate's pre-reflection definition as evidenced by representative quotations from their responses. If a section of the table is blank, that participant did not provide a quote that supported nor negated the definition features other participants used. Three of the responses included common knowledge that the learning in nature-based education must take place in nature. There were also four responses that addressed learning being hands-on and experimental in nature. Participant 1 also had unique knowledge that it was important for nature-based education to have real world applications.

Post-Definitions

After participation in the program, all participants re-addressed their current definitions of nature-based education as part of the data. Three of the four participants believed that their definition had expanded. One participant, Participant 2, believed that their definition had not changed but through the data had shown some consistent discussion features with the other participants who believed their knowledge had expanded. It is pertinent to mention that participant 2 had prior experiences volunteering before their enrollment in the course.

Features of the expanded definitions included more candidates speaking about quotes that supported the idea that there are real-world applications to nature-based education. There was also supporting evidence of quotes from participants' values about environmental education/global citizenship as well as the connection of natural curiosity and the exploration of nature to early childhood developmentally appropriate practice. Table 2 is a visualization of the common characteristics among participants' post-program definitions with representative quotes coded as those ideas.

Table 1. Visualization of the common characteristics among participants' pre-program definitions of nature-based education.

Definition Feature	Participant 1	Participant 2	Participant 3	Participant 4
Setting	"Basing learning in nature"	"Education that takes place in nature"	"form of learning that occurs in an environment surrounding nature"	
Nature as a learning tool	"This does not simply mean using objects in nature as tools, such as using leaves to count. Rather, it involves basing learning in nature, with real-world applications and connections."	"Education about nature"	"It must be hands on and related to the outdoors."	"formal and informal instruction that uses different elements of nature"

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Table 2. Visualization of the common characteristics among participants' post-program definition of nature-based education.

Definition Feature	Participant 1	Participant 2	Participant 3	Participant 4
Setting (and expanded setting)	"I don't know if my definition changed as much as it expanded or just added onto. Before my definition was very limited. It was strictly just learning outside in nature." "Now I think it's a lot broader and more universal."	"Education that takes place in nature" *stayed the same from pre-definition.	"a type of learning that occurs in an outdoor or environmental setting" *stayed the same from pre-definition.	"I thought (nature-based learning) had to be learning science outside focusing mainly on the science aspects of nature. But a lot of the instruction was integrated. There was music, movement, physical activity and even reading connections to the learning."
Definition Feature	**Participant 1**	**Participant 2**	**Participant 3**	**Participant 4**
Nature as a learning tool	"Nature-based education can involve nature-based materials or settings of nature to support the reaching of instructional goals."	"Education about nature" *Stayed the same from pre-definition.	"Not that I didn't know this already, but the importance of interactive nature activities. I think you can easily see it with all of our lessons."	"formal and informal instruction that uses different elements of nature" * Stayed the same from pre-definition.
Real-World Application	* Participant did not specifically make a post-	"It is important for students to know about the world	"It is not just an outlet to teach	"I can see future educators finding resources in their

	program quote that matched the real-world application that was mentioned in his/her pre-reflection.	around them, even with things they might not observe directly in their backyard."	(traditional) subjects outdoors." "…what we were teaching teaches them about the world around them…(described a story about observing pollinators at the reserve)…as citizens it's important to protect those species and realize they are important.	own communities to get student outside and to get them involved."
Definition Feature	**Participant 1**	**Participant 2**	**Participant 3**	**Participant 4**
Internalized Values of Nature for Early Childhood Development	"(in nature) There's endless opportunity for learning and for imaginative play…which is the primary way that early childhood students learn."	"I will keep in mind how much children like being outdoors and enjoy exploring and hands-on nature types of things."	"It (the placement) showed us the importance of nature-based learning in a child's development."	"I can see how anything like that (the placement) has them not just sitting. They are moving and around and doing all these (nature) things. They are not inside hitting the books."

Prior Nature Experience

In the data, the participants all had some prior experience with nature that could be classified as positive. Participants all reported remembering moments from nature experiences and described specific examples with varying levels of fondness. Participant 1 described playing in nature as a child and questioning the word around them (playing pretend as if stranded on an island, wondering why fireflies were able to glow). They also recalled raising strawberries in their yard and a love for being outside and exploring. Participant 2 mentioned participating in a scouting organization but felt that outdoor time was minimalized to a few camping trips and mostly indoor activities. The majority of Participant 2's prior experience came from opportunities to volunteer at the nature reserve where the study was conducted prior to participation in the field course. Participant 3 also mentioned scouting as their connection with nature as a child where they had achieved a top level of scouting and reported significant time outside learning while in the scouting organization. Those experiences also made Participant 3 feel confident in nature with a belief that their connection with scouting would be an asset when participating in the field site. Participant 4 described significant nature-based field trips to a waterway local to their community. They recalled learning about water health and oyster populations that were indigenous, but often overfished, in that body of water. Participant 4 also described a close familial connection who works as an environmental scientist. That connection allowed Participant 4 to also have some respect and connection with nature. These data are important to shape the context of the study because all four willing participants had some prior positive experience toward nature before enrolling the field course. It is a possible bias to be cognizant of since pre-existing concepts of nature may have influenced desire to participate in a study of a nature reserve field site. More research is needed to identify complex factors and the characteristics of candidates who choose to work in nature-based environments and how much teachers who work in nature might be influenced by attitudes toward and prior experiences with nature.

Skills Utilized

Participants reported on skill areas they believed they grew up in or practiced as a part of the nature reserve field experience. Evidence in both sources of data produced several transferable teaching skills. In several instances, candidates spoke of their skills utilized in the terminology of Charlotte Danielson's *Framework for Teaching (2022)* as it is a common tool used by the teacher preparation program in which all the students are enrolled. The framework is consistently reviewed in other field experiences at the college, so participants often use the language of this framework frequently and consistently when describing their teaching practices. Several candidates also discussed skills they believed were/were not transferable to other field placements. These data were collected to ascertain a context for the retained skill development of the candidates to help understand more about how the participants perceive if skills could transfer to future placements or careers.

All four participants possessed data that mentioned planning and preparation as a domain of skills that the nature field experience allowed them to practice. The first two participants only made general reference to subsets of planning and preparation (i.e. gained knowledge of students). Participant 3 spoke in detail about a scenario where they had to become an expert on worms for a weekly theme while Participant 4 quoted, "I used planning and preparation a significant amount of the time. With the weekly lesson plans and networking with the environmental coordinator, I got lots of feedback and would get the opportunity to make it (the lessons) better." Three of the participants described skills practiced within the context of fostering a quality learning environment. Participant 1 mentioned practicing skills where they had to create a culture for learning while teaching outdoors. Participant 3 spoke of the challenges practiced with working in an "interactive environment" for preschoolers. Participant 4 described the challenges of "exercising their classroom management" in a less structured outdoor setting. For instruction, Participant 1 provided additional details of the challenges of maintaining flexible and focused engagement of learning in a nature setting, while Participant 3 described strategies for asking questions and guiding students without giving too much information away. Finally in the domain of professionalism, Participant 3 was the only participant to mention getting the opportunity to practice reflective teaching with their partner as a part of the placement.

Value of Nature Field for Teacher Candidates

In the focus group interview sessions, participants were asked specifically what value they placed on a nature field experience for teacher candidates. They were also asked if there were things they believed were/were not beneficial during their participation in the nature reserve field placement.

For the question which focused on the value that the participants placed on the inclusion of a nature experience in teacher preparation programs, all four participants offered opinions. Participant 1 discussed the broadening of their definition of what education could be:

> *I grew up in the American education system. You come to school. You get a paper, pencil, and worksheet. You sit down and you learn. The placement really opened my eyes to how beneficial nature-based experiences are in terms of learning. You really saw the hands-on, the constructivism, and those aspects we learned in child development and psychology.*

Participant 3's thoughts focused on the idea of nature-based educational experiences being beneficial for teacher education in that they provide a wider view of the early childhood options available. "It's a different style of (early childhood) teaching. Right now, our program is very focused on classroom teaching. It's very helpful to see another side of (early childhood) education. Participant 1 expanded on the idea that a nature field placement expanded their ideas of the jobs that a teacher could be eligible to do. "I think, for me, it (the benefit) was kind of seeing more of a variety of ways you can apply education and teaching to different settings." Participant 4 had similar opinions about widening job opportunities, specifically noting that the Environmental Education Coordinator at the research site was also trained as a teacher. "I really enjoyed her (the Environmental Education Coordinator's) job. It was nice to see there are so many different routes we can take."

Participants were also asked to elaborate on any skills from the experience that were transferrable to their future career or other placements to identify the value participants placed on having an experience in a nature reserve setting. Participants 1 and 4 both mentioned the awareness of the challenges of a multi-age group and finding activities that were appropriate for the differences between 3- and 5-year-olds. Participant 1 believed that the "open air" setting provided challenges in classroom management that helped them become better at managing a large group with potential for distractions. Participant 2 described the transferability of more minor management strategies that were observed at the site, specifically, a strategy for completing a project where stages of the project were chunked and pictured step-by-step to help children complete the project independently.

Value of Nature-Based Education for Students

By the end of the experience in a nature setting, participants reported awareness and potential benefits to children learning in nature. During the focus group interviews the participants' conversations focused on two different aspects of potential benefits. Participants 1, 2 and 4 concentrated on the potential developmental health benefits of nature settings as an opportunity for children to move more, explore more, and engage curiosity. Participant 2 specifically mentioned valuing the benefit of an outdoor space. "I think it's important for them (students) to have that outdoor space. At my house, we don't have a yard, so I think it's important for all children to get that opportunity to go outside." Participant 3 mentioned their perceptions of the importance of teaching students about the world around them. When asked if they placed importance on nature-based education opportunities for teaching early childhood students, Participant 3 also described valuing teaching students to be active citizens in their environments. "They (the preschool students) got to learn about bees and butterflies…as citizens it's important to protect those species and realize that they are important in our world." There are several limitations of this study including effects of small participant number, interview question design, and lack of long-term data. In the case of the effects of small participant numbers, the study was constrained to the number of available enrolled candidates. While this study has offered insights to the perceptions of early childhood teacher candidates participating in a nature field placement site, it is only a tiny picture of one small enrichment program in a much larger pool and spectrum of nature-based educational program settings (nature-based schools, forest schools, etc.).

There are also questions to consider related to the participants' prior positive experiences with nature. The participants all had some prior positive experience with nature which could have skewed their perceptions of a nature field placement to focus more on positive attributes and less on negative attributes. In addition, the researcher does not consistently teach the course in all semesters, so the pool of participants was limited to the enrollment for the year in which the course was taught. This factor also affected the interview question design. Because the research time was limited to while the researcher was the professor of record, there was no additional time to do a pilot with the focus group interview questions.

While the researcher wanted to know more about any possible benefits to utilizing such a field placement in a teacher education program for early childhood educators, the study does not provide significant opportunity for transferability to other types of nature programs unless they are of similar structure, function, or design. This research also does not (yet) provide long-term data of the outcomes of the participants to see if there is any correlation between participating in a nature field placement and the likelihood of choosing a nature-based educational setting later in one's career.

Several steps were taken during data collection and analysis to ensure the integrity of the researcher and the data. First, because there were multiple sources of data between the interviews and the pre-post reflections, triangulation of data was completed during analysis to ensure that thematic patterns were consistent among data sources. During the interview proceedings an audio recording of the data provided opportunity for data to be recorded explicitly. Following responses, the researcher probed and clarified individual's responses to verify correct interpretation of the data transcript to maintain data accuracy.

Discussion

Data in this study provided detailed insight to the ideas and beliefs of the small group of candidates who participated in a nature reserve field placement setting. While the participant group was small, the research that exists about quality program elements for preparing teachers for nature-based environments is limited, meaning that this study still provides a needed contribution in the deficit of this specific type of research. Implications for the data in relation to the initial research questions provide some valuable interpretations.

For the first research question, data indicated that all participants in the group had some prior knowledge of the definition of nature-based education prior to participating in the field placement. It is uncertain whether this is due to current programming elements/nature-based education's presence in the research for best practices in early childhood education, or due to the long-term educational programming partnership that exists between the nature reserve and the college where the participants attend. The initial definitions of three of the participants matched well with the more universal definition provided by Meier & Sisk-Hilton (2013) and Prochner (2021), but candidates' definitions did not include the element of "regular opportunities to interact with nature." One participant did recognize that real-world connections might be valued in such placements, but otherwise no other sophisticated knowledge of best practices in nature-based education were present. Evidence was provided that most participants demonstrated expanded definitions that were more detailed after participating in the field placement in nature. Expanded definitions included awareness of more specific benefits for students including health factors, developmental factors, and expanded ecological knowledge.

For the second research question, responses in interviews and reflections provided the opportunity to examine skills participants perceived they practiced in a nature field placement. The most common responses among participants involved opportunities to practice skills in planning and preparation of lessons. Participants all described at least one characteristic from this domain with the majority of supporting information relating to the challenges of planning content and choosing developmentally appropriate activities for students. The second most popular domain among participants was the domain which addresses creating strong learning environments. Three participants believed they met challenges or grew in that area. Specifically, two participants cited practice and growth related to maintaining interactive engagement and classroom management while in nature while one participant specifically mentioned creating a nature learning culture. In the domain of instruction, a participant specifically mentioned skills for maintaining a focused environment in nature and another mentioned crafting quality questions as areas of practice. Finally, one participant believed they practiced reflective teaching while networking with a partner. While the placement was an informal field setting it was encouraging to see that participants perceived growth in teaching skills that were transferrable to other placements and environments. All the participants reported taking away some transferable skills, even if their future career plans did not include a nature-based setting. Participant 1 noted that they believed not all content was transferable (told a specific story about not believing they would ever teach owl talons in their future career) but noted that they would remember how much the students enjoyed seeing the hands-on example of the owl. During the focus group interviews, several participants noted that participating in the placement expanded their knowledge of differences in early childhood nature-based programming and broadened their awareness of nature schools and nature placements in public settings. These data indicate a connection to the need to raise additional awareness among teacher candidates that nature-based teaching is a specific and sophisticated set of pedagogies that have application in both school settings and public nature settings. As the program grows, it could benefit from continued implementation of initiatives focused on contemporary definitions of nature-based early childhood education to build candidate exposure to these best-practice programs. While some elements possessed characteristics of nature-based learning the program did not have access to a contemporary nature-based school.

Finally, in the third research question, there are implications in the data regarding participants' attitudes through participation in a nature-based field setting. All four participants discussed valuing a nature-based field placement for teacher candidates and reported valuing the developmental benefits of nature-based learning for early childhood students. Overall, it is uncertain whether this can truly be viewed as an attitude change. The data does seem to indicate a more expanded knowledge about value and benefits of nature-based programming. Unfortunately, as discussed in the limitations section, all four participants had some positive experience toward nature-based learning

prior to participating in the nature field placement. This limitation made it impossible to definitively determine growth or changing attitude through the experience. Attitudes were already positive prior to the field placement. More research is needed to discern what dispositions of teacher candidates might influence a candidate to choose a career in nature-based education and if experience in a nature field placement might change or grow candidates' attitudes toward nature-based learning.

Conclusion

Despite the limitations, this research does provide some valuable contributions and insights into the possible impact of a nature field placement for early childhood candidates. The results of the research evidenced involvement in a nature field placement as having the potential to provide opportunities for expanding teacher candidates' definitions and knowledge of the characteristics of quality nature-based education programs and learning initiatives for early childhood students. Evidence also indicated that participants reported a better awareness of nature career options in both school-based and public-based settings. Collected data also showed perceived growth in the knowledge of the benefits of nature for early childhood students' development.

More research is needed to identify quality program components for developing teachers prepared for nature-based education settings and the impact of nature field placement settings for teacher candidates who are interested in careers in nature-based learning, especially if the nature program growth continues at the rate at which current literature suggests. There is also additional significant research needed to determine the dispositions and skills of nature-based teachers to ascertain if there are common characteristics which lead them to choose nature-based classrooms or public nature education programs in their careers. Creating highly qualified candidates who are prepared to teach in nature -based education and nature-based learning settings continues to be a valuable topic of research for early childhood teacher preparation.

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Nature-based Early Childhood Educators' Perspectives on Embracing Fire as a Loose Part

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ABSTRACT

With the rise of nature-based early childhood education (NBECE) and emphasis on the importance of risky play, it is prudent to investigate a different approach to fire safety, through experimenting with fire and following necessary safety precautions within NBECE and other settings. This study explored fire as a loose part, safety considerations, and best practices for using fire in early childhood settings. An online survey instrument was disseminated via nature organizations and social media platforms examining demographic information, use of fire as a loose part and fire play approaches within early education settings with 290 qualifying respondents. The study used a convenience sampling technique to investigate practices and concerns focused on fire play through educators' perspectives of children aged two years through eight years. Results indicate that programs using open flame as part of fire play are using additional fire safety protocol and precautions and respondents cite safety as a primary reason for allowing fire play. Fire play, when it is allowed, can be done safely, thoughtfully, and carefully.

***Keywords*:** nature-based early childhood education, loose parts, risky play, fire, fire safety

With the rise of nature-based early childhood education (NBECE) and emphasis on the importance of risky play, it is prudent to investigate a different approach to fire safety, through experimenting with fire and following necessary safety precautions to use fire within NBECE and other settings. The purpose of this study is to explore fire as a loose part and safety considerations of fire play in early childhood settings. The study used a convenience sampling mixed method research approach to gather results and data representative of the NBECE target population. As a result of this research study, recommendations and best practices for incorporating fire as a loose part in a safe way in early childhood settings were formulated.

Literature Review

Fire making or fire play as part of early childhood settings is not well researched and often feared and avoided. In an informal search of more current risky play academic research articles, fire was mentioned, but only as an example of dangerous elements and not expanded on beyond that. However, fire can be viewed as an aspect of both risky play and a loose part. The literature review explored embracing fire as a loose part and current nature-based early childhood educators' fire safety practices.

Embracing Fire as a Loose Part

It is important to establish a working definition of loose parts as it relates to early childhood education. “Loose parts are often associated with play, but they are also vital components to learning and growth” (Gull et al., 2021, p. 5). In 1971, architect Simon Nicholson coined the term “loose parts” in his article entitled *How NOT to Cheat Children - The Theory of Loose Parts.* He wrote:

> There is evidence that all children love to interact with variables, such as materials and shapes; smells and other physical phenomena, such as electricity, magnetism and gravity; media such as gases and fluids; sounds, music, and motion; chemical interactions, cooking and fire; and other people, and animals, plants, words, concepts and ideas. With all these things all children love to play, experiment, discover and invent and have fun (Nicholson, 1971, p. 30).

In addition, Nicholson (1971) stated "In any environment, both the degree of inventiveness and creativity, and the possibility of discovery, are directly proportional to the number and kind of variables in it” (Nicholson, 1971, p. 30).

Gull et al. (2019) performed a scoping review, highlighting 15 articles in their quest to develop a working definition of loose parts. In the article, the authors wrote their loose parts definition to include:

> Loose parts are open-ended, interactive, natural and manufactured materials that can be manipulated with limitless possibilities. Interaction with loose parts includes experimentation, exploration, and playful interactions with variables through creativity and imagination. Participants have the freedom to explore variables, combine materials, and react to complex themes and ideas that emerge. Facilitators encourage participants, make loose parts available, stimulate discovery, provide opportunities, allow for open-ended play, and prompt meaningful connections and experiences. Through loose parts exploration participants develop imagination, creativity, and collaborative skills. Process is more important than the end product fostering overall growth and development (Gull et al., 2019, p. 51).

The researchers at Johns Hopkins All Children’s Hospital shared,

> Fire is a tool and a fascinating one. It's a basic element, like earth, air, and water. Fire is energy. In fact, it's a chemical reaction happening right in front of your eyes. It needs fuel and oxygen to burn, but once it starts burning, it doesn't stop until it runs out of one or both of them. That's what makes it both valuable and dangerous. (Johns Hopkins All Children’s Hospital, n.d. para.7).

Gull suggested fire as a loose part might include: “dramatic play, candles, charcoal mark making and art, mini fires, magnifying glass fires, a fire pit, and cooking over a fire” (2023, July 27). Natural materials found in the environment can often be used during dramatic play. According to Flannigan and Dietze (2017), “It seems that when loose parts are available to children, they not only perceive the functional use of the environment or materials, but also view such items as sticks, leaves, and trees as having imaginary qualities that children can incorporate into play episodes” (p. 56). They extended this to illustrate how children used logs as a pretend fire, adding more fuel, and pretending to warm themselves by the fire.

Current Nature-based Early Childhood Educators’ Fire Safety Practices

Nature-based early childhood education (NBECE) has been growing in popularity as educators find ways and spaces to take learning and play outdoors in a variety of formats, such as using outdoor classrooms, attending farm, zoo, or aquarium schools, implementing a forest school or kinderforest approach, or spending the afternoon outside daily in a public kindergarten classroom. Of note, nature preschools have been growing exponentially in the last several years. From a recent Natural Start Alliance (a professional development group for NBECE through the North American Association for Environmental Education) survey, nature-based preschools have grown 200% from 2017,

with over 800 programs registered on their site and around 25,000 children enrolled in nature preschools yearly in the United States (Natural Start Alliance, 2023). According to Larimore (n.d.), in NBECE "programs nature is at the core of the curriculum, there is extensive daily outdoor time over the course of a school year, and teachers implement high-quality early childhood practices as well as high quality environmental education practices" (para. 1).

Some nature-based early childhood programs have taken a different approach to fire safety, embracing fire as part of their programming. Tammy Lockwood, a family childcare provider in Lansing, Michigan, uses fire with her Umbrella House program with infants through school age children. She shares the procedures and rules for having a fire, including having a burn permit, calling the fire department before a fire is lit, having a latched fence outside the fire pit, appropriate safety precautions (water, fire blanket, fire gloves), supervision, cooking from outside the fence, and extinguishing the fire (Gull, 2023, July 27).

Similarly, programs create their own regulations and/or benefit risk assessment specific to the type of risky play, the setting, and the situation. Benefit risk assessments help identify and mitigate issues that might arise in a risky play situation. In Claire Warden's book (2012), *Fascination with Fire: Charcoal*, several benefits of interacting with fire are outlined, with connections to science, expressive arts, technology, numeracy, literacy, health, and well-being, and social. Additionally, hazards are listed, along with the level of risk, precautions to take, and revised risk levels. For example, with the hazard of fire spreading, it is a medium risk. Suggested precautions include having buckets of water and sand nearby, a fire blanket handy, a nearby fire extinguisher, appropriate cooling of ashes with water or sand, designated areas for building fire with high visibility, and keeping a small and controlled fire with awareness of how high winds might affect the fire. With these precautions, the revised risk level is low. Likewise for other hazards, precautions can be taken to make the fire building interaction as safe as possible while also building risk negotiation skills in children.

The following outline of developmentally appropriate fire related activities might be explored with support for individual needs and accommodations for full inclusion. When children have not experienced these activities early on, they may start them at any age and move on from there.

- Age 2: putting out a candle with a candle snuffer, feeling the heat of a fire, pretend fire making with sticks/logs, scarf flames, and a rock fire safety circle, dramatic play cooking over pretend campfire
- Age 3: sitting around a campfire, potentially cooking over the fire, using crayons on fire heated rocks, mark making with cooled charcoal
- Age 4: striking a match, lighting a candle, preparing wood for charcoal making, making a spark with flint and steel, using charcoal for art, expanding cooking options
- Ages 5+: making small, personal fires, creating charcoal ink
- Ages 8+: making an ember bowl, creating the group fire
- Ages 10+: creating their own fire making kit, exploring additional traditional fire making options, experimenting with fire add ons, such as orange peels and sugar, trail cooking, using lightweight camp stoves. (Gull, 2023, July 27)

Fire safety in many of these situations include having a bucket of water, bucket of sand, fire gloves, fire blanket metal tongs, metal pot for refuse, clean up cloths, and hand cleaning materials.
Additionally, Gull shared,

> Fire is a living loose part and has been part of our history as a species, often selecting for those who could survive (hunting, gathering, fire, etc.) . . . By "playing around" with the elements of fire, children understand the power and capacity of this basic element. It takes experimentation and

> exploration to light and keep a fire going. We learn to be appropriate around fire by being around fire, not by eliminating it from our lives. (2023, July 27)

Research Questions

While minimal guidelines for fire safety and experimentation are available, fire making is often not embraced as risky play or as a loose parts approach in early childhood education settings. As such, the researchers attempted to understand this topic more fully through the following research questions:

- How is fire considered a loose part in early childhood settings?
- What safety and other considerations do early childhood settings use with fire play?
- What best practices can be gleaned from other early childhood educators using fire in their settings?

Methodology

Research Design

An online mixed method survey instrument was disseminated via social media platforms examining background and demographic information, use of fire as a loose part, implementation, and safety guidelines. To ensure reliability and validity and reduce bias, the survey was sent to educators throughout the United States in all types of early education settings and programs. A pilot study was conducted, receiving responses from 10 early childhood practitioners to check reliability and validity, understand how the questions worked, the length of time to complete the survey, and if any adjustments needed to be made.

The study used a convenience sampling research method to gather results and data representative of the NBECE target population. Deming (1950) defines convenience sampling as "the science and art of controlling and measuring the reliability of useful statistical information through the theory of probability" (p. 2). "Convenience Sampling is a non-probability sampling technique commonly used in both quantitative and qualitative research" (Golzar et al., n.d., p. 75). Based on the projected sample size of the NBECE and related professional development organizations that granted permission to post, the study aimed for a minimum sample size of 271 total study participants. The sample size was determined based on survey sampling sizes from Ernst et al. (2012) and the calculation of a 90% confidence level out of 181,779 possible population (Raosoft, Inc., 2004).

Selection of Participants

Participants for the study were recruited from diverse NBECE and related professional development groups that focus on nature-based early childhood education. NBECE settings might include having an outdoor classroom, being a nature-based preschool or elementary school, using a kinderforest or forest school approach in their setting, childcare with an outdoor focus, regular programming in an outdoor context, or being a family childcare provider with an emphasis on spending time outside.

An announcement and invitation to participate in the study were shared with many related professional development groups that spanned the targeted age ranges. Participants anonymously answered the research survey where they had an opportunity to reflect on policies and viewpoints on fire as a loose part and current fire safety practices in their settings. The following organizations agreed to share or allowed the researchers to share the survey with their memberships and/or contacts with NBECE settings: Natural Start Alliance, The Grove by Samara Early Learning, Loose Parts Play, Loose Parts Learning in K-3 Classrooms, Natural Start Regional Groups, Nature Inspired Teacher, Eastern Region Association of Forest and Nature Schools, Tinkergarten, American Forest Kindergarten Association, and Nature Explore/Exchange Press. To qualify for the study, participants needed to work in the United States in an early childhood setting with two to eight-year-old children, be at least 21 years of age, and spend time

outside with the children in their care. Participants had an opportunity to reflect on policies and viewpoints on fire play in early childhood settings.

Instrumentation

After receiving Institutional Review Board approval of research, the survey link was shared with the selected professional development groups. In addition, a snowball recruitment technique was utilized. The online invitation included parameters of the study, a request to share with other NBECE early childhood educators, and a link to the online survey. The flyer was distributed to the professional development groups that gave permission in 2024.

After the qualifying questions for the study, the survey gathered demographic information and asked if the participants allowed fire in their settings. In Question 16 of the survey, the researchers asked,

> For the purposes of this study, we are defining fire play as an aspect of loose parts with more of an extension of curiosity and exploration around fire whereas fire setting would be an intentional attempt to cause harm with fire. Fire play might include charcoal, dramatic play, candles, lighting a match, crafting a small fire, bonfire as community program, burning a leaf with a magnifying glass, etc. Do you allow children in your professional care or facility to experience fire play with safety parameters?

Using skip logic, similar questions were asked to those who do not and those who do allow fire play in their settings. Information was collected on fire play activities, safety parameters, impacts of fire play, fire safety rules, personal or professional concerns or issues on the topic, and considering the use of fire as a loose part and risky play. Additionally, respondents could share any open-ended comments or thoughts. Those who answered yes were also asked about fire safety with an open flame or injuries that may have happened connected to fire in their programs.

Data Collection

Data, results, and findings of participant responses, opinions, and experiences were collected using an online survey instrument. A mixed method research approach was used to gather quantitative data and qualitative responses, with no personally identifiable results collected. SurveyMonkey was the cloud-based survey tool utilized to compile and securely store information. The descriptive analysis tools within SurveyMonkey were used to guide reports of demographic information, percentages, and charts based on the quantitative data collected. Although not required, the open-ended questions allowed participants to share additional information, perspectives, and experiences associated with embracing fire as a loose part. The open-ended responses were sorted, coded, and analyzed using a narrative analysis method to evaluate findings. As a group, the researchers looked at these responses, color coded each comment for themes represented and used the analytical tools within the program to see frequency distribution of responses.

Demographics

Of the 413 total responses to the survey, two-hundred ninety qualified for the study and completed the survey. Participants worked with children ages 2-8, were at least 21 years old, work in the United States, and spend some time outside in nature with the children in their care to qualify for the study. Fifty-four were disqualified for not meeting parameters of the study or agreeing to the terms of the study. Additionally, 69 were removed from the study as they did not complete all required questions.

Of the survey respondents, 267 (92.1%) were female, 15 (5.2%) were male, 5 (1.7%) were nonbinary and three (1.0%) chose not to disclose gender. Participants from 42 states were represented, and a wide variety of ages responded to the survey, ranging from ages 21 to up to 74. Two hundred eighty-seven (99.0%) of the respondents had completed at least some college. Diverse perspectives of educators and educational settings were essential to the study. Questions 11 and 12 asked participants their role and type of settings they worked (see Table 1).

Table 1. *Type of Early Educational Setting*

Educational Setting	Number (Percentage)
	n=290 total respondents
Nature-based preschool	134 (46.2%)
Non-profit	97 (33.5%)
Private	93 (32.1%)
Other	61 (21.0%)
Forest school	57 (19.7%)
For-profit	49 (16.9%)
Family childcare	44 (15.2%)
After school programs	33 (11.4%)
Public	33 (11.4%)
Non-Formal education programs	32 (11.0%)
Experiential-based school	30 (10.3%)
Note: Respondents could choose more than one setting.	

Additionally, responses from experiential, faith-based, forest kindergarten, Head Start and state funded preschool, elementary schools, farm school, and other settings were represented in smaller quantities. Some respondents wrote in the "other" category, settings such as Reggio Emilia inspired, university lab school, nature center, short-term programming, tribal immersion, adventure playground, community group, afterschool programs, camps, outdoor schools, etc.

Participants had various roles in the early childhood settings as noted in Table 2.

Table 2. *Role of Educators Responding to Questionnaire*

Role of Educator	Number (Percentage)
	n=290 total respondents
Teacher	179 (61.7%)
Program director	88 (30.3%)
Early childhood administrator	59 (20.3%)
Teacher educator	52 (17.9%)
Family childcare provider	41 (14.1%)
Professional development instructor	36 (12.4%)
Other	35 (12.1%)
Trainer/Consultant	29 (10.0%)
Note: Respondents could choose more than one role.	

Smaller numbers of non-formal educators, assistant teachers, after school care, camp counselors, higher education professors, faculty researcher, and mental health counselors were represented. Other respondents entered roles such as owner, librarian, director, occupational therapist, mentor, outdoor curriculum coach, advocate, forest school supervisor, etc.

In addition to their role and educational setting, Question 13 asked participants how old the children are in their care with the ability to choose multiple ages between two to eight years old. Respondents worked with the following age groups:

- 142 (49.0%) 2-year-olds
- 232 (80%) 3-year-olds
- 246 (84.8%) 4-year-olds
- 237 (81.7%) 5-year-olds
- 123 (42.4%) 6-year-olds
- 92 (31.7%) 7-year-olds
- 88 (30.3%) 8-year-olds

In Question 14, participants were asked how often children in their care played outside each week, weather permitting. Participants were able to select blocks of hours ranging from 0-3 to 20+ hours per week. There was a mix of all selections with 10-15 hours being the highest choice with over 25% spending time outside.

Question 15 asked participants to describe the outdoor setting used for play and learning. Respondents could select all applicable areas and results are included in descending order below:

- Outdoor Classrooms 180 (62.1%)
- Playground 149 (51.4%)
- Unfenced Open Space 130 (44.8%)
- School Garden 119 (41.0%)
- Access to Park or Public Spaces 104 (35.9%)
- Use of the "Beyond" 84 (29.0%)
- Backyard 65 (22.4%)
- Other 57 (19.7%)
- Large Asphalt Space 36 (12.4%)
- Adventure Playground 31 (10.7%)
- Courtyard 29 (10.0%)
- Landscaping Beyond the Fence 28 (9.7%)
- Parking Lot 28 (9.7%)

Other settings included a wide variety of outdoor settings, such as wooded areas with a stream, Nature Explore outdoor classroom certification, walking trails, parks, asphalt playground, nature center, tribal lands, beach, college campus, scout camps, national park, undeveloped land, farm, etc.

In Question 16, respondents were asked if they allow fire play (including the definition for the study) in their setting using skip logic for the following sets of questions. One hundred fifty-three (52.8%) allowed fire play in their settings while 137 (47.2%) did not allow fire play. Questions 17-27 were specific to respondents who said "no" to Question 16. Questions 28-43 were for those who responded "yes" to Question 16, reported in the findings below.

Findings

Research Question: How is fire considered a loose part in early childhood settings?

Perspectives regarding fire play as a loose part came up in many responses. In Question 31, educators who allow fire play to read a quote pertaining to loose parts by Nicholson and were asked how fire is applied as a loose part in their

setting. One-hundred seventeen of the 153 (76.5%) respondents indicated that cooking was used in their educational setting, while 110 of the 153 (71.9%) embraced the use of charcoal. The same number, 110 of the 153 (71.9%) also used dramatic play props. Ninety-three out of the 153 (60.8%) of the responses revealed that they encouraged exploration of fire as a loose part, while 74 out of 153 (48.4%) supported experimentation with fire as a loose part. Additionally, one respondent wrote in additional comments, "I see fire as an important element to get to know along with air (running, feeling the wind in your face, interacting with and noticing the effects of the wind), and water with which children have several places to play." Other responses mentioned the warmth of the fire, using elements to make pretend fires, children driving the exploration, and using fire as part of ceremonies.

Respondents who allow fire play shared perspectives on fire as a loose part. In Question 42, 78 of the 102 respondents (76.5%) shared comments relating to fire as a loose part. Fourteen respondents (13.7%) wrote responses indicating fire is not a loose part. Also, 14 respondents (13.7%) made remarks that considering fire as a loose part was a new concept or idea.

Additionally in Question 42, those who did not see fire as a loose part (13.7%) mentioned that there was more oversight and less freedom for the child to explore the element of fire freely in their settings. They see fire more as a tool, resource, or skill. One mentioned, I "do not allow students to 'free play' with fire." Some mentioned the other materials (charcoal, sticks, wood, kindling, etc.) that make up fire may be loose parts, but not the actual fire. One respondent wrote, "I don't think I would. Loose parts are elements that kids are free to experiment with and use as they see fit. Kids don't have that kind of agency with fire in our program." "Children are allowed to chop kindling, play with kindling sticks, construct fire structures, and play with charcoal. They are never allowed to regard fire as something to play with." Another said, "In our program, loose parts are much less risky than tools."

Several responses (13.7%) in Question 42 mentioned fire as a loose part as a new idea. One mentioned, "I never thought about fire as a loose part before. However, it is like snow, rain or ice. We use those elements as loose parts whenever we have them available." Some also "realized I actually do a lot with fire before an actual fire." Respondents were curious and encouraged about fire as a loose part and noticed ways the children in their care used fire (or the elements to make a fire) as a loose part.

Many responses to Question 42 saw fire as a loose part yet also indicated the need to have safety parameters and build risk negotiation skills. Representative quotes on fire as a loose part are in Table 3.

Table 3. *Qualitative Comments Embracing Fire as a Loose Part from Educators who Allow Fire Play*

"Fire is as open ended as the simple stick. The stick is at once a sword, a building material, and a paddle for magic potions; so too the fire is the means of culinary metamorphosis, a destructive engine, and a center of community so powerful it often goes without saying."
"Fire can allow for explorations and experimentation. Being able to burn sticks and cook foods, make charcoal, burn leaves are all ways to pique interest and curiosity for children."
"Tool for wonder, connection, and risk assessment skills."
"Fire is useful for warmth, community, cooking, gathering, focusing, relaxing."
"We use fire for ritual purposes. Lighting Shabbat candles or Hanukkah candles. . . . Fire shows up a great deal in children's dramatic play. It is a wild element fascinating for young children and mesmerizing for all."
"Fire is interactive with other materials. It is a phenomenon on it's [sic] own. It changes other parts it is combined with. Fire as a loose part allows for the construction and deconstruction of things as other loos [sic] parts do. It is beautiful. and can de [sic] dangerous. Like knives, scissors, etc. With care it can provide a great deal of exploration, confidence, and problem solving as well as great respect for its properties."
"Fire is as dynamic as any other feature of our adventure playground, in the sense that it's not prescriptive and is full of possibility."

"It's flexible, can be used for many means, creative, productive, and powerful."
"It changes and changes other objects that interact with it."
"I see it as a critical pillar of the loose parts philosophy!"
"Fire is an unpredictable, beautiful, fascinating tool that children are naturally attracted to. It creates Instant Respect and excitement and curiosity."
"Fire acts as another loose part offered by nature in that it presents opportunities for students to interact with it based on interest, curiosity, creativity and imagination. Just like with our use of sticks, logs, rocks, cones, leaves, etc. (all nature's loose parts), the hazards of fire necessitate that we collaborate with students to define safety agreements around our engagement with it."
"Fire as a loose part might be like a wooden block that a kid drives a nail in with a stick. It's a combination of loose parts that in ways is more dangerous/risky/hazardous than the individual loose parts used to make it . . . It is a dangerous loose part in the way a roaring creek is dangerous in that immersing oneself in it is hazardous but using another object like a stick can help you approach it and play with it (safely). Broken into components, the flames can be calming and magical to watch. The charcoal is seemingly unlimited like a good loose part but also can be applied to specific types of play."
"Fire, like nature is the perfect elixir that is both stimulating and calming in the perfect ratio. Fire, like other loose parts, is something that a child or adult can just be present with and contemplate. Just as fire dances, it ignites something beautiful in the child!"

Respondents were asked about a variety of related activities they may allow their children to participate in as part of Questions 17 and 31. Participants who said they do not allow fire play, do permit dramatic play and pretend fire play with loose parts with no actual flame as part of their programming. Respondents who allow fire play permit children to engage in a wider range of fire play activities, some of which actually include a lit flame. See Table 4 for fire play activities and engagement for both "no" and "yes" study participants, grouped by having less than 20% difference between the responses.

Table 4. *Fire Play Activity Engagement Similarities*

Fire Play Activities	Do not allow fire play	Allow fire play	Percent difference
	n=137 total respondents	n=153 total respondents	
Pretending to put out a fire	55 (40.1%)	78 (51.0%)	10.9%
Pretending to blow out birthday candles	103 (75.2%)	102 (66.7%)	8.5%
Pretend cooking over a pretend fire, such as use of an unlit hibachi grill, pretend gas stove in mud kitchen, etc.	99 (72.3%)	117 (76.5%)	4.2%
Dramatic play with props, such as rocks, sticks, logs, scarves, etc.	117 (85.4%)	135 (88.2%)	2.8%
Note: Respondents could choose more than one response.			

Pretend or dramatic play are predominant in both groups, highlighted by playing "at" fire rather than having direct experiences with fire.

In Table 5, responses from Questions 17 and 31 were examined between the "no" and "yes" groups that have more than 20% differences in spread between both groups.

Table 5. *Differences in Fire Play Activities*

Fire Play Activities	Do not allow fire play	Allow fire play	Spread between columns
	n=137 total respondents	n=153 total respondents	
Adult cooking over a fire for the group	6 (4.4%)	82 (53.6%)	49.2%
Creating a fire safety circle	15 (11.0%)	92 (60.1%)	49.1%
Sitting around a campfire	40 (29.2%)	118 (77.1%)	47.9%
Putting out a fire	6 (4.4%)	79 (51.6%)	47.2%
Bonfire as part of a community program	13 (9.5%)	86 (56.2%)	46.7%
Using charcoal for mark making	40 (29.2%)	105 (68.6%)	39.4%
Making a spark with flint and steel	1 (0.7%)	55 (36.0%)	35.3%
Individual cooking over a fire	1 (0.7%)	50 (32.7%)	32%
Lighting a match or lighter	2 (1.5%)	43 (28.1%)	26.6%
Burning a leaf or other object with a magnifying glass	6 (4.4%)	46 (30.0%)	25.6%
Crafting a small fire-tin can, pie plate, or other	4 (2.9%)	43 (28.1%)	25.2%
Exploring traditional fire making options	2 (1.5%)	39 (25.5%)	24%
Using logs and sticks to create a fire without lighting it	87 (63.5%)	132 (86.3%)	22.8%
Use charcoal for artwork	54 (39.4%)	93 (60.8%)	21.4%
Note: Respondents could choose more than one response.			

The children in settings that allow fire play have a much broader set of experiences and opportunities to interact with fire and fire safety. They also have more complex and diverse strategies for fire.

Twenty percent or above of participants who allow fire play also responded: lit a candle, created charcoal ink, used candles as part of a community or memorial service, or dipped/rolled a wax candle. At smaller percentages, some also used candles/ash/incense/etc. as part of religious observations, used crayons over heated rocks, experimented with fire add ons (orange peels or sugar), cooked on the trail, made an ember bow, created a fire making kit, put out a candle with a snuffer, used a lightweight camp stove, or participated in smudging. However, the spread between those who allowed/did not allow fire play was less than 20 percent with many of the activities not happening at all or in very low numbers with those who did not allow fire play. Other responses for those who said “no” to allowing fire play included items that often-reflected responses above such as collecting sticks, using a birthday candle, and engaging with community fire safety providers. One respondent stated, “We still use Smokey Bear. Only you can stop forest fires.” One used sterno cans for making s’mores with children indoors. Another mentioned, “children dance around the sacred fires in the Plankhouse.”

Participants who allow fire play entered additional options for fire play, such as collecting materials for fire making, boiling water for tea and/or using a Kelly Kettle, storytelling around the campfire, experimenting with snow and fire, and using the fire pit as a gathering spot. Several responses included a cultural or ritual aspect such as burning paper messages, walking around the fire for a birthday, singing special songs, birthday candles, and "experiencing the warmth of a fire in a sugar shack and log cabin." Another participant shared, "We chalk the seasons on the firepit blocks and the kids sing the earth goes round the sun for birthday kids as they walk around the fire circle with a small flame."

Research Question: What safety and other considerations do early childhood settings use with fire play?

Safety was specifically asked about as part of the survey and came up frequently during the open-ended responses. Respondents were asked about traditional fire safety activities, additional fire safety opportunities, fire-related injuries, and rules to promote safety.

Questions 18 and 29 asked respondents about engagement in traditional safety fire activities (see Table 6).

Table 6. *Engagement in Traditional Fire Safety Activities*

Type of Safety Practice	Do Not Allow Fire Play	Allow Fire Play
	n=137 total respondents	n=153 total respondents
Practicing Stop, Drop and Roll	78 (56.9%)	71 (46.4%)
Watching an age-appropriate video, book, or other materials on fire safety	62 (45.3%)	43 (28.1%)
Using coloring books about safety	33 (24.1%)	21 (13.7%)
Practicing fire drills	129 (94.1%)	111 (72.6%)
Locating smoke detectors	78 (56.9%)	48 (31.4%)
Finding exit signs	91 (66.4%)	55 (36.0%)
Locating classroom meeting spot	89 (65.0%)	102 (66.7%)
Visiting with a firefighter in full protective clothing	83 (60.6%)	58 (37.9%)
Hosting a guest speaker around fire safety from community experts and agencies	49 (35.8%)	30 (19.6%)
Visiting the fire station	39 (28.5%)	19 (12.4%)
Exploring a fire truck	81 (59.1%)	46 (30.1%)
Practicing calling 911 in event of an emergency	38 (27.7%)	28 (18.3%)
None	4 (2.9%)	13 (8.5%)
Other (please specify)	3 (2.2%)	26 (17.0%)
Note: Respondents could choose more than one response.		

A few who do not allow fire play mentioned that the yearly fire inspections were part of their activities as well. Other responses from those who do allow fire play emphasized the importance of fire safety, utilizing fire inspections and fire drills to emphasize fire safety, wildfire risks, and fire procedures with one mentioning, "Whenever we encounter a fire circle in the "beyond", which is about once a week, we pretend it has a fire and practice fire safety. We don't

walk within the boundary, we don't put things into or take things out (unless you are the grown up), etc." Others use songs that include fire safety and a social story about the school's fire safety approach.

In Questions 19 and 30, respondents were asked about specific fire safety activities (see Table 7).

Table 7. *Fire Safety Activities*

Fire Safety Activities	Do Not Allow Fire Play	Allow Fire Play
	n=137 total respondents	n=153 total respondents
None	101 (73.7%)	23 (15.0%)
Practicing safety behaviors within a fire circle	13 (9.5%)	104 (68.0%)
Gradual approach to learn about practical fire safety as exposed to fire	11 (8.0%)	100 (65.4%)
Practicing how to put out a fire	9 (6.6%)	80 (52.3%)
Fire play with safety parameters	7 (5.1%)	73 (47.7%)
Creating a benefit risk analysis around fire play within your program	6 (4.3%)	67 (43.8%)
Other (please specify)	4 (2.9%)	11 (7.2%)
Note: Respondents could choose more than one response.		

In Question 36, respondents who allow fire play shared the injuries or hazards that have happened as part of fire play in their setting (see Table 8).

Table 8. *Injuries or Hazards as a Result of Fire Play*

Injury or Hazard	Number (percentage)
	n=153 total respondents
None of the above	94 (61.4%)
Eye irritation due to smoke in eyes	32 (21.9%)
Minor burn	22 (14.4%)
Cuts, splinters, scrapes	22 (14.4%)
Smoke inhalation	12 (7.8%)
Breathing problems	5 (3.3%)
Other (please specify)	4 (2.6%)
Blisters	3 (2.0%)
Injury from cooking sticks, metal, tools or fire equipment	3 (2.0%)
Clothing or hair catches fire	2 (1.3%)
Fire spread outside of designated fire area	2 (1.3%)
Eye injury due to floating embers	1 (0.7%)

Major burn	1 (0.7%)
Fatality	1 (0.7%)
Chronic respiratory issues	0 (0.0%)
Start of a wildfire	0 (0.0%)
Note: Respondents could choose more than one response.	

As noted in Table 8, most programs (61.4%) allowing fire did not report any injuries or hazards. Minor issues were noted in smaller quantities. While several recorded eye irritations, one "other" response said, "Eye irritation was momentary and fleeting." One mentioned scraped knuckles from using flint and steel and another responded some children ate food that was too warm. While one respondent noted a fatality, when looking at the open-ended responses for that individual throughout the survey, the responses were non-sensical, such as "sada", "gfds", "wqd", "gs<", "sd", with no written indicators of a fatality.

In Question 23, those who do not allow fire play could write in responses around issues or concerns regarding fire play. Environmental concerns showed up in the written responses as not having enough/adequate space in their environment for this type of activity, the location is not conducive to exploring fire, not a good curricular fit based on location, concern around spreading of fire, and fires being hazardous in high wildfire areas. One respondent wrote, "Living in an [sic] tightly urban center with fires that have fatalities, it seems very inappropriate and insensitive to families who have suffered through such tragedies."

Developmentally appropriate practices (DAP) also emerged as a theme in some written responses, as educators shared lack of knowledge of DAP and fire play, appropriateness of fire when working with 2-year-olds, concerns when working with children with developmental delays or special needs, lack of self-control at some ages, meeting the needs of mixed aged groups, and wondering whether fire play fits within DAP. One asked, "Why would an average, regular facility/program put any child at risk of being burned?!"

Over 70% of the open-ended responses to Question 23 involved safety, with most writing in "safety" and many remarking on the need for supervision (see Table 9).

Table 9. *Qualitative Safety Comments from Educators who Do Not Allow Fire Play*

"In a public school setting, I feel it begins with safety and liability concerns. But, even if allowed, we'd have issues with space, class size, instructor comfort, and manageability."
"Licensing is not comfortable with the idea. Not having a safe set up for a fire is a worry. All the what ifs"
"Fire prevention, fire safety education is allowed and encouraged Lighting fires, using fire for play is not allowed. Injury prevention is paramount when caring for other people's children. A fire pit, fire place, fire circle would require one staff member to assigned to supervise the fire at all times. Classrooms working at the state's teacher: child ratios are not staffed well enough to provide high quality education and care for all of the children in the group, so do not have enough staff to tend a fire as well."
"Fire, while an actual requirement for life on this planet; the sun comes to mind!, is not for 'play'. It can mutilate and destroy and kill. Teachers can be distracted, and accidents happen. Why would an average, regular facility/program put any child at risk of being burned?! If a child is older, and in the right program, like scouts, then sure. In a care program for children the ages one usually see in childcare/preschool, absolutely not!"
"The risk of injury is too high. Smoke is very dangerous for young children's lungs and eyes and a small burn can be very dangerous. Fire and children are both unpredictable and a risky combination."
"That a real fire is not appropriate with 20 children to watch over"
"We have issues and concerns around playing with fire, as opposed to doing Montessori work, such as science experiments, with fire. We do not allow any fire activities for children unsupervised by an adult"

Additionally, some who do not allow fire play shared concerns over parent reactions, worrying about what parents will think, families not on board, that fire interaction should be a home-based activity, and lack of supervision at home. One shared, "I believe many staff and parents would be concerned that kids would try to start fires at home. Personally, I think that if taught appropriately, it is valuable for students to understand how fire helps us too." Another responded, "We teach fire safety. Some families choose to extend fire exploration say during camping. It's a family choice."

In Question 39, environmental concerns showed up in the written responses around issues and concerns around fire play. Concerns showed up around environmental conditions, such as smoke and neighbor complaints or worries, damaging nearby fields and buildings, high risk fire areas, appropriate places for fire building, weather related concerns, changing winds, and the environmental impact of burning wood. Another shared, "witnessing a fire in a park condones fires in parks by anyone." One wanted to collaborate with the host site more to have designated areas for interaction with fire while others recognized the additional time and effort to prepare and clean up from fire related activities.

Additionally in Question 39, DAP was addressed in these open-ended responses, as some shared concerns using fire with mixed aged groups, noting younger children not as body aware, and recognizing ability is not always tied to age. One wrote, "Getting a read on children and not assuming kids of the same age will all behave the same. Adapting activities to the kid and not a specific age." Some may allow fire in mixed age groups if the younger children are not attending that day. One responded, "We have a range of ages (3-9) that commune around our fires and use "fire as loose parts." Rules and restrictions vary with es h [sic] age group, so making sure each child is handling fire safely and using fire play in developmentally appropriate ways is the main issue within our learning environment." Additionally, "The biggest issues I have faced are having enough adults to monitor both the fire and the children and ensuing children have enough executive function skills to be safe around an active fire."

Respondents to Question 39 also mentioned teacher concerns and staff training. In addition to comments around the need for teacher training and conflicting viewpoints on whether to include fire play, others shared perspectives around training, competency, confidence (see Table 10).

Table 10. *Qualitative Teacher Education Comments from Educators who Allow Fire Play*

"Fire is a valued feature of our playground so we work hard to keep it safe and do a lot of adult education around it."
"The preschool teachers are not comfortable facilitating fire play. The very limited fire play we do with the young children is facilitated by preserve teachers in a methods class and the university professor."
"So far we have only explored the use of Fire with teachers who have been adequately trained and have years of experience. We hesitate to allow newer teachers or those who have not shown extreme responsibility to practice the new skills."
"Teachers have been trained forest school fire safety."
"Teacher training and teacher confidence in fire safety with children. Many of my teachers would rather avoid fire altogether, but we have seen it be an essential piece of our forest school."
"The biggest risk or concern is in educators who are uneducated and/or unskilled/unpracticed at engaging in collaborative benefit/risk assessment with students."
"Our staff are trained on how to safely start a fire with kids. If our staff are uncomfortable with fire play, they do not have to engage in it with their students."
"The teachers have to be well-trained in building, supervising, and extinguishing fires."
"Training for staff- only 4 of our current classrooms can do fires due to staff training and staff interest."

Many responded there were no issues, with one commenting, “There are no issues!! The children love it!! Their maturity presents at a higher level when they are around fire. They love the responsibility and trust!”

More than half of the written responses to Question 39 involved safety, typically sharing concerns and the need for safety measures (see Table 11).

Table 11. *Qualitative Safety Comments from Educators who Allow Fire Play*

“We have developed strong protocols by conducting staff-wide risk/benefit analysis sessions centered on fire. We don't have issues or concerns.”
“With plenty of conversations with families around safety as well as the need for children to experiment with fire we reduce the issues. families mostly are worried about safety and starting a fire in the community.”
“Fire is a valued feature of our playground so we work hard to keep it safe and do a lot of adult education around it.”
“Mainly, we just 'practice' our fire rules several times before we ever actually build a fire. A grown-up is in charge of the fire; students are not involved in the building/feeding process. We have firm boundaries around the fire (practice our fire rules, do not allow children to run or play close to the fire, designated fire ring with designated seating area, strict attention to ratio in order for the fire builder to not be responsible for watching the children.”
“Safety of course and communication about fire play. These words together do not communicate safety of children in a childcare setting. They also intrinsically bring up fear for people.”
“When we have a fire, we want it to be safe, enjoyable, and interesting for the children and parents/ caregivers. Careful management of the risk has minimized concern.”
“Creating an environment that promotes respect for fire and safety while not creating fear.”
“There is always a concern that a child may get burned. We try to make sure that doesn't happen through a variety of safety measures, but no fire is always safer than having a fire. But we believe that risk is worth the benefits.”

A few responses had concerns around the terms fire and play together: “I am very strict with fire at my school. I would never consider it play when fire is involved. We are intentional and have a lot of structure around fire usage.” Another said, “Again I would not consider the experiences with fire to be play. Experiential-yes. Exploratory- yes. Play-no.’” and “The issue is that you’re considering this as a form of play.”

Research Question: What best practices can be gleaned from other early childhood educators using fire in their settings?

From Question 35, respondents who allow fire play shared additional fire safety habits, showing the typical precautions that programs use (see Table 12).

Table 12. *Fire Safety Habits*

Additional Fire Safety Habits	Allow Fire Play
	n=153 total respondents
Supervision of fire area	127 (83.0%)
Practice safety rules and protocol around fire	126 (82.4%)
Use walking feet near fire/no running	123 (80.4%)

Designated area for fire	122 (79.7%)
Have first aid kit available	118 (77.1%)
Use of fire safety circle	111 (72.6%)
Thoroughly put out fire	111 (72.6%)
Keep fire extinguishing equipment available, such as a bucket of water or sand, hose, fire blanket, or fire extinguisher	108 (70.6%)
Clear ground of flammable items around fire area	108 (70.6%)
Teacher/student ratio considerations	106 (69.3%)
Clear area of tripping hazards	104 (68.0%)
Shoes are always required when engaging with a lit fire	91 (59.5%)
Verify with weather services/app to see if conditions are safe for fire lighting	80 (52.3%)
Tie back hair and loose clothing	78 (51.0%)
Implementing a benefit risk analysis of your fire setting	69 (45.1%)
All municipal fire regulations are followed	61 (39.9%)
Use of protective equipment around fire, such as fire gloves or potholders	58 (37.9%)
One teacher one risk	51 (33.3%)
Verify with fire department to see if conditions are safe for fire lighting	27 (17.7%)
Have a fence around the fire pit	9 (5.9%)
Other (please specify)	20 (13.1%)
Note: Respondents could choose more than one fire safety habit.	

Ten of the 20 "other" respondents mentioned they do not use an actual flame as part of fire play. One respondent wrote, "I can't continue if it's going to be called fire play." One mentioned, "The fence is a new concept for us based on push back from local licesning [sic] around a specific interpretation of a regulation. We have been doing fires for 20+ years in out [sic] program and theis [sic] new regulation is burdensome and does not see the capable child or the ability fo [sic] the adult to act as a sheild [sic]." As noted in Table 12, best practices around fire included: supervision of the fire area, practicing safety and fire rules, using walking feet near fire, having designated areas for fire, having a first aid kit available, using a fire safety circle, thoroughly putting out the fire, having fire extinguishing materials nearby, and clearing the nearby ground of flammable materials. Additional practices are noted in Table 12.

While respondents share many reasons for allowing fire play, the largest response for allowing fire play is to build and practice safety skills. Additionally, fire play has the potential to impact 21st century and other skills. If a program desires to include open flame as part of fire play, best practices noted from programs include:

- Fire Play Activity Development—Develop a rationale for why fire play should be used in your setting.
- Safety Guidelines—Create, implement, and follow safety guidelines that address all policy, procedures, concerns. Have conversations around safety parameters and how the program meets and exceeds safety, without the elimination of flame, around fire. Do the work to have the hard conversations.
- Training—Develop training that informs, demonstrates, and evaluates the use of fire play activities for teachers and staff.

- Developmentally Appropriate Practices—Adapt fire safety to developmental needs of children.
- Benefit/Risk Assessments—Use benefit/risk assessments for the program with continual assessment of risky play in the setting.
- Parent Education—Seek parental buy-in by communicating and educating parents on the benefits of embracing fire play.
- Environmental Concerns—Understand the developmental, local, and environmental issues around fire and limit fire as needed depending on local environmental needs.

Discussion

Based on the survey responses, analysis of quantitative data, and review of the qualitative comments provided, key themes based on the three research questions were established. The researchers made recommendations that will allow further consideration and development on fire play. Although defined for the purpose of this study and included at the beginning of the survey, the term "fire play" caused confusion and concern in minimal participants. While not directly asked, according to the demographic information collected, some programs that allow fire may not be licensed, limiting access to fire play for many children. Several participants did not view fire as a loose part; however, the survey opened up possibilities and they were curious to explore it more. A more expansive view of what fire play entails and relation to risky play and application with loose parts is necessary.

Safety is of the utmost importance and a common theme throughout the survey. The respondents for both the "no" and "yes" tracks agreed that it is important to teach children about fire safety in the event of a real emergency. By having loose parts materials and activities, children can act out and practice what they do in various emergency situations. Additionally, those who allow fire play are practicing more diverse safety protocols than those who do not allow fire play. They are doing the traditional fire safety practices plus going above and beyond with practical, hands-on fire safety practices.

Recommendations for Future Studies

Although this study provides impactful information on early childhood educators' perspectives on fire play, there are many areas where further investigation would add value to embracing fire as a loose part. Recommendations for future research and studies include looking at fire as part of risky play more specifically, the tension of using fire as a tool versus loose parts, international and indigenous perspectives, regional differences, mental health concerns, air quality issues, connections to wildfires, licensing and institutional requirements, and environmental impact. Professional development could include a certification to train and demonstrate the educator can lead fire play sessions to satisfy restrictions from outside influences.

Fire is used as a tool for cooking, heating, prescribed burns for land management, and other uses worldwide. As a tool, there may be strict parameters around the safety and use of fire. However, when viewing fire as a loose part, there may be a broader interpretation of how fire might be handled by children, wondering whether fire is being used as a tool or loose part in fire play situations. Of course, safety should be paramount in both situations. Exploring the paradox between using fire as a tool or loose part could help understand this topic better.

A convenience sampling research method was used to investigate the use of fire as a loose part and different research methods to gain unique perspectives are needed. Studies that also concentrate on a certain type of early education setting or specific representation of early education providers could add value to this important topic. Although not a direct question, several of the selections, open-ended questions, and "other" responses mentioned the religious, indigenous, ritual, and community aspects of fire play. Further research in how/why fire is used in these situations would add value to diversity and equity aspects of fire. By not allowing fire play with safety parameters, most children are missing out on learning essential skills of how to interact appropriately with fire, including the needed safety skills acquired by interacting with fire in safe spaces. Equity with fire play should also be addressed in future studies.

Emotional, social, and environmental factors could influence the use of fire play in educational settings. Recent events, local community occurrences, and personal circumstances for educators, children, and parents might impact this topic. Extreme mental health situations where there might be more propensity toward fire setting need further examination.

While not thoroughly investigated in this study, rules, restrictions, licensing, and program development were factors for many educators' use of fire play in their setting. Understanding how rules and licensing impact the use of fire play is needed. A follow up study could help provide further guidance and direction.

Limitations

Additional research and future studies are necessary to add value and a deeper understanding to this significant topic. The study included a diverse mix of early childhood educators, types of education settings, and geographic locations; however, international perspectives, indigenous views, and regulators' standpoints would add value. There could be a bias due to the method of convenience sampling for the study. Those educators who do allow fire play seem to have fewer licensing restrictions, perhaps because they are in settings that do not require licensing. Also, there was a higher response rate from college/graduate school participants so further inquiry as to why and its impact on the survey results. Our survey did not explore all avenues of topics that could impact fire play, such as deliberate fire setting by individuals that should be working with mental health providers.

Conclusion

Using a convenience sampling technique, this study investigated fire as a loose part in early childhood settings. Current NBECE practices and educators' concerns around fire in early childhood settings, along with safety and other considerations for fire play were examined. As a result of this research study, recommendations and best practices for incorporating fire as a loose part in a safe way in early childhood settings were formulated. Fire play, when it is allowed, can be done safely, thoughtfully, and carefully.

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Designing a Digital Platform to Promote Experiences of Nature (EoN) in Early Childhood: A Methodological Model Derived from Action Research

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ABSTRACT

This paper presents the development of a participatory digital platform designed to promote nature-based experiences for children aged 0 to 3 years. The project responds to the growing reduction of young children's opportunities to engage with nature in their daily lives, despite the critical role such experiences play in early development. Grounded in an action research framework, this initiative integrates both operational and scientific objectives. The platform was co-created through interdisciplinary collaboration and informed by a needs assessment involving early childhood professionals and caregivers. This article details the methodological model, participatory design process, and broader implications for supporting caregivers, fostering nature engagement from infancy, and contributing to interdisciplinary research in conservation and early childhood education.

***Keywords*:** early childhood, experiences of nature, digital platform, action research

As the IPBES[1] (2019) asserts, none of the Sustainable Development Goals can be achieved without transformative changes in our societal models, which require redefining our social paradigms and relationships with nature. But how can such a shift occur in societies where direct contact with nature has become increasingly rare?

In modern Western societies, an increasing body of research highlights a growing disconnect from the natural world. Ecologist Robert Pyle (1993) coined the term "extinction of experience" to describe the gradual erosion of direct, daily interactions with nature. In this work, we choose to adopt a broad understanding of both "nature" and "experiences of nature" (see below). According to Susan Clayton and colleagues (Clayton et al., 2017), experiences of nature (EoN) involve interactions with one or more elements of the natural world, which engage cognitive, sensory, emotional, and social processes. The effects of these encounters vary based on individual characteristics, the specific type of nature involved, and the surrounding cultural context.

Yet across contexts, the extinction of such experiences has far-reaching consequences for mental and emotional health (e.g., Kellert, 2002), but also for the development of environmental concern and pro-environmental

1 Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

behaviors. Louise Chawla (1998, 1999) has further demonstrated that early and meaningful experiences of nature are strong predictors of later ecological engagement and conservation-oriented values.

In the French context, several indicators suggest that this disconnect particularly affects children. A 2023 report by the French High Council for Family, Childhood and Age (HCFEA)[2] underscores that French children spend an average of less than 10 minutes outdoors daily, with 65% of children aged 6–12 not engaging in regular outdoor physical activities, and fewer than 20% having easy access to nearby natural spaces. Plus, consequences of this disconnection are particularly pronounced during the first three years of life, a foundational period for physical, emotional, and cognitive development (e.g., Cyrulnik, 2020).

The progressive extinction of EoN results from environmental factors, such as increasing urbanization, which reduces access to green spaces, as well as social and cultural barriers (e.g., Soga & Gaston, 2016). Outdoor time is often overlooked in institutional care for young children, where priorities may focus more on hygiene and structured indoor activities (Giampino, 2016). This cultural perception, reinforced by safety concerns and time constraints, limits opportunities for free exploration in natural settings. Additionally, people may dislike being outdoors (Soga & Gaston, 2016).

Contrary to older children and adults, very young children (up to 3 years old) are most often very enthusiastic in experiencing their natural environments (Wilson & Villeneuve, 2012): they try to watch, smell, catch, taste, listen to all the stimuli that are available in their surroundings (Giampino, 2016). We posit here that experiences of nature in early childhood are spontaneous. Yet, in several societies and cultures (for instance in France), very young children are rarely left in outdoor environments (Giampino, 2016). Therefore, in order to reintegrate EoN into young children's daily lives, one key issue is to inspire and equip adult caregivers—parents and early childhood professionals.

Designing the digital Fourmis & Cie platform to encourage experiences of nature in early childhood

In this context, we built an innovative participatory and free digital platform dedicated to consulting and sharing EoN practices tailored for children aged 0 to 3. This platform, named Fourmis & Cie, has been deployed with two complementary objectives: (i) an operational objective of providing a tool to encourage professionals and parents to take young children out; (ii) a scientific goal of investigating the diversity of early childhood nature experiences (EoN), the difficulties and opportunities associated with them, and their potential consequences for children, adults, and nature. To reach the scientific objective, we transparently encouraged participants to this platform to provide specific data for scientific research, as part of an interdisciplinary PhD thesis in conservation psychology, environmental sociology, and scientific ecology.

We chose to develop a digital platform as a tool to encourage EoN because we considered it was the only medium capable of responding to these dual objectives. It enables broad participation across diverse geographic and social contexts, fosters accessibility and allows dynamic exchange of practices between caregivers and professionals. Further, the platform represents a unique opportunity to gather large-scale and structured information in this field, providing a tool that simultaneously supports daily practice and generates a longitudinal research corpus. To date, the lack of such data prevents the mapping of early childhood experiences of nature (EoN) at the national scale in France.

Though, we were concerned by the apparent paradox of using a digital device to share and document EoN; this raises questions about how such experiences can be represented, structured, and circulated through a technological medium.

The platform was launched in April 2025. This paper therefore does not present results about EoN in early childhood but rather detail the methodological framework and participatory design process to invent and design this digital

2 Haut Conseil de l'enfance, de la famille et de l'âge

platform. This methodological model seeks to capture the tensions and opportunities inherent in designing a digital platform as both support for EoN practices and a scientific research tool.

A project led by an interdisciplinary academic and operational team

The development of the platform has been part of a multidisciplinary project Sciences with Society program. The project team consisted of different partners:

- The **CESCO** (Centre d'Écologie et des Sciences de la Conservation, UMR 7204) is an interdisciplinary research laboratory affiliated with the Muséum National d'Histoire Naturelle in Paris, the CNRS, and Sorbonne University. It specializes in conservation sciences to support ecological and social transitions.
- The **CERLIS** (Centre de Recherche sur les Liens Sociaux) is a research laboratory in the humanities and social sciences, affiliated with Université Paris Cité, Université Sorbonne Nouvelle, and the CNRS in Paris (France). It conducts research on various themes such as media, work, culture, and education.
- **Label Vie** is an associative group working towards ecological transition through an innovative approach to change management. A pioneer and leader in early childhood, Label Vie created the first sustainable development label dedicated to this field in 2009 with the Ecolo Crèche® label.
- **Mosaic** is a service unit affiliated with the Muséum National d'Histoire Naturelle in Paris and Sorbonne University, specializing in the development of digital tools for citizen sciences.

Two research engineers (LB and JLB) have been recruited for the project with operational partners. They helped the project team to enable the continuous documentation of the trade-offs between scientific objectives, technical constraints, and user expectations. Particular attention was drawn to grappling with the paradox of using a digital tool to promote activities in direct contact with nature. Indeed, EoN, in all their previously discussed dimensions - sensory, collective, emotional, etc. - could be defined as experiences that resist standardization. Yet, they are structured here through a digital activity form. This raised a critical question: how is it possible to structure content using a digital writing format so that it remains accessible to all, while preserving diversity and richness of EoN?

To do this, we conducted a needs assessment phase, which included:

- five individual interviews (see *Appendix A for the interview guidelines*)
- two focus groups
- two committee meetings with early childhood experts

These sources were crucial in identifying user expectations regarding their relationship with nature, pedagogical content needs, and digital practices. All this phase along, we also organized regular meetings with the project team, including plenary meetings with all four stakeholders (CESCO, CERLIS, Label Vie, Mosaic).

Discussion

ENCOURAGING EON IN EARLY CHILDHOOD (0-3)

The platform aims to encourage EoN in early childhood primarily through peer-to-peer exchange. To achieve this, we adopted the *activity sheet format (see figure 2)*, a widely used template in early childhood education; and for the majority of participants interviewed. As a familiar and structured tool, it provides clear guidance for sharing practices online. On the platform itself the wording "activity" *(figure 1; figure 2)* was retained in the user interface (e.g., button "share an activity"), as it was the most immediately understandable wording for users.

At the same time, we are aware of the limitations associated with this choice. The activity sheet model can appear overly formal or prescriptive and may not easily capture the multiple dimensions of EoN (as cognitive, sensory, emotional, and social processes; Clayton et al., 2017). Several professionals interviewed during the needs

assessment phase preferred the term *"exploration"* emphasizing open-ended encounters without predefined objectives.

To reduce these tensions, we made specific design choices to adapt the activity sheet format so that it both meets user's habits and allows to share a wide diversity of nature experiences. It influenced key pedagogical approaches in the platform's design, as follows:

- **Providing no definition of EoN, nor educational or developmental objectives**: the platform does not impose any definition of EoN Instead, each user is invited to develop their own interpretation of EoN, fostering a wide range of personal testimonials. The platform does not include fields for developmental objectives either, as is often the case in traditional activity sheets. Similarly, the platform does not provide top-down educational content created by the project team. Instead, we advocate for a more expansive vision of nature-based learning, where knowledge arises organically through experiences and interactions. Learning about biodiversity, and, by extension, its protection, does not necessarily require formal scientific knowledge. It can rather be cultivated through emotional and collective experiences, enriched by peer-to-peer exchanges (Chawla, 1999).
- **Being open to a wide diversity of EoN**: any sensory interaction of young children with natural elements. Reported activities ranged from general ideas (e.g., "vegetable painting with spices") to more specific ones (e.g., "hiking with a baby carrier in Calanques Park"). In order to accommodate this diversity, we kept mandatory fields on the activity forms to a minimum (see figure 1), selecting them in consultation with an expert committee. This decision was made to move away conventional early childhood activity templates, allowing the platform to evolve based on user interactions after its launch. As a result, users can enrich their submissions by filling out optional fields (e.g., budget, materials, season, weather, child's age, etc.). These optional fields help users search for content more precisely, enabling better filtering through the platform's activity catalog.
- **Being open to informal EoN:** By limiting the number of mandatory fields and providing ample space for free-text fields (see figure 1), we created room for contributions that do not conform to traditional educational formats. For instance, activities such as "jumping in puddles" as mentioned by one participant during the needs assessment. This choice enables the recognition and eventually the legitimization of forms of nature's interaction that are frequently practiced informally yet rarely documented.
- **Being playful**: By valuing the diversity of practices and offering flexibility, the platform creates a "ludo-narrative space" (Ryan, 2007), where individuals can freely experiment with nature experiences that are not necessarily goal-oriented or didactic. In this context, simply being in nature becomes an immersive, playful experience, one that can be shared and explored through an activity sheet that unfolds as a personal narrative. In line with the playful dimensions of nature activities, we designed the digital platform to be playful. While the primary users are adults, the design, platform name ("*Fourmis*[3] *& Cie*"), and user journey all adopt a playful tone that aligns with early childhood themes. A gamified user journey was incorporated, especially through thematic challenges displayed on the homepage (e.g., "Submit your autumn-themed idea of activity"). Additionally, users can upload photographs to accompany each activity form. This design choice highlights the aesthetic dimension of the EoN which plays a crucial role in valuing nature-based experiences (Brady, 2016).
- **Building a community to share practices:** we prioritize the community aspect of the platform. To foster this sense of sharing, the platform introduces an innovative feature: "experience feedback" on activities submitted by other users. These feedback sections mainly consist of free-text fields, but to promote deeper engagement, we also have included prompts that encourage users to provide more thoughtful responses (e.g., What did you enjoy? What were the strengths and challenges of the activity?). The activities posted on the platform are not subject to external validation or moderation, except in cases of non-compliance with the platform's terms of use. Further, we excluded a "like" function from the platform when sharing activities on the platform. The goal was to maintain a

3 « Ants » in French

supportive environment and avoid certain pitfalls associated with social media such as competition or judgment. To further enhance inclusiveness on the platform, we will also be carefully considering the communication channels that will be used to promote it, ensuring that we reach individuals who might otherwise feel illegitimate in sharing nature-based activities.

CONTRIBUTING TO RESEARCH

Beyond its function as an educational resource, the platform also addresses a scientific objective: to generate new empirical knowledge on early childhood EoN. With this platform, we aim to document, at a national level: (i) the types of EoN reported, (ii) the conditions that enable or hinder them (cultural, institutional, material, social, etc), and (iii) the perceived outcomes for both children and caregiver's adults. To address these research questions, we designed the platform, its architecture, data fields, and user journey to support caregivers in their daily practices while simultaneously generating a structured and analyzable corpus for research.

Designing the platform as a scientific data source

To do so, we first paid particular attention to choice of terms designing nature in the platform, in order to ensure scientific accuracy and everyday language. For example, we chose not to use the term "wild", whose contradictory representations could blur communication. This decision aligns with a study by Tian, Potter, and Phelps (2023), which explored the implications of the term "wild" in public policies related to conservation. The authors highlight significant inconsistencies in how wildlife is perceived across different national contexts, which directly affect legislation on biodiversity protection and management.

As a second example, we prioritized terms that are frequently used by future users, drawing on the work of Colleony et al. (2017), who analyzed the categories and names people naturally use to describe nature in a survey conducted in Paris region, France. Their findings enabled us to balance scientific rigor with the everyday language and perceptions of users, ensuring our terminology remains both accessible and scientifically grounded.

Achieving these research objectives needs to collect metadata during platform registration. To combine these needs with the need to ensure smooth navigation, we restricted collected data to the following ones:

- Basic demographic data (age, gender, profession, etc.) to characterize the study population
- An environmental sensitivity index of the professional. Among the diversity of existing scales (Tam, 2013), we chose to use Schultz et al. (2004)'s Inclusion of Nature in Self (INS) scale, which is widely used in conservation psychology to measure the degree of an individual's identification with nature

Interrogating the platform as a medium for EoN

Addressing the research questions outlined above requires interrogating the specificity of the platform as a medium of communication and how digital technologies interact with EoN and may reshape them. More precisely, several questions will be studied: how digital technology facilitates access and interaction; its potential to expand data collection and content dissemination, but also its possible tendency to standardize information. How, from a semiotic perspective (Pédauque, 2006), are digital documents shaped, used and put into circulation to convey specific aspects of the nature experience? How is the "documentality" (Frohmann, 2012) of the platform influencing these experiences? To answer these questions, we will combine both quantitative data (e.g., user activity on the platform, number of created and shared activities) and qualitative data (e.g., analysis of free-text descriptions provided by users). Once extracted, these data will be analyzed through a comprehensive approach that integrates the cognitive, social, and emotional dimensions of nature experiences (Clayton et al., 2017).

A comparative approach with other research methodologies used in the PhD project (i.e., field observations and semi-structured interviews with adults) will help us to understand the role of digital technologies as an "environment" (Bachimont, 2007).

Interrogating the specific role of the researcher within an action-research project

Embedded within this scientific objective is a reflexive approach, whereby the researchers also examine their own role in the platform's design and implementation. Indeed, researchers associated with this project were also, and originally, the designers of the digital tool. This dual role aligns with an innovative action-research methodology, where the creation of the platform itself becomes an integral component of the research. Action research encourages a reflexive approach, prompting researchers to critically examine their own practices while striving to transform the field of study (Faury, 2023).

By actively participating in the design process, researchers position themselves not as external observers but as engaged contributors, simultaneously transforming both the object and the subject of their research. This dual role offers significant advantages, as it enables a reflexive examination of the decisions that shape the platform's design, including pedagogical principles, writing practices, documents circulation, and editing choices; yet it also raises important questions about objectivity in research (Bedessem, 2020). While acknowledging these challenges, we propose a reflexive and context-aware analysis of these conditions by thoroughly documenting the platform's design process (see above).

The reflexivity embedded in this project extends to the evaluation of the platform's impact—on both individual and collective nature experiences, the communication strategies used, and the broader societal effects. We deliberately move away from two opposing views of digital technology: seeing it either as a barrier to authentic nature experiences or as a neutral facilitator. Instead, the platform is understood as a space of mediation, where intimate and sensory interactions with nature, and "more-than-human worlds" (Searle et al., 2024), are translated into shared digital content. This process reflects the notion of "triviality" as defined by Jeanneret (2014), that is, the transformation of experiences and knowledge into forms that are communicable, reusable, and culturally appropriated. Triviality refers to the fact that cultural artifacts (such as online content for instance) do not simply circulate between social actors but are also transformed, reshaped and reinterpreted in the process, through ordinary uses and media. By analyzing how users describe and share these experiences, we gain insight into how ecological knowledge is constructed and transmitted through everyday digital practices.

Following the platform's launch, research-driven adaptations may be implemented to refine its content based on these findings. Thus, the project operates as a dynamic living laboratory, an iterative process in which research and practice continually inform and shape one another through an ongoing cycle of innovation. While this approach may challenge the traditional notion of researcher objectivity (Bedessem, 2020), it also aligns with the principles of action research, aiming to foster a distinct ethos, understand as a behavior. By encouraging specific behaviors, we hope to inspire transformative changes (IPBES, 2019) and contribute to cultivating deeper individual commitments to biodiversity conservation.

Conclusion

The Fourmis & Cie project illustrates how a participatory digital tool can simultaneously serve operational and scientific purposes. By combining the sharing of EoN through activity sheet with collection of research data, it proposes an innovative model to support caregivers by generating new empirical knowledge about early childhood experiences.

Positioning the design of digital tools at the core of scientific production, *Fourmis & Cie* opens up new perspectives for analyzing the dynamic interactions between digital platforms, users, and data. This approach raises several compelling research questions that merit further exploration: How can the complexity of nature be effectively represented through digital activity forms? What effect can a digital platform have on users' daily behaviors? How should researchers define their role in an action-research project that seeks to inspire transformative change?

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Supplementary Materials

Figure 1. Homepage

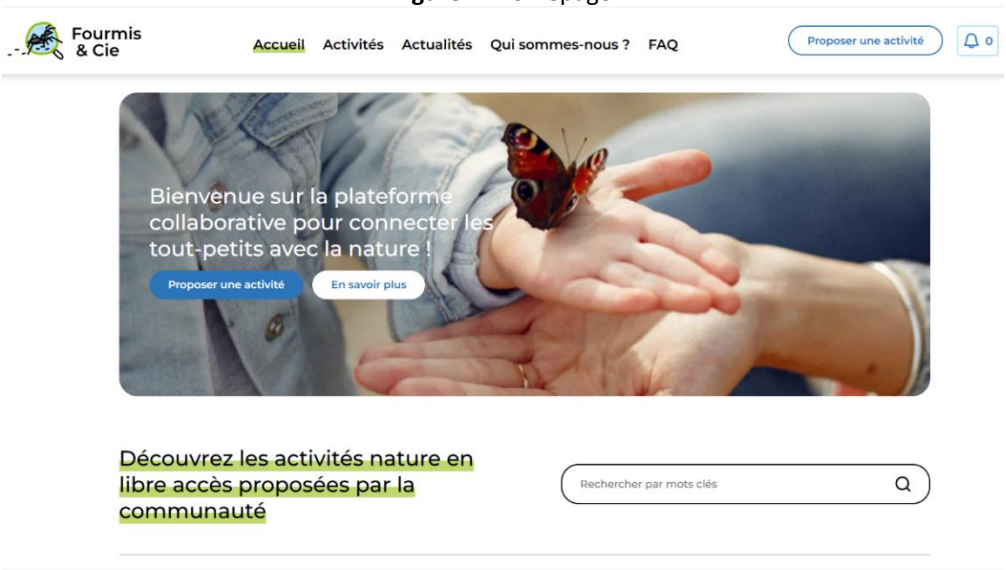
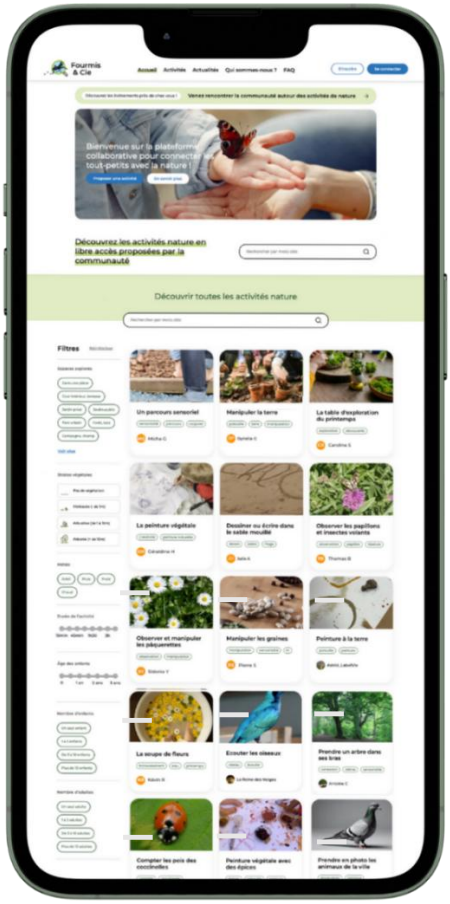


Figure 2. View of the activity's catalog (search function)



View of the activity catalog interface, illustrating the search function for exploring activities shared by caregivers and professionals.

Figure 3. Fields of the activity sheet form (Ages 0–3)

Fields	Type	Mandatory
Title, Short description, Associated keywords	Free text	Yes
Season (summer, winter, autumn, spring)	Multiple choice	No
Weather (sunny, rainy, cold, warm)	Multiple choice	No
Vegetation strata	Multiple choice	No
Activity location (indoor, garden, forest, beach, etc.)	Multiple choice	Yes
Age range (all ranges between 0 and 3 years)	Multiple choice	No
Limit on number of children (e.g., 1–3, >10 children)	Dropdown menu	No
Number of supervising adults necessary	Free text	No
Preparation time	Multiple choice	No
Activity duration	Multiple choice	No
List of necessary materials	Free text	**Yes**
List of necessary natural elements	Free text	**Yes**
Activity steps	Free text	**Yes**
Photos	Free text	No

Overview of the different fields available in the digital activity submission form on the Fourmis & Cie platform.

Appendix A - **Semi-Structured Interview Guide**

This guide was used during the needs assessment phase of the Fourmis & Cie project.

Target groups: Early childhood professionals and parents / caregivers

Interviewers: Louise Bouché ans Jérémy Lucas-Boursier

Method: The following questions were not presented to participants in this exact form—except for the definition of nature - but instead served as thematic guidelines that structured discussions.

1. Introduction, presentation and consent

After a brief introduction of the researchers and the purpose of the interview, participants are asked for their explicit consent for the conversation to be recorded and for their responses to be used in two ways:

- to inform the design and development of the Fourmis & Cie platform, ensuring it aligns with users' needs and practices.
- to contribute to the associated research project, led by Label Vie, Mosaic, CERLIS (Université Paris-Cité), and CESCO (Muséum National d'Histoire Naturelle).

Participants are informed that all data will be anonymized and may be used in internal project documentation or scientific publications. Once consent is obtained, we propose to frame the conversation with a broad definition of nature-based activities: any sensory interaction with natural elements experienced alongside young children.

2. Participant background

- Could you introduce yourself briefly?
- What is your current role/profession? How long have you been working in this field? What type of structure do you work in (type, size, location, public/private, engaged in Label Vie's network)?
- How many children are you usually responsible for? Do you care for mixed-age groups?
- How many colleagues do you usually work with?
- Could you describe a typical day (morning, lunch, afternoon)?
- Are specific moments of the day/week dedicated to structured activities (e.g., outdoor play, music, motor skills sessions)?

3. Relationship to nature

- In your current practice, do you organize or take part in nature-related activities with children? If so, what types of activities?
- How often do they take place? In what settings (indoor garden, public park, forest, etc.)?
- What is the average duration of these activities?
- How many children usually participate? Does the number affect how the activity unfolds?
- How many adults are usually involved?
- In your view, what makes a nature-based activity "successful"?
- What are the necessary conditions (equipment, organization, time, space, documentation) to implement it?
- If we define activities in nature as interactions with the living world in a broad sense—that is, with all organisms that have biological functioning, interacting both with one another and with non-living elements such as air, water, or soil—does this evoke anything in particular for you?
- Can you recall any activity that, in your opinion, significantly changed the children's (or your own) relationship with nature?

4. **Digital Practices**
    - Do you have access to digital tools at your workplace? If so, which ones, and under what conditions?
    - Do you use digital tools at home to prepare for your work or for children's activities?
    - Do you use any digital tools during outdoor activities with children?
    - Do you use digital or printed resources to plan activities (websites, apps, books, guides, etc.)?
5. **Expectations for the Platform**
    - What would you expect from a platform designed to support nature-based activities for children aged 0–3?
    - What would be the necessary conditions for you to use such a digital tool in your work (time, equipment, training, etc.)?
    - What themes or formats of activities would seem most relevant and useful for you and the children you care for?
    - How often do you think you would consult nature activity ideas?
    - How frequently do you think you could implement them with children?
6. **Participation and contribution**
    - Would you agree to share your own nature-based activities on the platform for others to use? If yes, would it be important for you to be acknowledged as the author of the activity?
    - Would you feel comfortable commenting on other users' activity sheets? What kind of feedback would you like to receive or give?
    - What criteria would be most important in choosing an activity (content, clarity, comments, rating system, etc.)?
7. **Suggested features and tools**
    - Are there any particular features or tools you think would support or encourage your use of the platform? (e.g., filters, bookmarks, personalized suggestions, activity journals, etc.). Would you be motivated, for example by monthly/weekly thematic challenges or a participation tracker?
    - Can you think of other ways to encourage users to participate and interact?
8. **Views on scientific research**
    - Would you agree to the usage data you generate on the platform being used for scientific research?
    - What comes to mind when you hear the term "scientific research"? Do you think of specific types of studies, researchers, or institutions?
    - Would you be interested in participating in a larger research project (e.g., user panels, feedback loops)?
    - Would this evoke any specific emotions, curiosity, pride, hesitation?

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Telling Stories and Taking Pictures: How children and teachers co-facilitate inquiry and reflection outdoors

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ABSTRACT

Play is crucial for early childhood development, and outdoor play fosters exploration and inquiry. Inquiry is a cyclic process of observing, forming questions, finding answers, and reflecting. Little research examines reflection in early childhood, and the current project addresses this gap by studying children's inquiry and reflection skills in an outdoor preschool. Ten children aged 3-6 years, already enrolled in the school's Afternoon Forest Adventures class, were observed twice a week interacting with each other, their teachers, and the environment. During these visits, the researcher participated in the pedagogical documentation process, reporting experiences through audio-recording children's conversations, taking photographs, and creating portfolios. Similarly, children took photos and had the opportunity to reflect on them. Detailed notes were taken alongside the photos, videos, and audio recordings by the researcher. Utilizing the Sort and Sift, Think, and Shift method, the photos were grouped into patterns identified across children's photos then cross referenced with children's verbal reflections and researcher observations of their play in a series of iterative analytic processes. Three key themes emerged from the data: 1) cameras act as inquiry and reflection tools; 2) cameras serve as an additional form of communication for young children; and 3) photos taken by children interact with affordances of the natural environment. These findings are critical for advancing early childhood education and development because they illustrate effective learning strategies driven by child-led inquiry.

Keywords**:** outdoor education, pedagogical documentation, photovoice, early childhood, Reggio Emilia-inspired, inquiry, reflection

Within early childhood education, the outdoor environment is well established as a learning environment that produces organic inquiry, discovery, and play. Naturally, learning is encouraged through the dynamic nature of outdoor learning contexts. With the ever-changing environment, children's curiosity is given the opportunity to flourish and there is always something new to be explored. The natural environment supports children's excitement, inquiries, and exploration (McClain & Vandermaas-Peeler, 2016). Centering time spent outdoors around children's inquiries opens the door for creating a curriculum that is relevant and of interest, thus maximizing the efforts in the classroom and increasing student autonomy of learning (Kumpulainen et al., 2014).

Reggio Emilia-inspired education prioritizes children's inquiries and emphasizes the importance of giving time and thought to the processes of observation, questioning, discovery, reflection, and integration (Katrein, 2016). Reflection is highlighted in education curricula as a necessary skill and something that needs to be scaffolded throughout the entire educational process (McNaughton, 2016). Yet, it is frequently left out of the learning cycle in early childhood.

Inspired by the Reggio Emilia approach, photo-documentation as a reflective tool was implemented in this study. In Reggio Emilia-inspired pedagogies, teachers take photos, share their reflections with parents and children, and then integrate reflections into the students' future projects (Katz, 1998). This is a cyclical reflective process designed to prioritize and center students' interests as well as ensure that teachers are taking their time in understanding students' curricular interests. Mirroring the use of photography as a non-verbal communication tool furthers the Reggio Emilia-supported philosophy that children are co-researchers (Edwards, 2011; Inan et al., 2010). Wang and Burris (1997) introduced this methodology and coined the term photovoice, describing a process where participants take photographs to represent their knowledge and thoughts. In an Icelandic classroom, photovoice was used as a means of expanding communication with children (Einarsdottir, 2005). Photovoice gave children autonomy and ownership over their unique thoughts and discoveries.

The present study aims to deepen understanding of the impact of introducing cameras to preschool children within the United States context. Inquiry and reflection processes, communication enhancement, and connection to peers, teachers, and nature were explored through the mosaic approach, using varying mediums to collect data (Clark & Moss, 2011). This in-depth case study of an entirely outdoor, Reggio Emilia-inspired preschool used child photos as well as researcher photos, videos, notes, and audio recordings, and children's inquiries were brought to the forefront of the cyclical process of child-centered curriculum.

The Learning Context: Outdoor Preschool

Within recent years, outdoor play has been diminishing at an alarmingly rapid rate (Bento & Dias, 2017; Moore, 2017). Sedentary lifestyles are becoming more common, childhood obesity rates are increasing, and children's desires to play outdoors are becoming obstructed by competing interests (Louv, 2008; Vilchis-Gil et al., 2015). The shift away from nature has resulted in the rise of "nature deficit disorder," a construct coined by Louv which results in diminished use of the senses, attention deficiencies, and more physical and emotional illness (Louv, 2008, p. 36). Spending unstructured time outdoors is critical, as it is associated with children's social and emotional skills, gross motor skills, and cognitive development (Dankiw et al., 2020). At preschool age, specifically, play is critical for development, and outdoor play in particular lends itself to exploration, inquiry, and opportunities for physical stimulation. Additionally, risky play is more accessible outdoors than indoors, and has been found to have numerous benefits such as, "increased physical activity, improved motor/physical competence, higher ability to assess risks and handle risk situations in an appropriate way, positive psychological outcomes, and general health" (Sandseter et al., 2021, p. 304). Currently, children are coming up short in their time spent outdoors and this can be linked to the increase of technology use in today's society. As one fourth grade boy said, "I like to play indoors better, 'cause that's where all the electrical outlets are" (Louv, 2008, p. 10).

Outdoor early childhood programs fill the deficit between increased technology use and less time spent outdoors by providing increased opportunities for children to play and learn outside, as compared to more traditional schools (Welch, 2023). Observation and discovery are encouraged by the constantly changing nature of the outdoor environment. Many outdoor education programs are centered around inquiry-based learning (McClain & Vandermaas-Peeler, 2016; Tiplady & Menter, 2021).

The research context is an outdoor preschool, The Wildflower School, inspired by the Reggio Emilia approach founded by Loris Malaguzzi, an early childhood educator. The approach was developed in Emilia Romagna, Italy, a town known for its strength in community following WWII as a part of a post-war reconstruction effort. The holistic Reggio Emilia early childhood education approach is internationally recognized as an exemplar of a high-quality social constructivist approach (Edwards et al., 2011; Inan et al., 2010). In the United States and elsewhere in the world, the term "Reggio Emilia-inspired" has come to symbolize children and teachers as co-researchers, where the child's inquiries are highly valued. As expressed in the poem *Hundred Languages of Children,* children have multiple languages, including expressive, communicative, symbolic, cognitive, ethical, metaphorical, logical, imaginative, and relational and their learning environments mirror and support children's diverse pathways of learning (New, 2007). To support this philosophy, the natural environment serves as the third educator, providing rich academic, social-emotional, and physical learning opportunities (Torquati & Ernst, 2013).

Malaguzzi believed that preschools should cater to the philosophy that children are natural researchers and should be afforded the opportunity to fulfill their curiosities and discoveries (Malaguzzi, 1996). Crafting a co-researching relationship with a child as a learning tool enables them to build a sense of ownership, autonomy, and interest with the learning topic. In the outdoor setting, environmental education can naturally occur when a child's inquiries are encouraged and prioritized. In practice, teachers are reflective about children's interactions with their environments, and use their own observations, accompanied by ongoing participation of children and parents, to guide conversation and curricula. Combining child-centered learning, the importance of the outdoors, and partnership in the classroom community results in a cyclical design of learning, prioritizing the inquiry-reflection processes of observation, questioning, discovery, reflection, and integration (Katrein, 2016).

Inquiry and Reflection Through Pedagogical Documentation

In the early stages of preschool education, children engage in the inquiry-reflection cycle often. In a preschool garden, for example, children begin the inquiry-reflection cycle through observing and questioning while digging, planting seeds, and picking plants, among other activities (Lanphear & Vandermaas-Peeler, 2017; Vandermaas-Peeler & McClain, 2015). Reflection and integration conclude this cycle through comparing methods used while planting and discussing what different plants need and why. Inquiry processes have been examined in early childhood education research, however, there is less literature examining reflection processes in young children. Thus, little is known about what reflection looks like in early childhood and how teachers guide this important step in inquiry-based learning.

To encourage and better examine reflection in early childhood, pedagogical documentation was introduced as a method for uplifting students' inquiries for further discussion (Edwards et al., 2011, p. 225). Pedagogical documentation in the early childhood context can include documenting experiences through audio-recording children's conversations, taking photographs, and creating portfolios (LeeKeenan, 1992; Merewether, 2018; Rayna & Garnier, 2021). Pedagogical documentation helps to aid educators and students in taking note of an experience as it is happening and then learning from it. When a child is presented with the opportunity to talk through their processes the capacity of understanding is broadened, and the child is shown that their thoughts and ideas are valuable and worth sharing (Green, 2015). When both the teachers and students are engaging in pedagogical documentation, it creates a medium of communication that makes the learning more tangible and easier to talk through with others (Macdonald & Hill, 2018; Rayna & Garnier, 2021). Merewhether (2018) kept a weekly, handwritten documentation book during one of her studies in a preschool. She modeled reflective practices and showed the students that they were equally valuable members of the research team. Every week the book was put on display and served as a vehicle for children to deepen their reflection process by engaging in conversations about the findings reported in the book (Merewhether, 2018). The present study is built on Merewhether's techniques by examining the important process of pedagogical documentation and including reflective practices in outdoor education in early childhood.

Research Questions

Studying inquiry and reflection in outdoor environments with preschool teachers and children as co-researchers is the central aim of this research. Specifically, the primary questions were: (1) How do cameras act as tools to facilitate the inquiry and reflection cycle, specifically in outdoor education? (2) How do children's photos serve as a communication tool? What can we learn from children's photos? (3) How do affordances in the natural environment interact with the pictures children are taking?

Method

Participants

The participants included 10 children, seven female and three male, ages 3-6, attending an entirely outdoor Reggio-Emilia inspired preschool, The Wildflower School. The students participated in an Afternoon Forest Adventures class which was observed one to two times a week from August through June. Six children also attended a separate

morning class at the school, meanwhile the other four only attended the afternoon classes which ran from 1:00 pm to 4:30 pm. Afternoon Forest Adventures Class was led by a full-time teacher and assistant director at The Wildflower School. She has an extensive background in the school system specifically working in special education classrooms, as well as educational background of the Reggio Emilia approach.

Setting

The Wildflower School has multiple outdoor spaces for students to explore, such as the lower forest, upper forest, barn, animal grazing area, and the pasture as shown in Figure 1. Most days are organized into hour-long sessions in each outdoor location where children guide their own play and discovery. Specific learning goals guide the school year and are heavily influenced by the school's values: noticing, engaging, expressing and collaborating.

Figure 1: Pasture at the Wildflower School

Procedure

The study was approved by the university Institutional Review Board. Parent permission was obtained for all participating children and the children's names reported here are pseudonyms. The first author observed the Afternoon Adventures class for an entire academic year, beginning in September 2022 and concluding in June 2023. Once to twice a week, the researcher visited the classroom and documented through audio recordings, video recordings, photos, and handwritten notes. Child-friendly cameras were introduced in February and used seven times over the following months. Children were given the opportunity to utilize the cameras parallel to their ongoing play, but only if they chose to do so. Some reflective conversations occurred immediately after the children took photos. After children took photos, the researcher would organize them into categories then bring electronic versions back to the class during the next visit. Conversations with the children were facilitated using the photos as a guide for reflection. On the final researcher visit photos that had already been organized by child and category were strung through one of the forest classrooms and audio recordings of the children's reflections were collected, as shown in Figure 2.

Figure 2. Children looking at their photos strung up in the middle of one of the forest classrooms

Coding

All seven days of children's photo-documentation were coded alongside researcher recordings and documentation using the Sort and Sift, Think, and Shift method (Maietta et al., 2021). Through a series of iterative processes, salient categories were initially identified in children's photos, video and audio recordings, and researcher observations. The photos were first grouped into patterns such as animals, selfies, other people, objects, nature, school house, camera movement, close up, looking up, looking down, upside down, and filters (on the cameras). Then, the categories were cross-referenced with researcher observations as well as children's verbal reflections collected through video and audio recordings and sorted into themes. Through repeated sorting and sifting through categories across data sources, cross-cutting themes were identified.

Results

To understand how preschool children's use of photography can impact their inquiry and reflection skills the researchers found patterns in the photos to guide conversations. These qualitative analyses produced three key themes: cameras act as inquiry and reflection tools, cameras serve as an additional form of communication for young children, and photos taken by children interact with affordances of the natural environment. Table 1 shows examples as they pertain to each key theme.

Children's Use of Digital Cameras in Outdoor Environment

Children's use of the cameras was entirely at their discretion. On any given day the children chose to use a camera, they took as many photos as they pleased, and the subjects of the photos reflected their interests. Little instructional guidance was given to encourage individual inquiry through the lens of a camera. Most pictures inherently included aspects of the natural world, due to the outdoor environment that served as the "classroom." Thus, components of nature and affordances of the natural environment appear as the primary subject of most photos. Animals were not only photographed often, but children also took a photographic interest in their peers interacting with the animals. Plants such as leaves, trees, bushes, and dirt hills were accompanied in pictures by light patterns and shadows. As weeks progressed and the children became more familiar with using the cameras, they began to angle the cameras to capture different views of their subjects from dirt-covered ground to sunny skies. Through the use of the inquiry-reflection process, children learned to utilize intentional camera movement as a technique in their photos to create a blurred effect. Lastly, the children took photos of people including themselves, their peers, and teachers. Pictures of others varied from candid shots of friends playing to posed portraits. This afforded opportunities for discussion of obtaining consent from someone before taking their picture. The teachers equipped the children with questions such as, "Can I take a picture of you?" and empowered the children to answer honestly and respectfully with phrases like, "No, not right now, I am in the middle of playing."

Table 1
Examples of the Main Themes

Themes	Examples		
Cameras act as tools in the inquiry-reflection cycle, specifically in education that centers children's interests in the design of the curriculum.	Angela, Wax Inquiry	Irene, Camera Movement	Irene, Food Pictures
Children's photos serve as a communication tool.	Nicole, Pictures of People	Angela, Interacting Through the Camera	Andrew, Non-Verbal Reflection

The pictures that children take interact with the affordances of the natural environment.	Interaction with Animals	Light and Shadows	Taking Pictures Upward

Cameras act as tools in the inquiry-reflection cycle, specifically in education that centers children's interests in the design of the curriculum

When children use photography to engage more deeply than usual with elements in the environment, they are practicing the first part of the inquiry cycle, observation. Questioning follows within conversation about the photos that the children take. Children uncover and discover new information and begin to form new inquiries and questions as a product of reflection. Integration naturally leads to the following observations and questioning to come. The following examples illustrate this process.

Angela, Wax Inquiry: The school house served as a space for bad weather days, bathroom breaks, and snack breaks. On March 22, while in the school house, Angela kept her camera around her neck as she played. Inside the school house there is a light room with many reflective materials, which Angela had been exploring. After becoming particularly interested in the ceiling, Angela made her way to the couch in the reading area to get a better look at what was above her, with her camera. As Angela used her camera, her eyes wandered to a shelf which was positioned to create a barrier to the kitchen. These shelves were always in the same place and housed the same materials. However, when Angela positioned her camera to look closer at the shelves and its contents she became increasingly interested in a box that contained un-melted soy wax beads. Photos of her observing as well as photos that Angela took are shown in Figures 3, 4, and 5, below. This inquiry sparked a full conversation with the teacher:

The researcher:	What, what is it?
Angela:	It's...Why is that bin...
The researcher:	What is it over here?
Angela:	It's in a pot.
The researcher:	Is it this?
Angela:	Yeah.
The researcher:	What's interesting about it?
Angela:	I don't know, but I just like it.
Teacher:	Do you want to come over here? You can probably reach and touch it. Oop. Be careful. What, what do you think?
Angela:	Cool.
The researcher:	Does it remind you of anything?
Angela:	Of wax.
The researcher:	Wax?
Angela:	Yeah.
The researcher:	Yeah, I think you're right. I wonder what it was used for.
Teacher:	Put your hand here, Angela. [inaudible 00:00:56] in the bucket. Do you know what this is? Soy wax to make candles.
The researcher:	Soy wax. I never heard of that.
Teacher:	To make soy candles, but it feels really cool to touch. Does that feel good?
Angela:	It tickled when you put it on my hand.
Teacher:	Yeah, it does tickle. Do you want to take a picture? Careful of your body.
Angela:	[takes picture]

Angela's curiosity about the soy wax beads was facilitated by her use of the camera. Her eyes were guided by the lens and ultimately aided her in the discovery of a new material. Every step of the inquiry and reflection process is portrayed through this interaction between Angela, her camera, and the teacher. First, Angela observed the wax beads, followed quickly by questioning what the beads were. She analyzed the shape, color, and made a guess at what they were. She reflected on what the beads felt like and what they could be used for.

Figures 3 and 4. Angela engaging with soy wax.

Figure 5. Angela's photo of the wax.

Irene, Camera Movement: Over time the children practiced reflecting on pictures through the scaffolded reflection process facilitated by the researcher. This included offering the children an opportunity to take pictures, sorting through each child's photos, and bringing them back for discussion during the next visit. After four months of this process, Irene approached the researcher with her camera while taking photos and eagerly asked to show some of the pictures she had taken that day. She showed blurred pictures, featured in Figures 6, 7, and 8 below, and said,

Irene:	I spinned and did that. It's a blob.
The researcher:	A blob? Because you spun?
Irene:	Yeah. I spinned. That was funny.

Irene's interaction with blurry photos demonstrates her active participation in the inquiry process. She observed her first blurry photo and acknowledged her inquiry by taking more. Questioning occurred through experimentation with the way that the camera's movement related to her body positioning as well as the outcome of the photo. After lots of practicing, Irene deepened her understanding through verbalization of her new photography skill, leading to integration of this knowledge into future photos.


Figures 6, 7, and 8. Irene's blurry photos.

Irene, Food Pictures: Irene frequently played by herself, often making visits to the mud kitchen. On this particular day (June 5) Irene had worn a camera around her neck while she worked on her creations. Once satisfied, Irene took many photos of her food. The same day, Irene approached the researcher with her camera to proudly show the photos she took in Figures 9, 10, and 11. She pointed out the pictures of her creations and explained what food she made as well as a story to go along with the food.

Irene:	It's a cake.
The researcher:	A cake? What-
Irene:	Actually, no, it's an egg, because of that green in the middle.
The researcher:	What kind of egg? Like a fried egg, sunny side up egg?
Irene:	It's a fried egg.
The researcher:	Nice. Oh, I see. Even closer picture.
Irene:	Yeah. So I could see the leaves better.
The researcher:	Oh, where'd it go?
Irene:	I ate it.
The researcher:	This is a cool picture.
Irene:	Yeah, that is. It's because the plate's gone. And I meant people to be so surprised that the plate's gone. Because I ate the plate.

Irene demonstrated her inquiry through taking her mud-kitchen creations one step further and capturing a photo. Within her explanation she made observations about the creations as well as reflected on what her intentions were. Additionally, she displayed metacognitive skills when she said, "And I meant people to be so surprised that the plate's gone."



Figures 9, 10, and 11. Irene's food photos.

Children's photos serve as a communication tool

In early childhood, linguistic skills are still developing, which lead to miscommunication between preschoolers and their teachers. Supplementation of communications with photographs can aid in teachers' understanding of children's interests and curiosities. The following examples demonstrate how this process can give freedom to a

child who may not feel comfortable or confident sharing with words their thoughts, feelings, or inquiries. Additionally, a child who may need extra time to transform their thoughts into words could benefit from having another tool to express what they are thinking.

Nicole, Pictures of People: Nicole is a child who frequently spent her time with the teacher or by herself. Almost half of Nicole's photos were of other people, as seen in Figure 12. The teacher provided input regarding this emerging pattern and suggested that the cameras may be a tool for Nicole to communicate her desires or to interact with her peers in a different way. The Reggio Emilia approach encourages teachers to take an observational role in children's learning. Nicole helps to expand understanding of her perception of her social environment by frequently taking photos of her peers.

Figure 12. Nicole's photo of peers.

Angela, Interacting Through the Camera: On multiple occasions, Angela took pictures of things that she had a hard time reaching or was not allowed to touch. Figure 13 is one example of an object that had boundaries placed on it. As a way of exercising patience and listening to boundaries, whether they be physical or set by the teacher, Angela found an alternative way of exploring things of interest. She took photos of these objects and reflected on this experience:

Angela:	So I took a picture of your backpack.
The researcher:	Do you remember when I brought this backpack? Which is, is that the same or different from the backpack I normally bring?
Angela:	Different.
The researcher:	Yeah. You guys were really interested in what I had on it. I told you you couldn't touch it. So what did you do instead?
Angela:	Take a picture.

Giving children an alternative option to interact with something usually off limits can present them with autonomy, empowerment, and exploration. This deepens their learning in the moment and in the future, providing them with many ways to show interest in new observations.

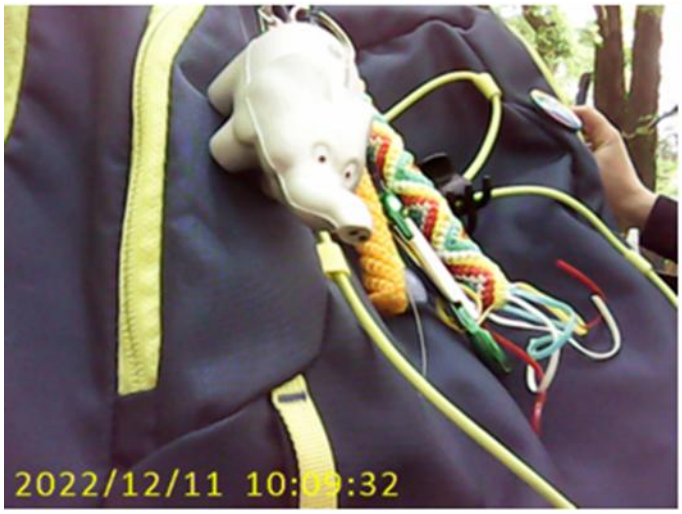


Figure 13. Researcher backpack that Angela was told was off limits to touching.

Andrew, Non-Verbal Reflection: Andrew was looking through pictures he had taken of trees at different eagles, observed how light interacted with the trees, and looked at how light interacted with other elements of the classroom, depicted in Figures 14, 15, and 16. When talking about the pictures, he used simple sentences and did not elaborate:

Andrew: I took that picture.
Sophie: You took this picture? What is this picture?
Andrew: That's mine.
Sophie: Yeah, but what is it of?
Andrew: The trees over there.
Sophie: Oh, what made you want to take a picture of the trees over there?
Andrew: Because they looked cool.
Sophie: They looked cool? Let's see what else we got. Another tree.
Andrew: Tree of somewhere there.
Sophie: Over there? And more.
Andrew: That one of those three trees are together.
Sophie: Oh. I think it's cool how they grew all together. Yeah.
Andrew: And that one is of the bench now.

Through verbal reflection, Andrew did not articulate deep thoughts on the photos he took. However, looking through his photos allows for his teacher to see where his interests may lie and potentially guide conversation and activities in the class to tend to deeper learning of those specific topics such as trees, light, and light reflection.

Figures 14, 15, and 16. Andrew's photos

The pictures that children take interact with the affordances of the natural environment

Time spent outdoors can have a positive impact on children's development of body awareness and motor skills as well as understanding how complex science and math concepts work in the world. Photography is used to add depth to the learning process for preschoolers. Through hypothesizing and testing, preschoolers build on concepts that relate to animals, such as feeding routines, taking care of a pen, and the life cycle. Children's photos show an early understanding of time and weather through pictures of light and shadow. Additionally, math concepts and metacognition are developed in real-world application by taking photos from different angles.

Interaction with Animals: On a day when significant time was spent on the farm, six children took photos. Every child who took photos included animals as the subject of some of their photos. While looking over the pictures together, Irene used reflection as a way of deepening her understanding of the farm animals. Figure 17 shows the picture of a chicken being debriefed in the conversation below.

The researcher:	What is this chicken doing?
Irene:	He is picking at the ground.
The researcher:	What do you think he's doing that for?
Irene:	I don't know, he's looking for bugs. Oh, he is looking for bugs. He's looking for bugs. That chicken's moving. So it's kind of blurry.

Figure 17. Irene's photo of a chicken.

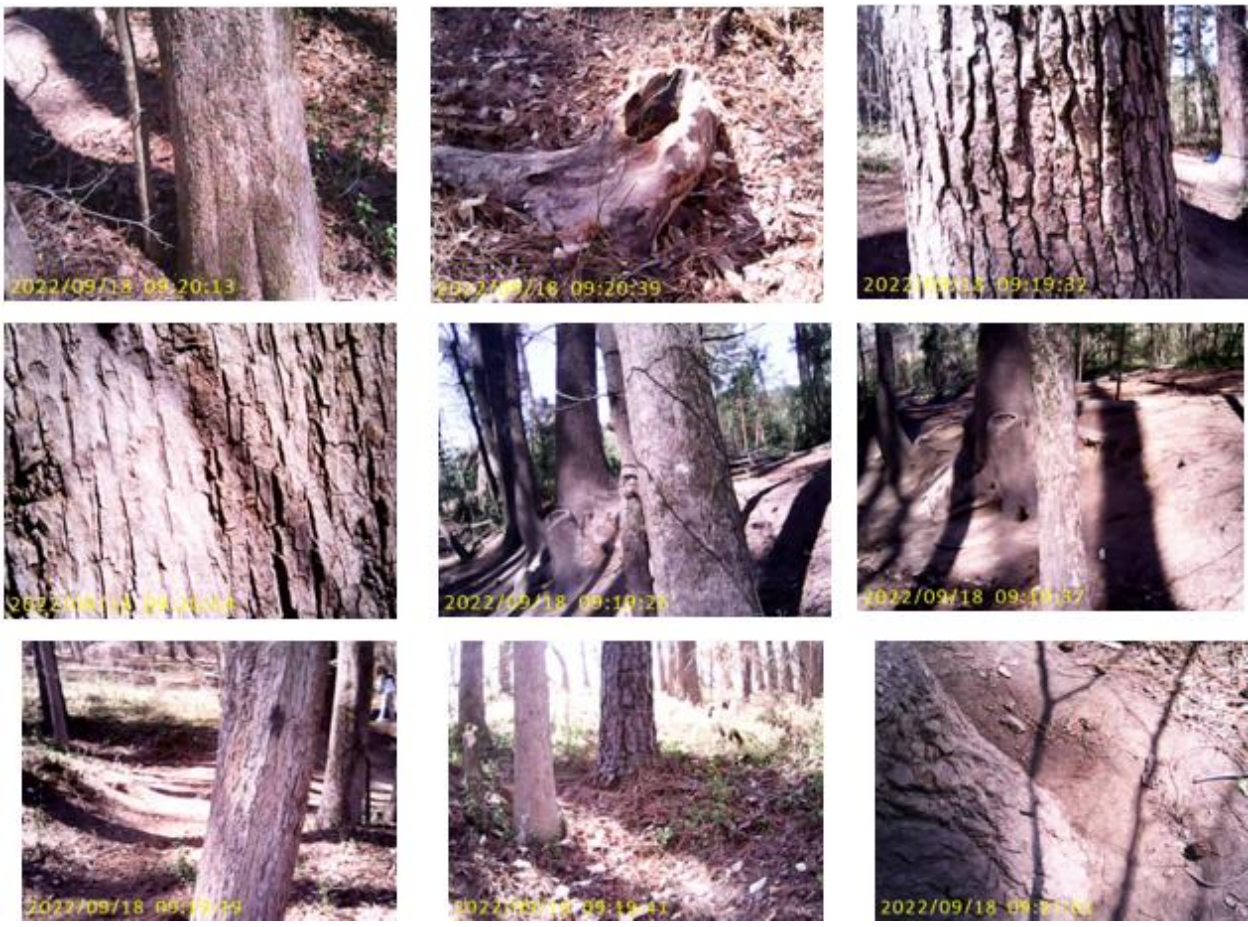
Haley reflected on the pictures she took of Nicole interacting with the animals, as shown in Figure 18.

- The researcher: So let's see. Haley, you took the most pictures of people. So we want to see those first?
- Haley: No, I want to see animals.
- The researcher: Animals? Okay.
- Haley: That's one of Nicole.
- The researcher: Nicole. What is Nicole trying to do?
- Haley: Trying to pet her. Trying to pet the chicken.

Figure 18. Haley's photo of Nicole petting the chicken.

In these two interactions Irene and Haley are building their understanding of what the farm animals, in this case chickens, do. The children were encouraged to question and create hypotheses about the chickens' behavior and then afforded an opportunity for deeper, educational conversation to be facilitated based on their photos.

Light and Shadow: Andrew took the largest number of pictures of nature compared to his peers. There is a recurring theme of light and shadows being featured, as seen in Figures 19, 20, 21, 22, 23, 24, 25, 26, and 27. This was not something that was reflected on verbally, rather Andrew showed his interest, inquiries, and observations through the use of the camera. Beginning to notice the ways that the sun interacts as a component of our natural world is so complex and has implications for understanding weather science, angles, time, etc.



Figures 19-27. Andrews photos of light and shadow in nature.

Taking pictures upward: Angela took photos looking upwards on many occasions, spread out across a couple of months. The pictures are in chronological order. Figure 28 shows a photo the researcher took of Angela taking her first upward facing photos. The following Figures, 29, 30, 31, and 32, show the photos Angela took. By the final photo she has taken a photo of her classmate who is also taking a picture of the elements above him. Her idea and understanding of the world above was evolving, and this breadth of perspective-taking became apparent to her educators through her photos.

Figure 28. Angela taking her first photo upwards.

Figures 29-32. Angela's upward photos overtime.

Discussion

The purpose of this study was to examine the intersection of the Reggio Emilia approach to education, the outdoor learning environment, and photo-documentation on the development of the inquiry-reflection process in early childhood. In particular, we investigated how cameras act as tools to facilitate the inquiry and reflection cycle, how children's photos serve as a communication tool and what we can learn from children's photos, and how affordances in the natural environment interact with the pictures children are taking. Photographs were utilized to put the children's learning experiences into context, delving beyond verbal descriptions. Einarsdottir's (2005) study on using photo-voice methodology in early childhood education explains how photo-documentation centers children's perspectives within their learning. In the afternoon adventure class studied in the present research, cameras acted as inquiry and reflection tools, served as an additional form of communication, and connected children with the affordances of the natural environment.

Existing work demonstrates that children's inquiries are centered in Reggio Emilia approaches to education and enhanced by supplemental photo documentation (Edwards et al., 2011, p. 225). This study expands on this knowledge by highlighting that children's parallel participation in photo-documentation can be an additional tool in

the communication of their inquiries and their introduction to the process of reflection. Previous research shows that outdoor schools provide accessibility to a dynamic learning environment and positive byproducts of spending more time outdoors such as development of gross motor skills, increased physical and general health, and enhanced risk assessment and management (Louv, 2008; Welch, 2023). This study showed that in addition to these previously established benefits, utilization of a camera in an outdoor context can aid in building affinity with the natural environment, encouraging child-centered approaches to education, and facilitating development of meta-cognition.

The credibility of photo-documentation as a tool for reflecting on children's inquiries in preschool classrooms was established through the pedagogies of the Reggio-Emilia approach to education (Katz, 1998). The introduction of children mirroring the use of photography to serve as an extension of communication has been modeled in Swiss and Icelandic classrooms (Butschi & Hedderich, 2021; Einarsdottir, 2005). This study incorporates the United States context into the conversation of alternative communication tools in early childhood learning environments. Additionally, this study combines the child-centered focus of photo-voice methodology and Reggio-Emilia education, with the outdoor environment, providing a unique intersection of learning approaches. The case study design of this project limited the generalizability of the study. Future research could replicate a broader participant pool aiming to uncover the implications of varying locations, demographic backgrounds, ages, types of schools, etc. However, the Wildflower School blended the pedagogies being studied harmoniously, expanding on the field's understanding of the application and implication of child-centered learning among the various contexts of outdoor education, pedagogical documentation, and Reggio-Emilia inspired education.

Photos were only taken when the researcher was present, once to twice a week, and photos are merely snapshots. Therefore, deep analysis on some photos could not be isolated when interpreting children's inquiries and reflections. Opportunity for future research could explore alternative methods of communication that span beyond verbal techniques to create a more holistic, mosaic approach to understanding children (Clark & Moss, 2011). Uncovering how preschool children express their thoughts, aids in supporting teachers working toward creating child-centered classrooms. Within the present study, the photos told the story of individual children's inquiry-reflection cycle through demonstration of observation (e.g., taking the initial photo), questioning and discovery (e.g., taking subsequent photos), reflection (e.g., looking back at photos and talking through processes, observation, and/or questions), and integration (taking more pictures extending new knowledge and understanding), thus, the entire cycle of inquiry (Katrein, 2016). Analyzing children's photos allowed for deeper insight on children's inquiries beyond standard communication. Incorporating children into the process of analysis by encouraging conversation on photos from earlier in the day, week, or month further engaged the child as the co-researcher and uplifted their interpretations within the study (Green, 2015).

Early childhood classrooms can adapt photo-voice methodology by making cameras readily available for children to use whenever they please. Modeling interaction with the inquiry cycle through the use of cameras can foster teacher-student communications (Merewhether, 2018). Additionally, children’s inquiries are encouraged when the teachers acknowledge their photo-documentation process. This can encourage autonomy for the child while fostering a learning environment efficient for growth and development that is responsive to the child's interests (Macdonald & Hill, 2018; Rayna & Garnier, 2021).

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Exploring Preschoolers' Nature Connection: A Comparative Study of a Zoo and Urban School Settings

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ABSTRACT

Understanding the connection to nature (C2N) in early childhood is vital for fostering long-term environmental stewardship. This study examines C2N among preschoolers from distinct educational backgrounds: a zoo-based school (Z School) offering extensive outdoor learning and a more conventional urban school (U School). The research aims to discern how these educational settings affect the children's natural affinity. Participants included 24 preschoolers from both schools. A Games Assessment Tool (MacKeen and Wright, 2020) that uses interactive games to probe the children's ecological perceptions and considers various dimensions of environmental understanding was used to evaluate environmental sensitivity, awareness, and preferences. Participants were tested in the fall and then again in the spring. Initial findings revealed that Z School students exhibited greater environmental awareness, while U School children showed increased environmental sensitivity. A significant observation was the anthropomorphism of inanimate objects by the children and a hesitancy towards forest play. The study highlights the significance of educational environments in shaping children's C2N. It indicates that active engagement with nature across different seasons and within various cultural and geographical contexts is essential for reinforcing a robust C2N. Additionally, the research underscores the importance of reshaping children's perceptions and attitudes toward nature to bolster their environmental understanding and preferences.

Keywords**:** preschoolers, nature connection, connection to nature (C2N), environmental education, early childhood development, comparative study, zoo school, urban school, seasonal variability, environmental attitudes

Scholarly research emphasizes the importance of early exposure to and immersion in nature for children's development, helping foster positive physical and mental health. For example, increased direct contact with nature enhances children's cognitive, attitudinal, emotional, and physical development (Driessnack, 2009; Giusti et al., 2014; Bratman et al., 2015). However, children typically experience limited interaction with the natural world from a young age (David Suzuki Foundation, 2012). Starting as early as preschool, educational settings can restrict the breadth and depth of children's encounters with nature due to factors such as limited access to green spaces and the educational strategies employed (Matz et al., 2019; Giusti et al., 2014; MacKeen et al., 2022). The implications

of reduced contact with nature are significant for fostering a culture of sustainability, as research consistently shows that children's connection to nature (sometimes referred to in the literature as 'bioaffinity' or 'C2N') is cultivated by both indoor and outdoor learning experiences (Omidvar et al., 2019; MacKeen & Wright, 2020). These early experiences are pivotal in the development of pro-environmental attitudes and decision-making (Chipeniuk, 1995; Ewert, Place & Sibthorp, 2005; Rickinson, 2001) and increasing the probability of conservation behaviours and attitudes as adults (Zhang, Goodale & Chen, 2014).

Within the literature, there are many ways of understanding an individual's C2N, including emotional connection (Mayer & Frantz, 2024), an appreciation and understanding of the interconnectedness between humans and other living organisms (Nisbet et al., 2009), a psychological love or attachment for all living things (Cho & Lee, 2018), and a general love for nature (Wilson, 1984). Our study is inspired by these conceptualizations of C2n and broadly defines the term as the degree to which an individual is both emotionally and attitudinally connected to nature.

Educational methodologies, like the Reggio Emilia approach, are designed to augment children's engagement with nature and integrate morepurposeful and intensive nature experiences into preschools' curriculums (Ärlemalm-Hagsér & Sandberg, 2017; Barratt Hacking, Barratt & Scott, 2007). The Reggio-Emilia method is an internationally renowned approach to early childhood environmental education and considered an integrated curriculum that provides children with various nature-related experiences during preschool life (Chartier & Geneix, 2007; Vandermaas, McClain & Fair, 2017). In research conducted by Omidvar et al. (2019), the impact of a Reggio Emilia-influenced curriculum on preschoolers' cognitive, emotional, and attitudinal relationships with nature was assessed using a variant of the Games Testing instrument, initially developed by Giusti et al. in 2014 that was designed to measure bioaffinity in Swedish pre-school children. Findings indicated that despite the Reggio Emilia-inspired curriculum providing more nature-related activities than the Canadian national average, the children's bond with nature was not as strong as anticipated, and the childrens bioaffinity scores were lower than hypothesized (Omidvar et al., 2019). This outcome prompted further investigation into whether the influence of the school's curriculum on children's connection to nature was negligible or if the assessment tool was inadequate for measuring such a connection. To address this, MacKeen and Wright (2020) and Mackeen et al. (2022) refined the assessment tool in consultation with experts and the developmental psychology literature and then conducted psychometric validity and reliability testing to develop an enhanced instrument that can be confidently used with preschool children.

This paper presents a study conducted in collaboration with the Saint Louis Zoo and the Dalhousie University Education for Sustainability Research Group, where the MacKeen and Wright (2020) refined tool was employed to assess the nature-related engagement of two groups of preschoolers in a new geographic setting: a nature-focused zoo school and a conventional urban preschool. The study aimed to evaluate and compare the extent of the children's variations in connection to nature between these two educational environments.

The Study Context and Methods

The Saint Louis Zoo hosts a unique preschool program for children aged three to five, situated within the Zoo's expansive grounds. This nature-based preschool dedicates at least half of its class time to outdoor activities, particularly for the older children, who regularly engage in the diverse ecosystems of the 1,300-acre Forest Park. With its focus on conservation, the Zoo aims to ensure that its educational programs nurture a more profound commitment to wildlife and environmental advocacy. The preschool's curriculum has been specifically designed with these objectives in mind, prompting an interest in assessing the effectiveness of their educational strategies.

Zoo Preschool (Z School) at Saint Louis Zoo embraces the Reggio Emilia approach, championing outdoor experiential learning. (For comparison purposes, each preschool is referred to by an initial. However, IRB approval included the use of Saint Louis Zoo Preschool as a named entity.) Classes meet from September to May for four hours each day; Two- and three-year-olds meet on Tuesdays and Thursdays, and the four-and five-year-old class meets on Mondays, Wednesdays, and Fridays. This older class is the subject of the current study. On Mondays and Wednesdays, the Zoo's facilities become a dynamic classroom, with students venturing out of the classroom daily to see animals in their Zoo habitats as well as explore the natural spaces of the grounds. "Forest Fridays" find them outdoors for their entire 4-hour session, engaging in child-led nature play punctuated with snack times and occasional teacher-led

stories or crafts in Forest Park. This unique setup was designed to foster development of empathy and connection with nature in these early learners.

The chosen comparison preschool called "U School" (name withheld per IRB) was selected for its many similarities to Z School, with the exception of immersive outdoor free play in nature. U School is located near the Zoo and is similar to the Z School in its private operation and commitment to the Reggio-Emilia educational philosophy. In fact, many parents consider both Zoo Preschool and U School when choosing an option for their child. Further, this institution echoes a similar ethos with play-centric, age-appropriate learning experiences. U School also offers one four-and five-year-old preschool class. However, it is a larger, stand-alone facility that offers full-day services for its students, including day care for children ages birth to two and preschool for threes and fours. The "Cardinals," U School's equivalent age group, attend preschool five days a week for eight hours each, with extended daycare options. Their outdoor engagement differs, with approximately two hours daily in a designated play area by the school or local park playgrounds, which is equipped with nature-inspired amenities like garden beds and a mud kitchen, alongside structured play equipment and biking space.

This study focuses on contrasting the impact of Zoo Preschool's extensive outdoor and nature play opportunities with the more traditional outdoor play structure at U School to gauge whether there is a correlation between these differing pedagogical approaches to schooling and the children's connection with the natural world. While the team hypothesized that the Zoo school participants would have greater C2n based on a curriculum that intentionally focuses on nature and outdoor experiences, the study was designed, and the researchers conducted themselves in testing so that these presuppositions would not impact the testing of the participants.

Study Sample

Participants were recruited from the four-and five-year old classes at each school. This process involved communicating the study details to parents and obtaining IRB consent from each student's parents. Students were asked to participate in the games on the day of the assessment. The study sample includes only students who had parental consent and assented to participate in both sessions of the games assessment. From the Z School, eleven students from the "Grizzlies" class joined the research, ranging in age from 3.5 to 5 years (average age of 4.68 years). (Note: the 3.5-year-old child was an exceptional admit to the class that is typically reserved for children already aged four by the start of school.) The gender distribution among these participants included seven males and four females. The U School contributed thirteen "Cardinals" to the study. The ages of these participants spanned from 4.25 to 5 years (average age of 4.67 years), distributed between seven male and six female students. Results of a parent survey yielded no significant differences in SES or parental environmental attitudes and beliefs.

Procedures

To evaluate the children's connection to nature, we employed the Games Assessment Tool developed by MacKeen and Wright (2020), conducting the games with students in the fall of 2022 and then again in the spring of 2023. While a number of C2N measurement tools exist, the MacKeen and Wright (2022) tool was chosen because it is specifically designed for young children and is the only current tool that has been psychometrically validated. In 2022, MacKeen et al. established the validity and reliability of the testing tool. The validity results indicated that further modification was necessary to clarify the foundational concepts used in the tool. Once the additional modifications were complete, reliability results showcased that this version of the environmental knowledge and connection to nature instrument produces representative, generalizable and trustworthy results. More specifically, five of the six games met adequate or excellent internal consistency: the degree to which the items in a test adequately measure the targeted concepts (MacKeen et al., 2022; Henson, 2001; Ponterotto & Ruckdeschel, 2007). This validated version of the tool was used to complete the assessments for this study.

In both the spring and fall, the assessments occurred over several days during times teachers designated the least disruptive. Researchers asked each student whether they would like to play a few games, and those assenting proceeded with the activities in a designated common area adjacent to the children's regular classrooms to maintain a consistent and comfortable environment. Each assessment session lasted about 20 minutes and was administered

by two researchers: one interacted directly with the child, administering the games, while the other recorded scores and observations. While the intent was to complete the series of assessments in one sitting, children were informed they could take a break or stop at any time. Several participants did choose to stop and return to classroom activities. Those children were asked again to participate another day, and some of them continued and finished the assessment in a second session. Only children who completed the assessments in the fall were asked to participate in the spring session. All children included in this analysis completed both fall and spring assessments.:. For accuracy and accountability, each session was audio-recorded, allowing checks for accuracy of recorded responses. Alphanumeric participant codes (i.e., Z1, U1, etc.) were used on the score sheets to maintain the integrity and confidentiality of the data. This process not only preserved the anonymity of the participants but also allowed for an unbiased assessment of the results.

The Testing Tool

The study used a geographically adapted version of the game-based assessment tool crafted by MacKeen *et al.* (2022) to measure the children's connection with nature[1]. This instrument is divided into three sections that explore various dimensions of the children's environmental understanding: environmental sensitivity, environmental awareness, and environmental preference, employing two interactive games in each category. Each of these sections and their games are described below:

Testing for Environmental Sensitivity

Environmental sensitivity refers to one's feelings toward nature, including empathy and concern for the health and well-being of the environment (Giusti, 2012; MacKeen et al., 2022). This section is designed to understand the children's empathetic outlook towards nature.

- The first game, a sorting activity, involves categorizing cut-out images of both animate and inanimate objects. The children discern whether these items can experience harm or feelings, allocating their answers to "yes" or "no" bins, thus yielding binary outcomes.
- The second game employs emotive decision-making, where children are presented with a series of environmental scenarios via photographs. They assign cut-out emoticons of happy or sad faces to these images based on their perceptions of positive or negative environmental actions, such as the act of watering plants versus the occurrence of water pollution, also resulting in binary outcomes of "happy" or "sad."

Testing for Environmental Awareness

Environmental awareness encompasses a knowledge and perception-based understanding of the environment and its functions, such as ecosystem services and human behaviours and their impacts on nature (Giusti, 2012; Mackeen et al., 2022). This section evaluates the children's cognitive grasp of ecological systems and their processes.

- In a matching game, children associate cut-out images with photos representing various ecosystem services on a game board, like linking timber to a picnic table. This exercise offers multiple-choice responses and is analyzed particularly for the choices involving money and vehicles, categorizing them as correct or incorrect matches.
- A two-part game further explores this domain. The initial phase prompts the children to describe their understanding of various forms of pollution and deforestation, generating qualitative, open-ended responses. Following this, a sorting task asks them to consider if these pollutants could harm themselves, animals, vehicles, people, or forests, leading to binary "yes" or "no" answers.

[1] See https://cdn.dal.ca/content/dam/dalhousie/pdf/sites/esrg/ModifiedTool_2021.pdf for copy of tool

Testing for Environmental Preferences

Environmental preferences refer to one's positive or negative feelings towards their surrounding environments, such as being afraid of the ocean or enjoying a neighbourhood park (MacKeen et al., 2022). The final section delves into the children's personal preferences and comfort levels with different natural settings.

- The first game involves a discussion board with images depicting various settings like a playground, indoors, or a forest. Children express their favourite places to play and where they feel most secure, providing qualitative feedback.
- The second game reverses the inquiry, asking them to indicate places they least prefer to play or feel unsafe, also yielding open-ended qualitative responses.

This nuanced methodology aims to capture a spectrum of the children's environmental consciousness, from their intuitive feelings to their informed knowledge and personal preferences, offering a comprehensive view of their relationship with the natural world.

Analysis

Data was gathered in the fall of 2022 and spring of 2023 using scoresheets, which were then systematically transcribed into an Excel spreadsheet to streamline the analysis process. To ensure privacy, each participant was ascribed a unique code that anonymized their identity. The quantitative data derived from sections one and two of the assessment were explored through descriptive statistical methods, as outlined by MacKeen & Wright (2020). Measures of central tendency were employed to discern the average responses within each game, while measures of dispersion were utilized to examine the range and distribution of the data, providing insights into the variability among participants (Payls & Atchison, 2014).

For the qualitative data in sections two and three, an inductive analysis was conducted to uncover patterns and themes, allowing for a rich interpretation of the children's verbal and decision-making responses.

These analytical approaches were uniformly applied to the Z School and U School datasets. After the analysis, the results from each institution were juxtaposed within the same seasons (fall and spring) and longitudinally across the two seasons to capture any developmental shifts or trends over time. This comparison aimed to shed light on the children's environmental understanding and preferences over the academic year.

Results

This results section synthesizes the findings from our research, analysing game data gathered during two distinct periods: fall 2022 and spring 2023. We present a comparative analysis of the outcomes from Games 1A, 1B, 2A, and 2B, followed by an in-depth examination of two primary areas:

1. Specific Question Outcomes: Detailed insights from the responses to questions within the games.
2. Connection to Nature (C2N) Metrics: Evaluation of the study participants' C2N scores and average C2N scores for each participating school.

Subsequently, we explore the results from Games 3A and 3B, which illuminates the participants' preferences. A key aspect of our analysis is the comparative evaluation between two educational institutions: Z School and U School. This comparative lens extends to an analysis of the overall trends observed between the fall and spring data sets.

Fall Results

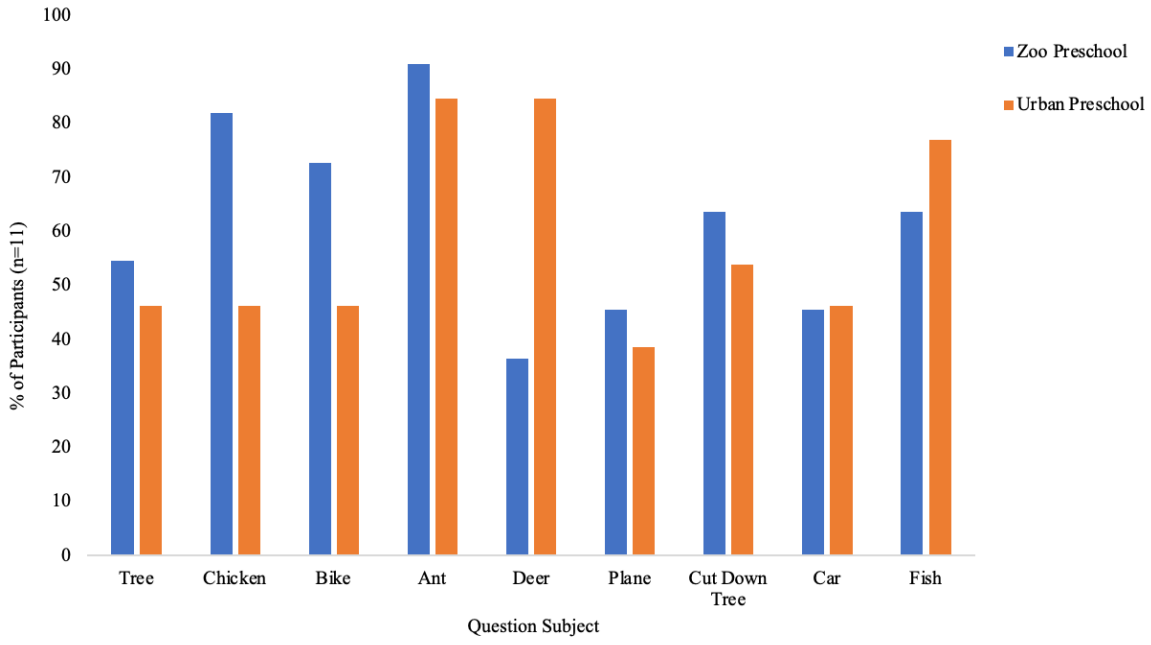
Game 1—Environmental Sensitivity

Game 1A asked participants to determine whether various objects (both animate and inanimate) had the capacity to feel pain. Game 1B involved participants assigning either a happy or a sad face to pictures of various environmental situations (i.e. watering a plant, smoke in the air). The scores associated with the individual questions varied between schools and the objects participants were asked to consider. When it came to the more natural objects (e.g., tree, fish, ant, deer), connection to nature (C2N) (i.e. participants answering "yes" to an object being able to feel pain) was moderate to high. A notable exception was that of the Z School, whose participants exhibited a low connection to specific components of the game, such as the picture of a deer, with only 36.4% of students answering correctly (i.e. stating deer could feel pain) (Figure 1). Alternatively, one of the U School's highest scores was on the deer question, with 84.6% of students answering correctly, suggesting a strong C2N through the image of the deer. The Z School and the U School scored the highest on the ant question, with 90.9% and 84.6% of students, respectively, showing C2N through this image (Figure 1).

Equally as interesting to the C2N scores associated with natural objects is the participants' responses to inanimate objects (e.g. plane, bike, car), with only 45.5% of the students answering correctly, meaning 54.5% felt these objects could feel pain. It is also important to note that 64% of Z School students and 54% of U School students asserted that a cut down tree cannot feel pain, leaving 36% and 46% believing it can feel pain. When considering the cut down tree, our team evaluated the answer of "yes- a cut down tree can feel pain" as not being connected to nature. However, the team could consider this in future iterations of the game's testing, as children may have a more nuanced way of thinking about this once living object.

Figure 1

Zoo Preschool and Urban Preschool participants' (n=11) answers during Fall testing to Game 1A about environmental sensitivity: “Can a (X) get hurt or feel an owie?”



In Game 1B, when pictorial emoticons were matched with positive and negative environmental actions, C2N was quite high. The lowest score for a question amongst both schools was 72.7%. The Z School did not do particularly better than the U School on either the clean and positive questions (i.e. watering plants, planting a tree, cleaning up) or the negative and dirty questions (i.e. plastic on the ground, cutting down trees). Z School students answered the watering plants, dirty ground, and cleaning up questions the best, with 100% of students displaying high C2N. The watering plants question was also the highest C2N amongst the U School students, and the dirty water question,

with 92.3% of students answering them correctly. However, U School students did tend to achieve higher C2N when asked questions associated with a positive and clean environment.

Participant Results and Class Averages: In terms of the participant scores and class averages, both the Z School and U School scored very similarly for Game 1A, exhibiting a moderate C2N with overall averages of 61.6% and 61.5%. In Game 1B, both schools displayed a high C2N, but U School scored 8% higher than Z School with a score of 83.8%, resulting in them achieving a higher overall score of 4% for environmental sensitivity.

Game 2—Environmental Awareness

Game 2A provided students with two sets of pictures. Set 1 included pictures of objects (e.g. a carton of milk, a wool hat, etc.), and Set 2 showed images of sources needed to produce the products (e.g. a cow, money, etc.). Participants were asked to match items from Set 1 with Set 2. Game 2B presented students with images of negative environmental scenarios (e.g. air pollution, cutting down trees) and pictures of different entities that could potentially be impacted by the environmental scenarios (e.g. animal, car, forest, you). Participants were asked whether the entity could be hurt by each of the negative environmental scenarios (i.e. Can a forest be hurt by air pollution? Can you be hurt by air pollution?). Results from both games are presented in terms of scores on the individual questions and scores of the participants and, therefore, the class averages.

The Z School's C2N exhibited in game 2A was relatively low to moderate, with a few outliers with high scores. The students scored highest on the car questions for all environmental scenarios in Game 2B except for cutting down trees, where the car question had the lowest score. Other than this, there were no questions in Game 2B that Z School students did consistently poor or well on. Alternatively, U School students showed a higher connection to the animate objects (i.e. people, animal, forest) as the car question was the worst (more students stated negative environmental situations could hurt the car) across all four sections, showing a lower connection to the inanimate object.

Participant Results and Class Averages: Both schools displayed a moderate C2N across Game 2A and 2B and, therefore, their overall scores for environmental awareness as the scores fell within the 50%-65% range. Z School did 10.3% better than U School in Game 2A, averaging 61.2%. Alternatively, U School did 2.8% better than Z School in Game 2B, averaging 52.3%. Overall, Z School scored higher in the environmental awareness category, with an overall class average of 55.4%. In comparison, U School students averaged 51.6%, but neither school exemplified a strong sense of environmental awareness.

Game 3—Environmental Preferences

Game 3A assessed participant preference by providing images of various settings (i.e. the playground, forest, indoors) and asking where students play the most, where they like best to play, and where they feel the safest to play. Game 3B was the inverse of this, asking students to choose where they play the least, where they do not like to play, and where they feel the least safe to play. The results are assessed differently from the other games as this question cannot be broken down into right and wrong answers.

Among the Z School participants in Game 3A, none stated that the forest was where they played the most or where they felt the safest. However, when asked where they preferred to play, participants chose the outdoor settings, as 18.2% stated they liked the forest, 9.09% preferred a farm or backyard, and 63.6% preferred the playground (Figure 3). This left 0% of students choosing to play in an indoor setting. U School students exhibit a very high connection to a playground setting as it was the most selected answer over all three questions in Game 3A. The second most popular answer amongst U School students was inside. The more natural outdoor settings such as farms, forests, and backyards were rarely selected across all three questions, revealing U School's low connection and preferences for such settings (Figure 2).

In Game 3B, the street was the most common answer, with Z School participants across all three questions of where they play the least, do not like to play, and do not feel safe, with the forest being the second most recorded answer.

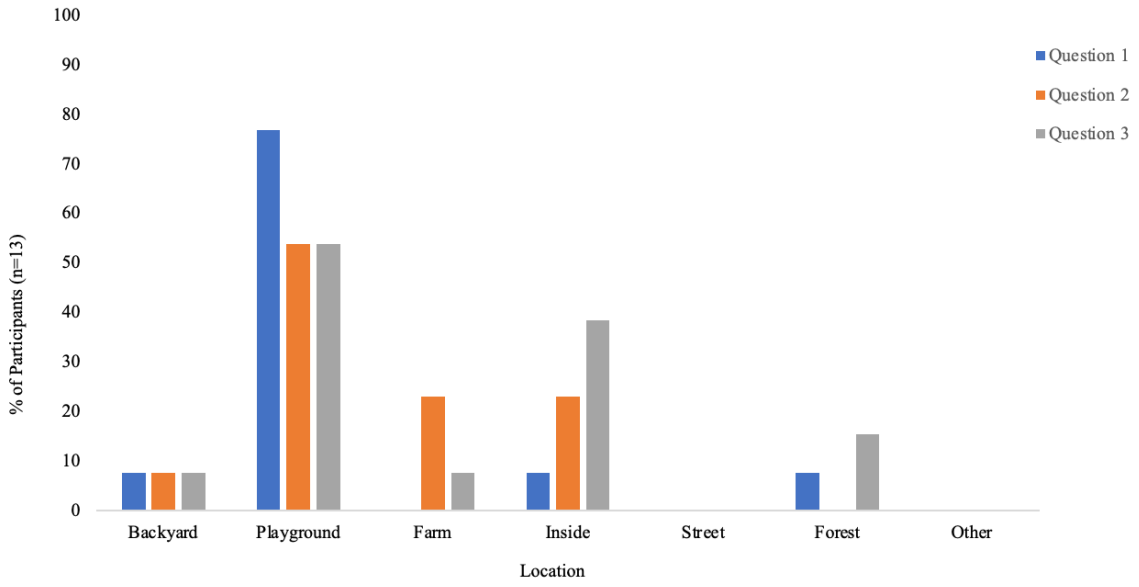
All other settings received low selections from students, if any at all, highlighting a low connection to the street and forest, most notably. For the areas where students do not play, answers were spread relatively evenly over the various settings. However, most U School participants, 46.2%, stated that the forest was their least favourite place to play, while the street and farm were among the other least liked settings. As for where students feel the least safe, the street was overwhelmingly the most recorded answer.

Spring Results

Game 1—Environmental Sensitivity

For Game 1A, the Z School continued to do better on the questions involving animate objects, while questions involving bikes, cars, and planes scored relatively low. Z School students demonstrated a stronger connection to trees compared to their fall results, with 100% of students answering this question correctly, stating that trees could feel pain. The U School exhibited the opposite, with only 53.9% of students having a connection to trees, making it one of their worst. However, U School students demonstrated a strong connection to deer and ants, with these objects having the highest C2N during both fall and spring data collection periods. The car question continued to score low for Z School and U School, as only 36.4% and 53.9% of students stated that cars could not feel pain, respectively. In Game 1B, Z School students showed an observably higher C2N when asked about positive acts towards the environment, including watering plants and planting a tree. Every one of these questions had 90.9% of students showing a C2N, with the highest connection observed among the negative and dirty questions being 72.7% of students. There was no such pattern within the U School data as connection strength varied from scenario to scenario.

Figure 2
Urban Preschool participants' (n=13) answers during Fall testing to their environmental preferences in Game 3A: "Where do you play most (Q1), like to play (Q2), feel most safe playing (Q3)?"



Participant Results and Class Averages: As for the participant results and associated averages, there were observable differences between the fall and spring data within each of the schools and between the two schools. The Z School's average, and therefore C2N, increased by 14.2% from fall to spring to 75.8% C2N for Game 1A (9.1% higher than U School's average), with both schools displaying a moderately high C2N for this game. Game 1B produced much different results as the U School average increased by 7% from fall to spring, making it 17.8% higher than the Z School spring average. This indicates that U School's C2N was notably higher than Z School's in Game 1B. When considering

the overall results (i.e. combining 1A and 1B scores) for environmental sensitivity, the U School scored 4.4% higher than the Z School, keeping consistent with the results of the fall data that showed U School possesses a higher environmental sensitivity.

Game 2—Environmental Awareness

The Z School participants showed a strong connection to animals in Game 2B, as this is the most well answered question across three of the four subsections. There was also a high success rate with the car question, demonstrating no significant difference between answers dealing with animate or inanimate objects among the participants. All of the U School's scores in Game 2B showed a low to moderate level of connectedness, ranging from 23.1%-61.5% C2N. Participants did not do consistently well on any particular question, but the car question remained the lowest C2N for U School students, and their answers overall showed sustained low C2N when inanimate objects were involved.

Participant Results and Class Averages: The Z School displayed a stronger C2N in Game 2A as their average was 11.8% higher than U School's, while U School displayed a stronger C2N in Game 2B with a 4.4% higher average. This resulted in Z School having a higher overall score for environmental awareness by 3.6%. Both Z School's and U School's overall Game 2 spring scores varied slightly from the scores achieved in the fall and, therefore, remained at a moderate C2N.

Game 3—Environmental Preferences

While Z School students' preferences for more natural outdoor locations were low to begin with in the fall, they dropped further during the spring. Similar to the answers recorded in Game 3A during the fall, 0% of Z School students stated they most frequently play or feel safest in the forest, with only 18.2% saying they prefer to play in the forest (Figure 3). Instead, they answered inside or the playground most frequently across all three questions (Figure 3). 0% of U School students answered forest for any of the questions posed, but the most popular answer for where they feel the safest was their backyard, as 46.2% recorded this as their answer (Figure 3).

The forest and street were overwhelmingly the most recorded answer in Game 3B across the fall and spring for both schools. As such, many students do not prefer something other than the street or forest as a location to play.

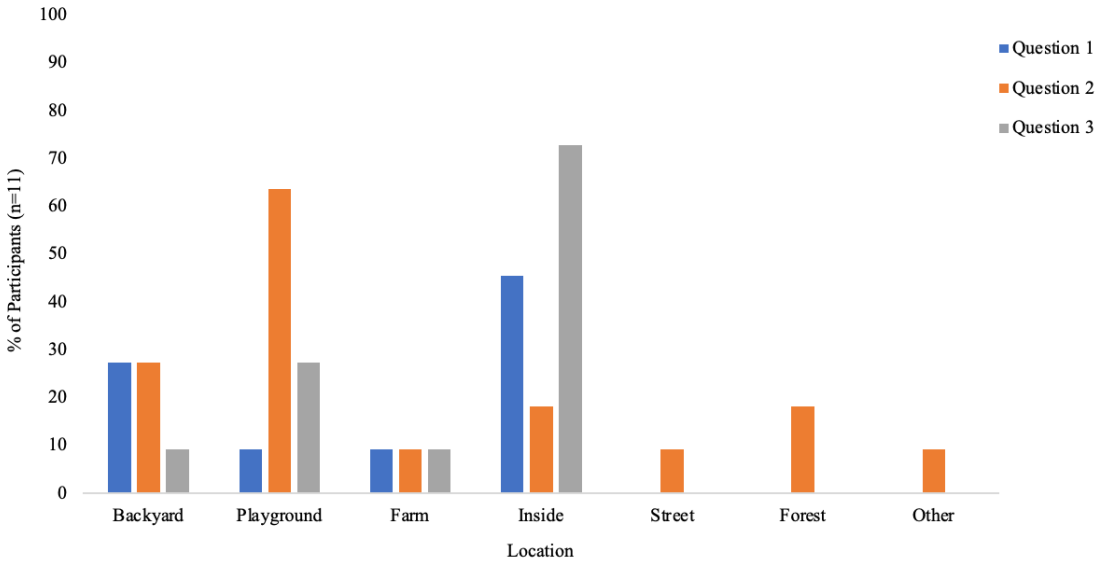


Figure 3
Zoo Preschool participants' (n=11) answers during Spring testing for Game 3A about their environmental preferences: “Where do you play most (Q1), like to play (Q2), feel most safe playing (Q3)?”

Overall Results

When considering all the data from both schools and seasons, U School performed better overall for both games concerning environmental sensitivity (Game 1A and 1B), while the Z School performed better for both the games relating to environmental awareness (Game 2A and 2B) (Figure 6). As for environmental preferences (Game 3A and 3B), neither school particularly favoured many of the more natural outdoor choices except Z School's desire to play in the forest and U School's feeling of safety in backyards. Both schools showed a high disfavour for playing in the street and/or forest.

Discussion and Conclusion

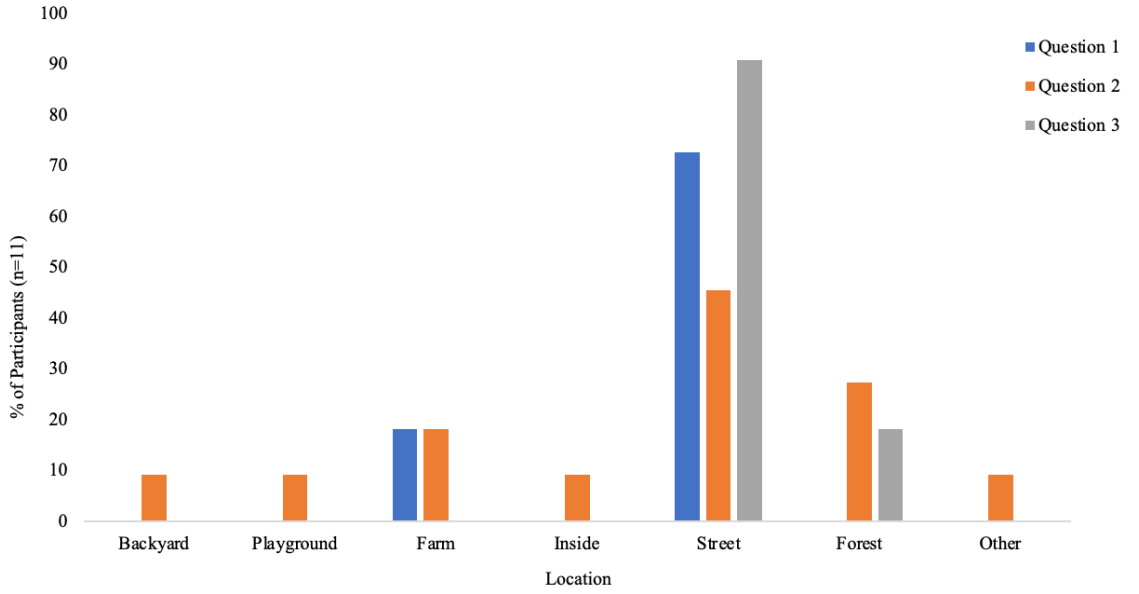
This study aimed to assess the Connection to Nature (C2N) among students from two preschools with differing levels of nature exposure in their preschool settings. Our findings indicate that the C2N of our participants varied depending on the season that the testing took place and the nature of the objects considered.

A notable observation across both Z and U Schools was the diminished C2N scores when children were asked about inanimate objects like cars and airplanes. This could be attributed to the children's age, as media and toys often imbue these objects with life-like qualities (Kail and Barnfield, 2015).. Supporting this, Sommer et al. (2019) found that young children typically ascribe moral value to inanimate objects, perceiving them as capable of experiencing harm, a view that evolves with age. It may also be that children were contemplating the people inside of a plane or a car when asked if the object could be experiencing pain. Further, what is alive can also be disputed amongst scholars. For instance, our team decided that if a child said a cut down tree could feel pain that this was a connection to nature, but some might consider a tree to never feel pain (although there is research now to the contrary) and that a cut tree is dead and therefore could not be considered living. The team will consider this in future iterations of the testing tool, as children may have a more nuanced way of thinking about this once living object.

The study also recorded a drop in C2N scores from fall to spring, which is consistent with other studies of that have demonstrated that children in developed nations tend to spend less time outdoors in colder seasons (Tucker and Gilliland, 2007; Castonguay and Jutras, 2010). This trend could be attributed to the children's reduced interactions with and exposure to key elements of nature during the winter season (Beery et al., 2020; Duffy & Verges, 2010). While the time spent outdoors remained consistent across seasons in both the Z School and U Schools, much of nature itself, such as flowers, trees, wildlife, and insects, are less active during the colder months providing fewer chances for children to form meaningful connections. Studies have supported this idea as they have shown that even with sufficient amounts of outdoor time during the winter season, the reduced abundance of flora and fauna can influence children's perceptions of the environment (Beery et al., 2020). Conversely, Sanderud et al. (2019) suggest that active winter play can enhance children's understanding and appreciation of nature, pointing toward a potential strategy for maintaining or increasing C2N during winter.

This drop in scores could also be associated with external, familial factors that occur beyond preschool hours. One study determined that there is a shift in adults' attitudes towards the environment during the winter months as it is associated with increased challenges such as higher heating bills, seasonal depression, shovelling driveways and defrosting cars, icy walkways/sidewalks, and so on (Nisbet et al., 2011). The children could be influenced by parents who experience these negative feelings, ultimately reducing their connection to nature (Ergler et al., 2016; Castonguay and Jutras, 2010). Additionally, this could lead to families spending less time outdoors during the winter season than they typically would in the warmer spring and summer months (Ergler et al., 2016; Castonguay and Jutras, 2010). Even with Z School and U School keeping the amount of outdoor play similar across all seasons, this potential reduction in cumulative outdoor time can also be contributing to the observed decrease in C2N scores during spring testing (Ergler et al., 2016). Tillmann et al. (2019) observed, seasonal changes impact children's outdoor engagement, with winter often perceived as less inviting.

Figure 4
Z School participants' (n=11) answers during Spring testing for Game 3B about environments that they **do not** like: "Where do you **not** like to play (Q1), where do you **not** like to play the most (Q2), where do you **not** feel safe playing (Q3)?"



In Game 3, we observed a reluctance among students concerning forest play. This aversion could stem from various sources, including parental attitudes, the inherent features of forests, or the children's urban or rural backgrounds (Skar, 2010; Sonti et al., 2020). Sonti et al. (2020) reported that safety concerns lead to avoidance of forested areas, an attitude that may be transmitted to children, affecting their comfort and connectedness with such environments. Further, it may have been that the pictures shown of a forest were unfamiliar to the children. The Z School children regularly have "Forest Fridays," where they play in a forest park with trails. The imagery used in the test depicts a much wilder setting that was perhaps not as attractive to the participants. This reinforces the idea that the pictures used in this tool should be modified for the cultural and geographical context in which it is being used. Further, the team intends to examine the children's parents' attitudes toward nature to determine if there is a correlation between parental C2N and their child's.

When looking at the study overall, some conclusions can be drawn that may be helpful to those conducting this type of research in the future, which we explore below.

Connection to Nature (C2N) Variability: This study demonstrates that the connection to nature among preschoolers may be influenced by various factors, including the nature of the objects considered (animate vs. inanimate), seasonal changes, and preferred play settings. This highlights the complexity of C2N in early childhood education and the need for diverse and adaptive educational strategies.

The Impact of Seasonality on C2N: The study observed a decline in children's C2N scores from fall to spring. This could be due to reduced interactions with nature during the winter months when flora and fauna are less active. Despite consistent outdoor time while the children are at their respective schools across the seasons, external factors such as parents' negative attitudes toward winter and reduced family outdoor activities may also further contribute to the decline in the children's C2N scores, highlighting the importance of fostering positive winter play experiences to maintain or enhance children's connection to nature, and perhaps to impact their parent's attitudes toward seasonal experiences.

Figure 5
U School participants' (n=12) answers during Spring testing for Game 3B about environments that they **do not** like: "Where do you **not** like to play (Q1), where do you **not** like to play the most (Q2), where do you **not** feel safe playing (Q3)?"

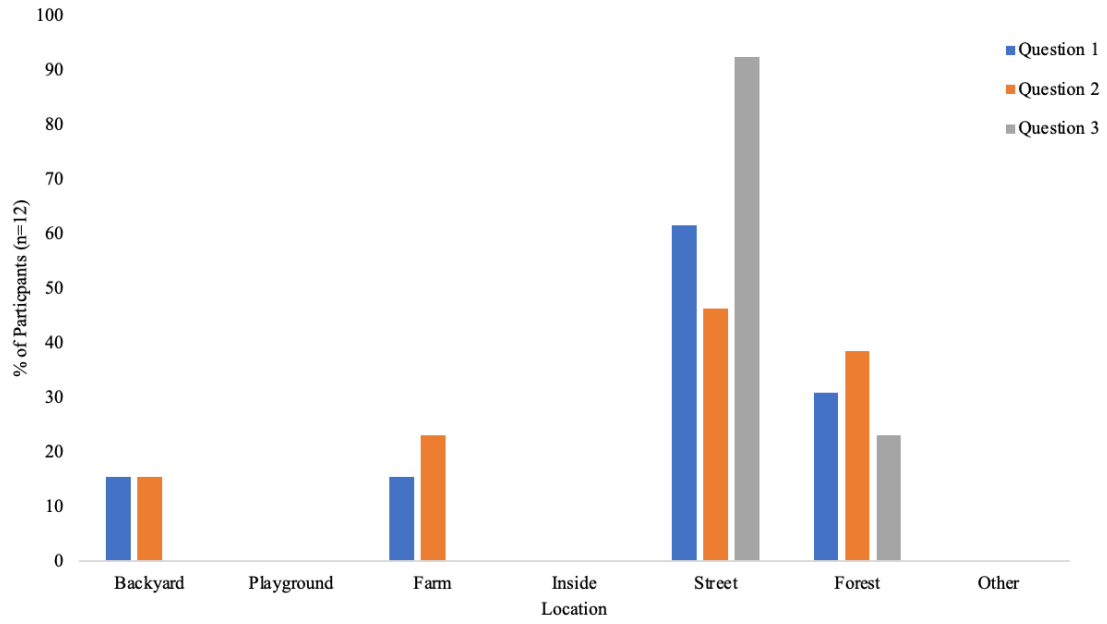
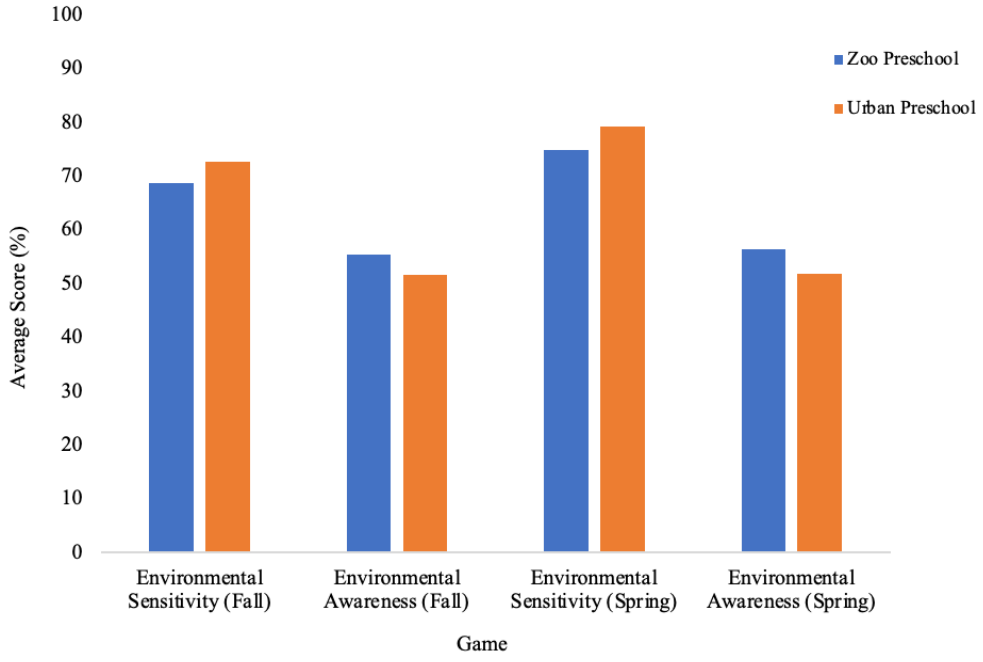


Figure 6
Overall Fall and Spring Z School and U School averages for Game 1—Environmental Sensitivity and Game 2—Environmental Awareness



Influence of Educational Settings: This study compared two educational settings (Z School and U School) with different levels and types of nature exposure. The findings underscore the significance of the academic environment in shaping children's C2N. With its more immersive nature-based education, Z School generally showed better environmental awareness performance, while U School displayed higher sensitivity towards the environment. This also lends credibility to the suggestion to examine to what extent parental attitudes (in addition to the educational setting) can influence a child's C2N.

Children's Perceptions of Inanimate Objects: A notable observation was that the children ascribed life-like qualities to inanimate objects like cars and planes. This could be a reflection of their developmental stage and the complexity of the person-object distinction. Literature suggests that children begin to develop the distinction between animate and inanimate objects as early as 12 months (Opfer & Gelman, 2011). However, in the case of cars and planes, there is the additional layer of people potentially being involved. This issue is related to how children contextualize objects based on the features, such as faces or biological motion (Opfer & Gelman, 2011). This observation highlights how the level of complexity of the chosen object or picture can impact the outcome of the testing results.

Reluctance Towards Forest Play: The study observed a general reluctance or unease among many students concerning forest play. This aversion could stem from various sources, including parental attitudes, the inherent features of forests, or the children's socio-economic and/or cultural backgrounds. It indicates the need for further exploration into how environmental attitudes are shaped and the potential for educational interventions to alter these perceptions positively.

This study's outcomes suggest actionable paths for educators and policymakers. There is a need for tailored educational approaches that consider the diverse factors influencing children's C2N, including seasonal changes, the nature of play settings, and children's developmental stages and cultural contexts. Further, our study opens avenues for future research, particularly in exploring how different environmental and educational interventions can enhance children's C2N on both a small and large scale.

Further, this study showcases the use of the MacKeen and Wright 2020 games testing tool in a new light and its use for comparing connection to nature scores between two educational settings and in a pre-post study design. The pre-post study design allows the researcher to uncover nuances in the data over an extended period and have a more complete understanding of the children's complex connection to nature after curriculum interventions (i.e., a longer period of time in preschool). Finally, there is also scope for longitudinal studies to track how these connections evolve and influence children's long-term attitudes toward nature and environmental stewardship. Our research group encourages such studies and is open to collaborations and information sharing related to future research endeavours in this area.

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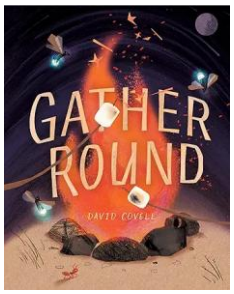
CHILDREN'S BOOKS AND RESOURCES REVIEW

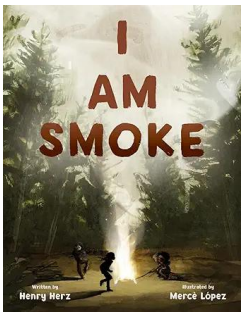
Carla Gull
Book and Resource Review Editor
Merry Lea Environmental Learning Center of Goshen College, USA

Fire Engineers: Book and Resource List

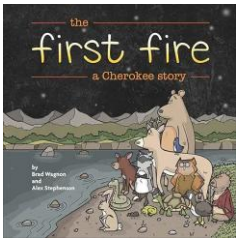
Wildfires continue to be in the news. Fire can be a real and devastating issue. Fire necessitates safety and preventative measures; however, it is also a tool or element that humans have used for thousands of years. As I facilitated fire sessions with children and studied the concept of loose parts more in depth, I noticed Simon Nicholson mentioned fire as a loose part and children enjoyed playing around (with safety parameters) with the elements of the fire triangle. This sparked a journey to understand fire play with young children. I hope these resources inspire you to consider how fire (even charcoal!) might safely be a part of your early childhood program!



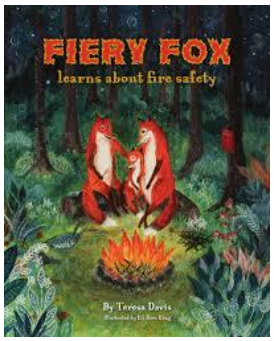
Gather Round **by David Covell**
This newer book shows campfires as a power to bring people together. A daughter and her father build a fire to stay warm and for safety in the dark. Visitors warm themselves by the fire. Fire is described as a living thing in this book, which I love! The backmatter has fire safety considerations and community building ideas. Makes me want to sit 'round the campfire! Best for ages 3-5.



I Am Smoke **by Henry Herz**
This read aloud is written at an easy pace and uses a poetic approach to smoke, highlighting the many uses of smoke over time. The words invite movement of the participants, while also cautioning the harm smoke can do. Smoke has been used for seed sprouting, pest control, communication, taming bees for honey collection, flavoring and preserving food, religious observations, medicinal purposes, and more. The book shares how the nutrients in smoke grow into trees that eventually become a campfire, which completes a life cycle. The backmatter gives additional details around the main points of smoke and its use in civilization. Rated for ages 4-9.



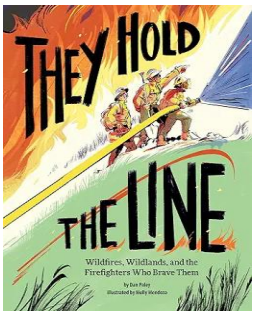
The First Fire: A Cherokee Story **by Brad Wagnon**
A bolt of thunder is sent to give fire to the animals as time begins. The fire helps combat the cold and darkness. In this indigenous story, many animals try to capture fire for use; however, it is the small water spider who successfully harnesses the gift of fire for warmth and shares it with others. Cultural aspects of this story show reverence for the water spider, explanations of the natural world, and oral storytelling traditions. Recommended ages 3-5.



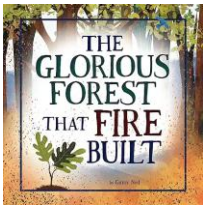
Fiery Fox Learns About Fire Safety **by Teresa Davis**
Fox finds a lighter in the woods. As he drops it on the ground, it sparks a fire. The fire travels through the woods. Animals flee. Fiery Fox's dad, a firefighter, comes to put out the fire, and stays low out of the smoke. He learns to let adults know if a lighter or matches are found. Their family roasts marshmallows over the fire and reiterates fire safety rules. There is a scavenger hunt to find various things in the book. A safety checklist is included for adults, along with thank yous and inspiration for the book. Rated for ages 3-8

The Organic Artist for Kids: A DIY Guide to Making your own Eco-Friendly Art Supplies from Nature **by Nick Neddo**
Neddo supplies many approaches to using natural items for creating art materials with children. One section focuses particularly on charcoal with approaches and techniques for creating and using charcoal in art. He instructs on making a tipi fire, charcoal ink, and other fire related concoctions. He seamlessly connects charcoal to other nature supplied art approaches in the book. Suggested ages 4-11.

Go Wild! 101 Things to Do Outdoors Before You Grow Up **by Jo Schofield and Fiona Danks**
This book is organized in sections around shelter, fire, foraging, cooking outdoors, tools and weapons, bushcraft skills, water and keeping clean, keeping safe, and further information. The fire section shares safety measures, how to make a fire, types of fires, using a lens or no matches to start a fire, fire by friction, and fire essentials. Fire is also used as part of bushcraft skills and cooking in the book. I can't wait to make an ember bowl! 9 years and up

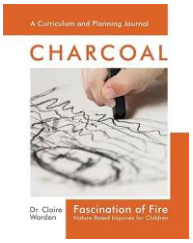


They Hold the Line: Wildfires, Wildlands, and the Firefighters Who Brave Them **by Dan Paley**
This books is rich with vocabulary, technical aspects of firefighters, and supportive illustrations. The text can be read on many levels, such as a simple story with more detailed insets. The book highlights the impact on fleeing animals, The backmatter looks at historical and newer approaches to wildfire management. Additionally, the book introduces the firefighters, their protective gear, and general fire safety. Ages 7-10.



The Glorious Forest that Fire Built by Ginny Neil
While fire can be very devastating, this book recaps how fire benefits some forests through fire ecology, such as nutrient recycling, new growth, survival of specific species, managing pests and diseases, creation of habitat, and preventing larger fires. The book shows forest succession after a fire. Suggested ages 6-9.

Additional Resources



***Charcoal: Fascination of Fire* by Dr. Claire Warden**
This curriculum and planning journal introduces the reader to charcoal, considering possibilities in our spaces, curricular links, daily planning, developing skills, and benefit risk assessments. I love her mind maps, journal prompts and reflections, photos, and options for making and using charcoal. There are two versions of this–the newer one is updated and more of a workbook, though there is merit in both.

Zaske, S. (2017, Feb. 23). Teaching children to play with fire. *The New York Times.*
Zaske contrasts the experiences of her children in Germany learning about fire interactions versus the American experience that largely prohibits children lighting a candle or building a fire. She advocates that teaching children to explore fire in a supervised manner helps demystify the allure of fire while providing children with practical skills for fire safety.
https://www.nytimes.com/2017/02/23/well/family/teaching-children-to-play-with-fire.html

Rosin, H. (2014, March 19). The overprotected kid. *The Atlantic*, *19*.
Rosin questions trends in society that limit opportunities for children to engage in risk. While looking at the topic of shielding children in general, she shares examples of fire play with children at The Land, an adventure playground in the UK; benefits of engaging with fire; and potential risks. Find a PDF on Google Scholar.
https://www.theatlantic.com/magazine/archive/2014/04/hey-parents-leave-those-kids-alone/358631/

***Embracing Fire as a Loose Parts podcast episode by* Loose Parts Nature Play**
This podcast episode shares experiences and considerations around the possibility of fire as a loose part, drawing on experiences with creating small individual fires and professional development for educators with fire as a loose part. Safety considerations and resources are shared.
https://loosepartsnatureplay.libsyn.com/embracing-fire-as-a-loose-part
Additional resources and handout:
https://loosepartsnatureplay.org/2023/07/27/embracing-fire-as-a-loose-part/

Sample Benefit Risk Assessments

Into the Woods Outdoor Nursery: Use of Fire Risk Assessment
https://www.intothewoodsnursery.co.uk/assets/risk-assessment---fire.pdf

The Ace Centre Forest Friday Risk Benefits
https://www.ace-chipping-norton.co.uk/wp-content/uploads/2020/01/Risk-Benefit-Assessment-Fires-for-NS.pdf

Risk Benefit Assessment: Fire skills session by Tim Gill
https://rethinkingchildhood.com/wp-content/uploads/2011/11/woodcraft-fire-rba.pdf

Outsideplay.org
While fire play is not directly addressed in this quality resource for educators, many supporting behaviors are included in this outside play tool for teachers. Broken into chunks of usable information, the website gives insight, reflection, and materials to take your students outside. Check out the section on risky play!
https://www.outsideplay.org/app/learning-hub

Gull, C., Goldstein, S. L., & Rosengarten, T. (2025, this issue). Nature-based Early Childhood Educator's Perspectives on Embracing Fire as a Loose Part. *International Journal of Early Childhood Environmental Education*.
In this study, we explore fire as a loose part, why educators allow fire play or not, and safety measures around children's fire interactions. Ultimately, we found that educators who allow fire play do so to encourage safety. These children also get more practical experience interacting with fire and build safety skills beyond stop, drop, and roll. Read it in this issue of IJECEE!

Fessler, D. (2006). A burning desire: steps toward an evolutionary psychology of fire learning. *Journal of Cognition and Culture*, *6*(3-4), 429-451.
I am not sure how we missed this as part of our fire play research; however, Fessler does a deep dive into fire play by children, reviewing ethnographic research about cultures where children are exposed to fire more as part of their daily lives. While published in 2006, he recognizes the high contrast between fire in western culture where it is largely seen as decorative and areas where fire is utilitarian. He creates a table of the results of his survey looking at multiple cultures across the world and findings around serious burns, when fire interaction initially occurs, gender nuances, fire as potential entertainment, when children are competent with fire, and how children learn about fire. An interesting point includes how fire is often not explicitly taught in societies that use fire as a utilitarian approach.
https://www.danielmtfessler.com/wp-content/uploads/2013/12/Fessler-2006-Burning-Desire.pdf

***Elemental*, Disney and Pixar Movie, 2023**
While not explicitly connected to children playing with fire, I laughed and felt all the emotions in this film. This animated movie follows the main character, Ember, who grows up in the family store, "The Fireplace". While the main four elements are highlighted, fire is the main focus through the cultural identity of the fire community, discrimination in a world not meant to accommodate fire, Ember's fiery personality, and the concept of playing with fire as opposites attract when Ember develops feelings for someone from the water community. Watch the credits–there are plenty of fire puns riddled throughout.

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INTERNATIONAL JOURNAL OF EARLY CHILDHOOD ENVIRONMENTAL EDUCATION (IJECEE)
Addressing Issues, Policies, Practices, and Research That Matter

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The journal has two broad visions:

(a) To encourage thoughtful sharing of information about important ideas, conceptualizations, and frameworks, as well as effective practices and policies in early childhood environmental education; and

(b) To reach an extensive global readership in order to maximize the impact of the thoughtful information.

Thoughtful information may manifest through book reviews, description of educational approaches and programs, research investigations, and development or interpretation of theoretical perspectives. Associations among and between the following will be emphasized:

- Young children
- Family circumstances
- Community opportunities
- Policy mandates or recommendations
- Environmental activities, education, or experiences
- Mechanisms or processes related to knowledge acquisition
- Attachment or maintenance of affective dispositions
- Abilities, behaviors, or skills development related to good decision making in a range of environmental contexts; and
- Cognitive, economic, and social influences or impacts.

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