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Addressing Policy, Practice, and Research That Matters

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Environmental Education for Toddlers and Their Caretakers as a Context for Language Development: Opportunities and Challenges

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ABSTRACT

In this qualitative study, the author investigated nature as a context for language development. Participants included 15 toddlers and their caretakers who enrolled in a series of environmental education workshops on the topics of grass, butterflies, spiders, and leaves. Using field notes and photographs, the study sought to investigate elements in nature that prompted children and adults to initiate episodes of joint attention as well as challenges and opportunities for language development within the context. Findings indicate that children gravitated towards insects while adults were more inclined to discuss plants. It was also found that certain arachnids and insects such as butterflies offered limited opportunities to generate labels/vocabulary and did not afford a close relationship or connection with toddlers

Keywords: early childhood, environmental education, biophilia, language, nature

Young children's language development has been at the heart of studies seeking to address the important role that meaningful experiences and interactions play in equipping children with knowledge of all aspects of language so that they can advance socially and academically (Justice et al., 2010; Mashburn et al., 2008). Language development, however, is a complex process as young children require more than meaningful experiences to build a repertoire of receptive and expressive language. In other words, language knowledge is strongly influenced by the quantity and quality of language that is directed to children in relation to their interests and actions and how much the young child is involved in extension activities (National Academies of Sciences, Engineering, and Medicine [NASEM], 2017).

Congruent with a developmentally appropriate perspective that favors concrete, meaningful activities in which children use their senses to explore, learn, and develop language (Kostelnik, Soderman, Whiren, & Rupiper, 2019), environmental scholars suggest that educators should capitalize on children's innate inclination to connect with nature, or biophilia (Kellert, 2012; Wilson, 1993) to support learning in all domains, including language (Kellert, 2002). Biophilia is a construct that has been discussed in terms of a symbolic dimension that highlights nature as a "source of language and imagination" (Kellert, 2002, p. 130). In doing so, the wheels of language and cognition and set into motion. Specifically, Shepard (1993) asserts that the initial awareness of animal taxonomy so prominent in early childhood, a time when the child notices body parts (e.g., nose, eyes, mouth, toe) represents only the beginning of a natural inclination inherent in human beings to use nature as a source and instrument to develop the many dimensions of language.

The cognitive aspects of the nature-child relationship have been addressed under a cognitive biophilia construct, a term that Lawrence (1993) coined to encapsulate the idea that symbols and images of nature propel complex thinking. As Kellert (2002) asserts "few areas of life provide young people with as much opportunity as the natural world for critical thinking, creative inquiry, problem-solving, and intellectual development" (p. 124). This process begins with a foundation that relies on a series of labels gradually acquired as children begin to walk, talk, and ask the name of objects and organisms that they encounter (Shepard, 1998).

Addressing language development in the context of nature is important as knowledge of purposeful strategies can assist parents and educators in their efforts to support language acquisition and development beyond the constraints of a classroom or a home. The purpose of this qualitative descriptive study was to identify child and adult initiated episodes of joint attention at a local park within the context of a Starting Out Wild (SoW) environmental education workshop. A qualitative approach was used to understand and tap into young children’s inclination to connect with organisms found at a local park as a way to promote language development.

The Context: Starting out Wild (SoW)

SoW is a toddler/parent environmental education program tailored for children ages one to three years that was launched in 2013 at a park in South Texas. SoW lessons involve children and their caretakers in direct and indirect experiences with nature. Much of the content of each one-hour workshop was based on Growing Up WILD (Wildlife in Lesson Design) and Project WILD curriculum guides. A SoW lesson includes several segments. Initially, children gather for a welcome song and an introduction to the topic of the workshop, which includes a read aloud. Then, a nature walk with parents and children allows time for application and exploration. Next, following the theme of the day, all participants complete a craft and have a snack. Finally, a good bye song and/or a discussion help to bring closure (see Table 1 for sample schedule). During the Fall 2019 when this project took place, program coordinators planned four workshops based on the topics of grass (August), butterflies (September), spiders (October), and leaves (November). Aspects of the first three workshops are discussed in this article.

Table 1
Sample SoW Schedule for the Topic of Grass

	Language	Activity
First 15 minutes	Spanish	Introduction Show several samples of grass. Allow children to touch the grass and ask: ¿Who ate grass today? Read aloud: “Tall, tall grass” by Denise Fleming. Who lives in the grass? Let’s go find out!
Second 15 minutes	Spanish	Nature Walk Name parts of the grass including stem, leaves, flower, and seeds. Provide scripts to parents to encourage use of topic related vocabulary. Focus on 3 language input strategies.
Third 15 minutes	English	Craft
Fourth 15 minutes	English	Closure Review what was observed and summarize lesson.

A bilingual version of SoW was conceptualized in coordination with the education coordinator, Cindy (pseudonym), at the park. The goal was to better serve the increasing number of Spanish-speaking young children and their parents. The project also sought to better understand how nature can serve as a vehicle to promote young children’s language development in a bilingual/dual language environment. With this in mind, a 50/50 language allocation model was designed. Language allocation refers to the distribution of languages for instructional purposes. In this case, the decision was made to conduct the first half of the class in Spanish and the second half in English. Because Spanish was, in many cases, the child’s first language, an initial exposure to the concept in a familiar language can support comprehension and subsequent transfer of concepts and vocabulary to their second language (Cummins, 2017).

Children aged between one and three years do not necessarily engage in formal language production or expressive language to a significant degree. Therefore, data collection focused on observations of children’s engagement and expressed interests while participating in the nature walk (second 15-minute segment of the program as described

in Table 1). Additionally, the study explored opportunities and challenges for language development within the workshop placing adults in the role of facilitators and providers of language input.

SoW Workshops within Fields of Promoted Action

During the different phases of the workshop, facilitators purposely emphasized the topic of the day and encouraged children to observe and use their senses to explore. The nature walk immersed children in fields of promoted action (Chawla, 2007), which can be defined as the conditions in which children's exploration of nature occur under adult encouragement and close guidance. In this case, adults purposefully incited exploration of a specific plant or small animal.

The field of promoted action generally involved a well-defined perimeter. The nature walk began in the area right outside the classroom. Then, the walk continued across the parking lot and next to the pollinator garden. Finally, participants made full circle by returning to the savanna area. This 15-20 minute experience was marked by multiple stops in which promoted action included:

- looking at organisms that related to the lesson being taught on that day;
- drawing attention to organisms that adults found interesting (often related to workshop's topic); and
- discussing and extending organisms and affordances that children identified as interesting and that adults deem safe.

Parents received a handout with suggested ways to provide language input as children entered those fields of promoted action. Facilitators and parent sought to expose children to rich, context-based vocabulary. Strategies provided to parents in an index card or handout included:

1. labeling objects/organisms that children found interesting;
2. purposefully labeling objects or concepts related to the focus of the lesson (parts of a spider);
3. extending children's utterances;
4. encouraging exploration; and
5. asking open-ended questions.

These strategies allowed facilitators to operate under a guided inquiry approach by directing children's attention to specific organisms and objects in nature that each lesson focused on. We understood that children would also initiate conversations/or engage in actions connected to anything that invited a relationship as they walked the trails.

Theoretical Framework

This study used biophilia as a framework to better understand and analyze nature as a valuable source of symbolic experiences and as a vehicle to facilitate communication, thought, and language. Wilson (1984) defines biophilia as a biologically based, inherent human need to affiliate with life and life-like processes. In general, Kellert (2002) classifies contact with nature under three categories: direct, indirect, and vicarious or symbolic. A direct experience with nature involves spontaneous play or exploration of unmanaged natural spaces such as a backyard, vacant lot, a mountain, etc. Indirect experience with nature is generally more restricted and often leads to physical contact, but is programmed, monitored, and closely managed as is the case in zoos, nature center classes, guided trail tours, etc. A symbolic or vicarious experience with nature exposes children to images or symbolic depictions of nature including animals, plants, and non-living things.

For young children participating in the SoW workshop, the combination of concrete, symbolic, and indirect experiences in nature promoted cognitive and linguistic engagement at high levels. Lawrence (1993) used the term cognitive biophilia to assert that "the human need for metaphorical expression finds its greatest fulfillment through reference to the animal kingdom. No other realm affords such vivid expression of symbolic concepts" (p. 301). This

type of connection with nature is inherently connected to experiences in which one can use the senses to gain awareness and subsequently act or react in relation to nature and move our reasoning forward.

Extending the idea of nature as a trigger of cognitive activity, Arreguín-Anderson (2015) proposed the term linguistic biophilia to assert that children's natural gravitation toward nature in at an early age can also provide opportunities to learn an ample vocabulary. This newly acquired terminology eventually evolves into "the child's linguistic repertoire and is accompanied by morphemic and syntactic knowledge when the adult purposefully uses more complex sentences" (p. 53). A nature walk or exploration of a natural space such as a trail in a park for example, immediately exposes a child to objects, organisms, or referents in need of a label.

Exposure, however, does not guarantee engagement. Key to child-nature connection is the presence of affordances. Affordances in nature are powerful tools to develop language and cognition. Chawla (2007) describes affordances in terms of relationship that can emerge between the child and an object or organism. A roly poly bug (isopod crustacean), for example, provides a unique type of affordance in nature. As it moves about and airs the soil, the roly poly affords the opportunity to be observed. Rocks that are small enough to be picked up, examined and played with afford opportunities to enact the sense of touch and just as importantly, these objects and organisms propel a sense of wonder and enjoyment.

From a sociocultural perspective, however, the wheels of language learning/development as children engage with nature's affordances must be set into motion by a "more knowledgeable other" (Vygotsky, 1978) in this case peers or adults in children's lives. Initially, however, a child must become interested in an object or organism in episodes that child either initiates or is enticed to engage in. These episodes of joint attention (Chawla, 2007) allow adults to produce contingently responsive language (NASEM, 2017) or language that is closely connected to the child's interest in the exact moment when both, child and adult, make eye contact in relation with the object/organism.

Episodes of joint attention represent moments in time in which two individuals pay attention to the same object/organism. These episodes can generate multiple opportunities for language (vocabulary) development in the form of labeling, discussing, comparing and questioning. A generative word leads to the naming and discussion of additional aspects or details related to the object/organism/action. In the context of nature-based play, generative words relate directly to affordances within nature, that is, objects or organisms that the child is spontaneously attracted to and can establish a relationship with.

Review of Literature: Nature and Language

Research has shown that the relationship or assumed affiliation that children can experience towards nature may be influenced by the amount of time spent outdoors and the aversion or affinity with nature that adults and other individuals model or demonstrate in the presence of children (Ballouard, Provost, Barre, & Bonnet, 2012; Chawla, 2007; Kahn, Weiss, & Harrington, 2018; Kharod, 2017; Rice & Torquati, 2013; Zhang, Goodale, & Chen, 2014). Kharod and Arreguín-Anderson (2018) explored how participation in a nature preschool mediated preschoolers' caring attitudes and behaviors towards and connection with nature. Findings shed light on the role of direct experiences along with interactions with caring adults and curious peers play in a gradual progression from aversion to affinity with nature.

In addition, adults and peers are a key factor in terms of the knowledge children acquire and the language they develop both in the presence or absence of nature as a stimulus. Nature schools for example, have capitalized on parents' desire to immerse their children in curriculum that develops all learning domains using nature as a context for learning (Arreguín-Anderson, 2015; Bailie, 2016; Dell, 2018; O'Brien & Murray, 2007; O'Brien, 2009).

Although still scarce, an emerging body of environmental education research has started to focus on young children's communication skills and vocabulary growth. In a study with younger children at a nature preschool, Dell (2018) used participatory methodology to explore how young children ages (3-4 years) attending preschool described their learning experience. Data collected included children's photos and descriptions as they engaged in their daily activities. One segment of the findings indicated the presence of scientific knowledge/language in the photographs'

caption. As evidenced in these pictures, children learned the names of plants and animals in their local ecosystem. Acquisition of scientific terminology has also been identified in Forest schools. For example, O'Brien and Murray (2007) investigated the impact of Forest Schools on 24 children over an 8-month period and identified language and communication as a significant theme. Specifically, the researchers highlighted young children's sophisticated uses of written and spoken language (vocabulary and syntax).

Methods

This basic qualitative study sought to explore the role of nature as a space for language development in the context of parent-toddler participation in a bilingual SoW workshop. The goal was to identify instances of child-initiated and adult-initiated episodes of joint attention in relation to affordances within the nature trail. Merriam (2009) describes basic qualitative research as an inquiry in which one closely looks at how people "construct their worlds". In this case, special attention was paid to the meaning-making experience as parent/caregiver and young child interact with nature in a context of guided inquiry. The study sought to answer the following research questions:

1. What elements of nature are young learners spontaneously drawn to as they initiate episodes of joint attention in the context of an environmental education workshop at a local park?
2. What elements of nature are adults spontaneously drawn to as they initiate episodes of joint attention in the context of an environmental education workshop at a local park?
3. What are opportunities and challenges for the use of contingent responsive language during a bilingual SoW workshop with toddlers at a nature park?

Setting and Participants

This study took place at sustainable natural urban park located in south central Texas. The participants were selected from a convenience sampling pool that included parents/caretakers and children who attended one or more of a series of four bilingual SoW workshops offered at a local park from August to November during the Fall 2019 semester. Participants included 15 children ages one to three years with varied levels of language development. Seven of the participating children had Spanish surnames and spoke Spanish as their primary language.

The park where the study took place covers more than 330 acres. Nature trails highlight different landscape areas including a savanna loop, an oak loop, water loop, and a geology trail. Given the duration of the workshop (one hour), activities were generally planned near the savannah loop trail and close to the native plant demonstration garden. Two volunteers and an environmental education facilitator set up materials for each workshop on Thursdays.

Data Collection and Analysis

Field notes, audio-recordings, along with photographs, allowed the researcher to capture children's spontaneous behaviors as they walked the trail, completed a lesson related craft, and listened to a story. A consent for participation was obtained from parents prior to the beginning of the series of workshops with the understanding that parents/caretakers' and children's verbal and non-verbal engagement with nature would be documented. The goal was to critically evaluate the types of opportunities for language development that emerged during the nature walk as children spontaneously explored and walked the trails with their parents/caretakers.

The process of data analysis began on day one as photographs, audio recordings, and observations were coded to group/categorize children's behaviors in relation to nature (both self-initiated and prompted) while identifying opportunities for language development. Using a constant comparison approach (Merriam, 2009), the researcher analyzed field notes in terms of:

- Children's spontaneous engagement with organisms (plants and animals) and other affordances within the nature walk.

- Adults' spontaneous identification of and engagement with organisms (plants and animals) affordances within the nature walk) and challenges/opportunities to develop language.

When children gravitated toward an object/organism in the park, these selections were coded as a category labeled "children identified affordances". This emerging code remained as a constant throughout the different workshops. Additionally, a predetermined code based on the purpose of the study was "opportunities for language input", which explicitly tied to adult initiated episodes of joint attention. Creswell (2014) asserts that a combination of emerging and predetermined codes may help capture information learned during data analysis as the researcher defines themes or categories for a research study. In this case, it was specifically critical to document the type of dynamics that naturally favored language development. It was evident that we needed to capitalize on children's identified affordances. Therefore, using a balanced approach, we remained alert to adult's interventions and adult's initiated episodes of joint attention.

Findings

Research Question 1: What elements of nature are young learners spontaneously drawn to as they initiate episodes of joint attention in the context of an environmental education workshop at a local park?

Child Initiated Episodes of Joint Attention: One Cooperating Beetle!

The toddlers in this program identified multiple elements or affordances, within the nature walk, that generated episodes of joint attention. Most affordances related to insects and included a beetle, a grasshopper, a queen butterfly, a dragon fly, and a stink bug. This is a crucial aspect of young children's behavior and biophilic inclination as it confirms the role that nature can play as a trigger for learning in all domains. Experiences in nature that children find interesting are precisely the type of opportunities that adults can capitalize on to produce contingently responsive language input. The importance of the language that adults use in response to children's spontaneous attraction to organisms in nature is related to "children's ability to learn words for things and events that interest them and are already the focus of their attention" (NASEM, 2017, p. 133).

Congruent with previous research (Lindemann-Matthies, 2005; Wandersee & Schussler, 1999), one common pattern during the workshops was children's spontaneous attraction and preference of animals over plants. In this case, children were overwhelmingly attracted to insects that happened to crawl, fly, hop or just move coinciding with their path. This type of organisms, that Chawla (2007) refers to as "responsive affordances" (p. 15) fascinated children because as they engaged, these insects' further actions (e.g. flying, crawling) caused additional curiosity.

During the first workshop, we gathered samples of grass to illustrate that grass comes in different shapes, sizes, and colors. We also discussed the fact that we eat products from grass at home and shared with children that insects also enjoy the benefits of using grass as shelter. With this in mind, the goal of the nature walk was to guide children in the appreciation of the different types of grass found in the park. We asked parents/guardians to guide their interactions using the following open-ended questions: Where can we find grass? What does it look like? And what lives there? These questions would serve as focal points and wide nets to capture possible inquiries as the nature walk progressed. It was precisely in looking for what lives there? That children happened to observe ground black beetles near pasture areas of the park. Beetles are insects with three pairs of legs, and a hardened pair of wings. Workshop facilitators explained that beetles can be easily found in almost any habitat so it was no coincidence we spotted them on the sidewalk near the grass.

Contingently Responsive Language to Capitalize on Children's Observations

Children were mesmerized by the beetles' slow pace as they climbed small rocks and crossed the path towards more dense vegetation areas. This insect did not seem disturbed when picked up and placed on one of the facilitator's hands. Due to its smallness and quiet demeanor, this beetle afforded interaction. As it moved with ease, children observed closely and intently how the claws on the beetle's hind, middle, and fore legs helped it attach to the skin while maintaining balance (see Figure 1).



Figure 1. A black beetle at the park

In this case, affordances, such as the beetle, became a generative topic that also afforded conversations and propelled language production often leading to the use of more specialized terminology. For example, the beetle's head and thorax presented opportunities for close observations and as children followed the beetle's every move, other names of body parts emerged: "Mira sus antenas... Tiene un abdomen muy grande." (Look at its tiny antennae...It has a large abdomen.) Even as the group walked away, children were seen pointing to the insects while parents elaborated with phrases such as: "That was a beautiful insect, right", and "¿En qué se parece tu cuerpo al cuerpo de un insecto?" [In what ways is the beetle's insect similar to yours?] Once observations were made, the beetle was softly pushed back on the ground near the grass to continue its journey.

Research Question 2: What elements of nature are adults spontaneously drawn to as they initiate episodes of joint attention in the context of an environmental education workshop at a local park?

Nature's Toilet Paper! Plants as Opportunities/Affordances to Develop Language

As indicated in the schedule of each workshop, facilitators used concrete objects and read alouds to draw children's attention and provide a focus for the day's activities. This approach was effective within the confines of the classroom. However, once the group stepped out and into the trail to explore the topic, facilitators embraced a flexible approach promoting children's curiosity (as indicated in finding one), but also capitalizing on affordances present in the trail as the group walked towards specific areas of the park. As opposed to children, who were attracted to animals (insects), a pattern in these workshops was adults' inclination to discuss and draw attention to plants.

For example, one episode of joined attention centered on what education coordinator, Cindy, called "nature's toilet paper", or velvet leaf mallow, a shrub that can reach 3-5 feet in height (see Figure 2). The plant's heart-shaped leaves are velvety to the touch and might have easily gone undetected if it wasn't that during one of the nature walks, Cindy stopped; pointed to the plant; approached it and encouraged children to touch it by saying: "This is Cindy's

toilet paper.” Given its size and length (with issues of safety in mind), this plant allowed physical contact and the use of the sense of sight and touch. In other words, it afforded a relationship and connection to the child’s interests (Gibson & Pick, 2000). Generally, objects and living organisms found in nature are likely to lend themselves for interactive encounters contingent on physical aspects of the organism such as proximity, size, and height. A rule of thumb is to consider organisms that engage the senses and are situated at eye level. As White and Stocking (2008) assert “children judge nature not by its aesthetics, by the manner of their interactions and sensory experiences with it” (p. 2).



Figure 2. Nature’s Toilet Paper

To encourage use of the senses while providing contingently responsive language, parents approached the plant, felt its smooth texture, and invited children to do the same while saying “suave [smooth]”. Immediately, children proceeded to touch the surface of the leaf while smiling. This episode of joint attention led to the use of additional words such as *textura* (texture), *suave* (soft), *liso* (smooth), *ancho* (wide), *delicado* (delicate), *terciopelo* (velvet), and *velvet-leaf mallow*. These labels were provided by Spanish speaking parents and lead facilitator in the context of descriptive phrases such as: “Mira que lisa se siente la hoja” [See how smooth the leaf feels] and “Its texture reminds me of velvet”.

Toddler’s fascination with the velvet-leaf mallow shrub proved that adult-initiated episodes of joint attention in nature are also likely to successfully engage children in physical and linguistic exploration when the selected organism or object represents a true affordance for the young child. That is, the selected object/organism supports physical contact and a close relationship.

A more distant experience however, occurred when we attempted to discuss grass with children while on the trail. Researcher and facilitators knew that varied types of grasses were found in the park. However, given their inaccessibility in relation to children’s ability to reach them, we gathered several types of grass and brought them to the classroom as a hands-on focusing activity, knowing that later, we would probably limit this experience to observing from the sidewalk (see Figure 3). Although touching the different type of grass in the classroom seemed to amuse children, the experience was removed from its natural context as we walked the trails. Once outside, issues of safety prevented us from allowing children to freely wander in the grass.



Figure 3. Observing grass from the sidewalk

Research Question 3: What are opportunities and challenges for the use of contingent responsive language during a bilingual SoW workshop with toddlers at a nature park?

The Challenge to Connect with Butterflies and Spiders: Generating Episodes of Joint Attention with Unresponsive Insects

Two of the topics of study during the SoW workshops included butterflies and spiders. These topics represented a challenge in terms of the relationship and proximity they could afford. Affordances are key to the discussion of nature as context for language development. A spider for example may emerge in close proximity to a child, but it does not afford a relationship beyond that of a close observation. As Heft and Chawla (2006) point out “children are more likely to stay attentive and engaged when features of their environment that they notice are responsive and give them immediate, pleasurable feedback...” (p. 151). This was not necessarily the case with the spiders and butterflies that young children encountered at the park. During our nature walk butterflies and spiders were unresponsive to a significant degree and their presence was unpredictable during the fall semester when this study was conducted.

In preparation for the spiders’ workshop for example, the lead facilitator visited the park the day before to locate spiderwebs and spiders around the perimeter generally covered during the nature walk. Fortunately, the presence of spiderwebs in areas near the ground and a black and yellow Garden spider (see Figure 4) allowed us to continue our plan to at least show spiders to children. Only one spider allowed adults to generate episodes of joint attention or moments in which both adult and child actually could engage in conversations related to the spider. For example, when children seemed curious about the spider’s head, the lead facilitator responded by saying: “Oh, what do we have here? I see a combined head and thorax...or cephalothorax. Wow! We are learning so much! Point to your own head and your thorax!

Additionally, the spider presented opportunities to name prominent body parts including the cephalon-thorax, the abdomen, and the eight legs, which we counted one by one. Given the limitations, this small encounter was significant because in general, adults and children tend to avoid unresponsive, small invertebrates such as insects and spider (Kellert, 1993).



Figure 4. Garden spider at the park

The topic of butterflies, proved to be more challenging than spiders. Because the number of butterflies present at the park was relatively small and only few landed near us, it was difficult to involve children in episodes of joint attention. The limited or non-existent opportunities to engage young children in open-ended, hands-on, sensory experiences during the butterflies workshop had a negative impact on the amount of descriptive language and labeling that adults were able to use (see Table 2).

Table 2
Affordances related to Spiders and Butterflies

Affordances	Spider	Butterfly
Sensory experience	No	No
Close observation	Yes	No
Opportunities to investigate	No	No
Words generated through purposeful naming	Head, cephalothorax, abdomen, legs, and spiderweb.	Wings, orange, and flower.

Conclusions and Implications

Young children are naturally curious and inquisitive. Therefore, learning that encompasses all domains including language occurs best when opportunities for active hands-on engagement are purposefully designed. This study sought to examine ways in which an environmental education workshop involved young learners in episodes of joint attention with the specific goal of developing language. That is, we sought to identify elements in nature that enticed participants to engage, discuss, and learn. With this in mind, we explored affordances present at a local park that parents and their toddlers found interesting and worth exploring.

Young children spontaneously gravitated towards animals, specifically insects, present along the path in the nature trail during a series of SoW workshops. This is important because it confirms the critical role that responsive affordances such as moving insects play in the establishment of meaningful relationships between young children and nature (Chawla, 2007). This urges environmental educators at local parks to seriously consider the design of workshops where local species of animals are featured and purposefully embedded as topics of study. Insects such

as beetles, can spark multiple episodes of joint attention. This purposeful identification of responsive affordances aligns well with a guided inquiry approach, leading child, parent, and educator to learn more about elements of the local habitat.

Under a developmentally appropriate perspective, initiatives that seek to truly connect with children will move beyond the initial cataloguing and mapping of local organisms to a consideration of these organisms in relation to the affordances they represent for young children. The beetle for example, afforded observing, following, describing, and picking up. A butterfly on the other hand, would not necessarily merit a space in the catalogue given its relatively rare presence during the season of the year when workshop takes place. It was noted that affordances related to butterflies were close to non-existent; therefore, not relevant for the young child. Only readily available affordances can potentially spark engagement and are congruent with a generative approach to language development. To increase the likelihood that children will find an organism appealing and interesting, it will need to be responsive and afford proximity.

The findings illustrate that a balanced approach that promotes child-initiated explorations in combination with adult-guided inquiry is critical to programs that seek to promote a long-lasting connection with nature while encouraging learning in all domains. Children's inherent agency and inclination to affiliate with nature can be the driving force behind initiatives that seek to enhance language development at an early age.

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Sustainability education in progress: Practices and pedagogies in Finnish early childhood education and care teaching practice settings

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ABSTRACT

The purpose of this article is to report on a study exploring the sustainability work (i.e., practices and pedagogies related to sustainability education) of Finnish early childhood education and care (ECEC) teaching practice settings. Recently, the early years and ECEC have gained increasing attention in sustainability education matters. Educational policy for ECEC has been developed through legislation and renewed curricula for the early years. Research on how sustainability is implemented in ECEC settings as well as in Finnish teacher education is still sparse, but indicates there is a policy-practice gap. The study was conducted in collaboration with municipal ECEC teams (n=34) in teaching practice settings (n=11) in the Helsinki metropolitan area. Data was collected using the *Assessment Tool for Promoting Sustainability in ECEC* (PROSUS) by Furu & Valkonen (2020). The results show that there is great variability in terms of extent and depth in how sustainability work is carried out by the settings. In general, social-cultural issues are addressed at greater depth than ecological and economic issues. The study implies that there is a need to intensify professional development activities that support the capacities for sustainability work in ECEC teaching practice settings in order for teacher education to be effective in the realm of sustainability.

Keywords: early childhood education and care, teaching practice, sustainability, assessment tool

The early years are important for the development of basic values, attitudes, knowledge, and skills in general, but specifically in relation to sustainability. The role of young children in the pursuit of sustainability and their overall civic participation in environmental matters has increasingly been acknowledged during the past few decades, often times inspired by Hart (1997). Current international agreements, such as the Agenda 2030 (United Nations, 2015), emphasize that children and young people are key agents in creating a better future. Children have also been increasingly given a voice in international research (Ärlemalm-Hagsér & Elliott, 2020).

For change to come about, education is of utmost importance. Early childhood education and care (ECEC) has increasingly been recognized as a valuable arena for sustainability education (Davis, 2015; Ärlemalm-Hagsér & Pramling Samuelsson, 2018). This emphasizes the importance of high quality education and care in the early years as well as the role of well-educated staff in the ECEC settings. However, according to Pramling Samuelsson and Park (2017), children do not always experience quality education from educated staff. In order to apply sustainability throughout the ECEC field, we need to promote approaches that mainstream change across both the education system and individual settings (Ferreira & Davis, 2015). Further, incorporating the principles of sustainability into ECEC must be built on robust research. During the last decade there has been a rapid increase in research concerning sustainability in the ECEC context (Ferreira & Davis, 2015; Ärlemalm-Hagsér & Pramling Samuelsson, 2018).

Ärlemalm-Hagsér and Elliot (2017) underline that further research is needed to explore how sustainability is understood and enacted in the daily activities in ECEC. There is also a need for research that explores how sustainability is approached both in theory and practice in teacher education, in order to support future teachers' engagement in sustainability education. A recently published research volume by Elliott, Ärlemalm-Hagsér and Davis (2020) gives voice to approaches that challenge the dominant narratives around sustainability within ECEC and pedagogically engage adults along with children in transformation.

In recent years, sustainability has been increasingly addressed in Finnish ECEC teacher education, but there is still a considerable gap between policy and implementation (Wolff & Furu, 2018). For student teachers, teaching practice (or student practicum) offers a possibility to contest, integrate and develop theoretical understandings in living practice. Student teachers develop their professionalism in collaboration with staff in the teaching practice settings. Thus, these settings are important arenas supporting student teachers in their development of capacities for sustainability education. Hence, how sustainability is understood and addressed by staff in teaching practice settings is of special importance for the overall implementation of sustainability in ECEC.

Reports by The Finnish Education Evaluation Centre (FINEEC) indicate that the staff is unsure of how to work with sustainability in daily practice (Repo et al., 2018), and that sustainability is even seen by some as an alternative pedagogy (Repo et al., 2019). According to FINEEC reports, staff desire a clear pattern for the principles of developing a sustainable organizational culture and wish to have more concrete examples of how to implement policy on sustainability education into practice. These reports raise questions about the implementation of sustainability education in teaching practice settings and their readiness to enhance student teachers' capacities in this urgent matter.

Thus, the aim of the current study was to explore the sustainability work of Finnish ECEC teaching practice settings. The study was guided by the following research question: How is sustainability currently addressed within the settings? More specifically, we studied what practices and pedagogies the teams reported to adopt in their daily work. The research phenomenon was explored from a staff perspective in partner settings of University of Helsinki during early Spring 2020.

Theoretical framework

In this section, we first address some of the core concepts of this study. We then give an overview of previous research in the realm of the study and present some of the central theoretical perspectives that underpin our research.

Conceptual cornerstones: Sustainability and sustainability education

Lately, the concept *sustainability* has increasingly been used in both science and policy. In this article, we use the concept to refer to a condition where human life does not hurt any life (human or non-human) on Earth today or in the future (Wolff & Furu, 2018). Sustainability thereby includes the protection of ecological diversity as well as a fair distribution of resources among people. However, the concept *sustainable development* is still widely used in both policy and research. Although widespread, the concept has been criticized for its association with a neoliberalistic paradigm based on economic growth (e.g. Wolff, Sjöblom, Hofman-Bergholm & Palmberg, 2017; Ideland, 2019). The concept stems from the Brundtland Report *Our Common Future* (WCED, 1987) which states that a sustainable development must guarantee a good life also for future generations. The concept sustainable development is also used in the *The Agenda 2030* (United Nations, 2015), which is currently the main international agreement aiming concerning global sustainable development. During the past few years, this agreement has increasingly been addressed in sustainability education as well as ECEC policy (e.g. Corcoran, Weakland & Wals, 2017; Siraj-Blatchford, Mogharreban & Park, 2016).

In the research literature, two main definitions of *sustainability education* can be found (Hedefalk, Almqvist & Östman, 2015; Wolff, Skarstein & Skarstein, 2020). Firstly, it is defined based on three interrelated dimensions i.e.

education *about, in* and *for* the environment. The word 'about' emphasizes cognitive aspects of education; 'in' highlights the educational experiences taking place in the environment; and 'for' recognizes the need for action and for developing environmentally friendly or sustainable behavior. Secondly, sustainability education is defined according to three interrelated dimensions of sustainable development: the ecological, the social/cultural, and the economic. However, the division of sustainability into separate dimensions have also met critique, especially that the economic dimension is separated as its own dimension, which according to Sauvé (2002) signals that economic interests dominate our world. In this article, we use the expression sustainability education in a broad sense, including the entirety of educational practices that make transformation of values, attitudes, knowledge and skills related to sustainability possible.

In their review of previous research Wolff, Skarstein and Skarstein (2020) distinguish four ideas on what sustainability education in the early years might focus on. The *outdoor play and learning* idea emphasizes children's opportunities to become familiar and build meaningful relationships with nature through sensory rich exploration and self-directed play. It also promotes children's agency in learning and give adults an important role as role models in showing their interest, knowledge and appreciation for nature. In the *competent child and agency* idea children are viewed as active participants with their own rights and their own views of the world. The idea of *practice architecture* emphasizes that ECEC settings should be places that practice sustainability with the adults as role models working together with children. The *posthumanistic approaches* counters the deeply entrenched notion of human exceptionalism.

Finnish ECEC at glance

Finnish ECEC is part of the Nordic tradition and builds on core values such as democracy, caring, and competence (Einarsdottir et al., 2015). The basic values in the national core curricula for ECEC are based on international and national agreements (Finnish National Agency for Education, 2020). Finnish ECEC adopts an integrated approach to care, education and teaching, with a particular emphasis on pedagogy. It aims at promoting children's holistic growth, development and learning and ECEC settings work in tight collaboration with the caregivers. Children are viewed as active participants and the pedagogy is driven by playful learning. The ECEC setting is understood as a community where children and staff learn together and from each other. Education for children aged 0-5 yrs (day care) and for children aged 6 yrs (pre-primary) are integrated parts of the educational system. ECEC is mainly provided by municipalities in day care centers, along with a relatively small number of private providers. The Act on Early Childhood Education and Care (2018) states that staff teams consist of either two teachers in early childhood education and care and one child carer or one teacher, one social pedagogue and one child carer. Lack of educated staff is however a challenge in many settings.

Although ECEC inherently addresses many sustainability related issues (Ärlemalm-Hagsér & Pramling Samuelsson, 2018) and environmental issues have been part of the framework for Finnish ECEC since the 1980s, sustainability is a relatively new concept in Finnish curricula for the early years. It was introduced in the *Act on Early Childhood Education and Care* in 2015 and in the *National Core Curriculum for Early Childhood Education and Care* in 2016 and the *National Core Curriculum for Pre-primary Education* in 2014. The Act states that every child has the right to develop versatile skills, which lay the foundation for a sustainable lifestyle. The national core curricula highlight sustainability in four dimensions (ecological, social, cultural, and economic) and the organizational culture is supposed to build upon the principle of sustainability (Finnish National Agency for Education, 2014; 2018). When it comes to how these principles and objectives are to be realized in daily work, however, few specific instructions are given. It is therefore assumed that sustainability education follows the overall pedagogical approaches in contemporary Finnish ECEC.

Previous research into sustainability in ECEC and ECEC teacher training

Research on sustainability in ECEC has increased in recent years (Elliott, Ärlemalm-Hagsér & Davis, 2020; Hedefalk, Almqvist & Östman, 2015; Somerville & Williams, 2015). Most studies have targeted the ecological dimension through various environmental aspects of sustainability education in the early years. To a lesser extent, studies have

addressed the economic and social/cultural dimensions of sustainability education in the early years (Ärlemalm-Hagsér, Berg & Sandberg, 2018). A general shift towards promoting children's agency for change and civic participation can be seen (Huggins & Evans, 2018) as well as a turn towards building on relational worldviews (Weldemariam & Wals, 2020).

However, available research indicates that both ECEC student teachers and staff are unsure of what sustainability means and how sustainability education for children can be realized (Dyment et al., 2014, Huggins & Evans, 2018; Wolff & Furu, 2018). According to Ärlemalm-Hagsér and Elliott (2017) there is a need for studies of transformational pedagogies that promote sustainability among educators, especially in pre-service teacher education, and support staff to be "leaders for culture change" (Ferreira, Ryan & Davis, 2015). Moreover, as Huckle and Wals (2015) argue, it must be considered that research and literature so far seem to have failed to acknowledge or challenge neoliberalism as a hegemonic force blocking transitions towards genuine sustainability.

Previous research on sustainability in the ECEC context shows that sustainability education is a multifaceted issue. Research on environmental behavior has shown that sharing knowledge alone is not enough to change behavior (Kollmus & Agyeman, 2002). Individuals need to become engaged in questions that mean something to them, that is, knowledge has to be grounded in their own bodies and feelings (Emilsson & Johansson, 2017). Children, as well as staff and students, need opportunities to make meaning of their own experiences (Furu & Kaihoviirta, 2020; Furu, 2019). When children can create their own meaning, knowledge becomes integrated with their emotions and children own that knowledge (Pramling Samuelsson & Park, 2017). Taylor (2017) and Wals (2017) underline that a shift is needed in terms of supporting an understanding of humans as part of nature, capable of caring and supporting the web of life. In this sense, nature contact is at the core (Beery et al., 2020).

In Finland, research on sustainability education in the context of ECEC is sparse. To date, there are no studies on sustainability in ECEC teaching practice settings and only a few studies on how staff and/or student teachers understand and/or address sustainability issues (Reunamo & Suomela, 2013; Salonen & Tast, 2013; Salonen & Hakari, 2018; Wolff & Furu, 2018; Furu, Wolff & Suomela, 2018). Reunamo and Suomela (2013) set out to study how staff valued and approached "extended environmental education" in ECEC in the light of the extended Palmer's model of environmental education (Palmer, 1998). The results showed that staff focused mainly on learning aspects and social relations, while ethical and participatory aspects of environmental education were not as highly valued in the daily work. The studies by Salonen & Tast (2013) and Salonen & Hakari (2018) reveal a gap between attitudes and actions among ECEC staff in their daily lives. Albeit good intentions, the educators in the study did not adopt a sustainable lifestyle due to lack of time and resources are perceived as obstacles. Interestingly, age was a defining factor, as older educators were more prone to live sustainably than young educators. The results of the three above mentioned studies raise questions both on how staff in ECEC approach sustainability issues in their work and on how their personal attitudes, awareness, and knowledge might impact their work as educators. They are however based on empirical research which was conducted already in 2012. This means that the results might not be valid in the current situation, as the societal context and our collective understanding of sustainability issues have changed and rapidly in the past few years and become more visible both in the child culture and within the ECEC context. Studies by Wolff and Furu (2018) and Furu, Wolff and Suomela (2018) show that the understanding of sustainability issues among student teachers varies considerably and that most students have a limited understanding of how the concept can be interpreted in the realm of ECEC. Studies by Furu (forthcoming) and Furu and Kaihoviirta (in progress) show that sustainability issues are addressed with great variability in ECEC settings. Sustainability education is currently not addressed systematically due to knowledge gaps among staff and organizational challenges (e.g. lack of leadership). Another potential cause is the lack of professional language for these matters among staff.

Methodology

The research reported in this article is based on a study where the sustainability work was explored through ECEC staff's descriptions and self-ratings of their daily practices and pedagogies. An understanding of the research phenomenon was developed on basis of analysis and interpretation of the responses to a tool including quantitative

as well as qualitative data. As such, the study is methodologically a form of *bricolage* (Denzin & Lincoln, 2018) or a quilt of data that provides different perspectives on the research phenomenon.

Data collection tool

The *Assessment Tool for Promoting Sustainability in ECEC* (PROSUS) by Furu & Valkonen (2020) was used as data collection tool. PROSUS is an adapted version of the OMEP Environmental Rating Scale for Sustainable Development in Early Childhood (ESD Rating Scale). The OMEP ESD Rating Scale was originally developed as a tool for enhancing ECEC quality with special focus on sustainability issues (Siraj-Blatchford, Mogharreban & Park, 2016). It has been translated to several languages and adopted globally during the past years.

Based upon experiences from previous research utilizing the Swedish version of ESD Rating Scale in Finnish context (Furu, forthcoming; Furu & Kaihovirta, in progress), a translation and major adaptation was made in order to better fit the Finnish legislation and national core curricula for the early years as well as contemporary research on sustainability education in ECEC. Therefore, PROSUS builds on five aspects in each dimension of sustainability (see Table 1).

Table 1
The three dimensions and respective five aspects (A-E)

<p>1 Ecological sustainability</p> <p>1A To understand oneself as part of the ecosystem 1B To have a respectful relationship with nature 1C To enjoy, play and learn in nature 1D To take responsibility for the environment 1E To prevent and mitigate environmental problems</p>
<p>2 Social and cultural sustainability</p> <p>2A To develop social and emotional skills and prevent bullying 2B To promote equality and address individual needs 2C To respect multiculturalism 2D To promote gender equality and to conduct gender sensitive education 2E To address the diversity of families</p>
<p>3 Economic sustainability</p> <p>3A To learn modesty and economy 3B To make responsible acquisitions and use materials and resources in a sustainable manner 3C To use energy and water in a sustainable way 3D To develop a conscious approach to food 3E To develop a healthy life style and physical and mental health</p>

PROSUS contains one open question for each aspect, all following the same model: “In what ways do you currently address (...) in your daily practice?” and a 7-point rating scale for each aspect with descriptive indicators based on general principles as follows:

1 (inadequate) indicates that the issue is not addressed or only sporadically or seldom

3 (minimal) indicates that the issue is addressed to some extent, but mainly from a teacher perspective

5 (good) indicates that the issue is explored and discussed on a regular basis in versatile ways where children are active participants engaging in playful and arts-based learning and critical reflection

7 (excellent) indicates that the issue is addressed systematically in a goal-oriented manner that involves external actors from the local community and pays regard to global perspectives

For every dimension, there is also an open-ended question, following the model: “What ideas do you have for developing (...) sustainability in your daily practice?” where teams can put forth any suggestions and ideas. The scoring system consists of a 7-point scale (see above) but the respondents also used interim points of 2, 4, and 6. These interim points were recoded according to the following: 2=1, 4=3, 6=5. Each team is also given the possibility to describe any ideas or reflections they have about how they could address each dimension of sustainability in their future work. In the current study, the tool was materialized as a paper questionnaire, but the tool was digitalized in January 2021¹.

Context

The study was conducted in Spring 2020 in collaboration with partner settings (day care centers and pre-primary schools) of the Swedish ECEC teacher education at the Faculty of Education at the University of Helsinki, Finland. Of the 18 partner settings, five settings had completed the questionnaire previously and were therefore excluded from this study. The questionnaires were sent to all remaining partner settings (n=13) and of these 11 settings participated in the study. All settings are municipal and located in the Helsinki metropolitan area. Altogether, 34 teams participated in the study. 6 teams were working with children 1-3 years, 10 teams with children aged 3-5 years, 2 teams with children aged 1-5 years, and 4 teams with mixed ages. Twelve teams worked with children aged 6 yrs (pre-primary schools). The participating teams consisted of both educated staff with appropriate education for ECEC and un-educated staff. According to current legislation, Finnish ECEC teams consist of a minimum of three staff members, preferably one teacher in ECEC (who is also the team leader), one social pedagogue in ECEC, and one childcarer. All pre-primary school teams included a teacher in ECEC, but nearly half (n=11) of the teams in day-care centers did not include a teacher in ECEC. This reflects the national shortage of teachers in ECEC. The teams lacking a teacher in ECEC were commonly led by a social pedagogue who has basic studies in early childhood education (60 ECTS or higher education credits²).

The teams were asked to work with the questionnaire in three steps. First, each team member was asked to individually reflect on and describe the sustainability practices aligned to each aspect on the rating scale. Second, teams were asked to gather for common reflection and discussion around each aspect on the scale and to rate their

¹ Link to information in English about the PROSUS tool as well as versions in Swedish and Finnish: <https://blogs2.abo.fi/prosus-projektet/the-tool/>

² Finnish higher education institutions use the ECTS system (European Credit Transfer and Accumulation System) in measuring a student’s workload. In this system one full-time academic year is equivalent to 60 higher education credits.

work according to the scoring system. They were also instructed to collaboratively bring up and describe any ideas around future work on each dimension. Third, all team leaders filled out the PROSUS questionnaire that was sent back to the researcher as well as a form with background data concerning staff composition and educational background, number and ages of children in the group, as well as special interests and/or knowledge in terms of sustainability.

Analysis and interpretation

The study is based on a qualitative analysis of the written data obtained in the PROSUS questionnaire from all teams (n=34). Initially, a descriptive content analysis was adopted within each aspect and each dimension. The analysis was guided by giving attention to content and form of sustainability engagement in the descriptions staff had provided. In the following stage, recurrent themes and patterns across the data were identified in search for narratives that reflect how staff understand and address sustainability issues in ECEC. Thereafter, data was analyzed critically with focus on silences and exceptions in order to identify possible counter-narratives within data in order to understand the issues in sustainability education that are currently not addressed and that are under-developed. A quantitative analysis of the collected numerical data obtained in the PROSUS provides an illustration in the form of descriptive statistics (mean, median and standard deviation) (Table 2). Two questionnaires were excluded from the quantitative analysis due to too much missing data. The sample used in the quantitative analysis thus consisted of 32 teams. IBM SPSS Statistics 24 was used to analyze the data. Lastly, the analysis of both quantitative and qualitative data was reflexively interpreted and scrutinized in the light of prior research.

Ethical considerations

The study follows the ethical principles of research issued by the Finnish National Board on Research Integrity (TENK, 2012). The leaders of Swedish ECEC in the municipalities with partner settings were informed about the research project and research permissions were obtained. The ECEC settings were contacted by phone and e-mail and questionnaires were sent to the center directors of the participating settings. All responses were given a numerical code (municipality, day care unit, and team) in order to guarantee confidentiality during the process of reporting of results.

Results

The analysis of the answers to the open questions in the PROSUS tool shows that sustainability is addressed in all ECEC teaching practice settings that took part in this study, but with great variability in terms of extent and depth in how each of the three sustainability dimensions are implemented by the teams. While some settings do not give any answers to some of the questions posed, others provide rich descriptions with many examples of their current practices and pedagogies. Below, we first present metanarratives of how each dimension of sustainability is addressed by the participating teams in the ECEC teaching practice settings. We describe the daily practices, and pedagogical approaches made visible in the written responses and the values and pedagogical foundation they rely on. Thereafter we present how these metanarratives correspond with numerical assessment of sustainability work.

Ecological sustainability work as connecting to nature, but not worrying children

Ecological sustainability is addressed by the teams mainly through promoting children's nature contact and by supporting pro-environmental behavior. Nature contact is supported in versatile ways and affordances for children to *enjoy, play, rest* and *marvel* are provided. Spending time outdoors and/or in nature every week or even daily is a prominent element in this narrative. Seasonal changes in nature are noted and discussed. Children and staff observe nature together and use specific vocabulary for plants, birds and animals. Emphasis is put on respecting and caring about all forms of life. Altogether, the dominant worldview that emerges from this narrative is anthropocentric, i.e., humans are predominantly described as separated from Nature. Interestingly, there are traces of a more ecocentric view of humans as connected to the entire web of life in that stories and picture books are mentioned as materials

that support the understanding of oneself as part of the ecosystem. Only one team addresses the importance of biodiversity explicitly as they state *"We are all dependent on each other. Even humans."* (team no 23).

A prominent feature of ecological sustainability work is the focus on litter. Children and staff collect litter during walks and trips, and sorting rubbish is part of the daily practice. Some teams mention that lack of separate dustbins for paper, glass, carbon, plastic, and compost prevent them from addressing the "reduce, reuse, recycle" approach fully. This follows the tradition of environmental education that has long been part of Finnish ECEC. However, taking a broad responsibility for the environment as well as preventing or mitigating environmental problems is a delicate topic. Some teams point out that, depending on the age of the children, this is a balancing act and they avoid the topics altogether in order not to create worries or anxiety among children and only suggest these issues be addressed if children initiate the discussion and/or in collaboration with the parents. At the same time, other teams say that children do bring up questions and discussions on these topics, as they encounter them in media and in their families. Altogether, the narrative about current sustainability work in the ecological dimension reflects the tradition of focusing on nature in early years education since its beginning as well as the emphasis on environmental education that was evident before the turn of the millennium (Ärlemalm-Hagsér & Elliott, 2020). In this sense, although the practices and pedagogies are implicitly in some settings in transition towards more biocentric or ecocentric worldviews, the broad picture is one of teaching practice settings not explicitly addressing the worldviews and values underlying sustainability education in the ecological dimension.

Social and cultural sustainability work is to respect each other

Social and cultural sustainability is a commonly addressed topic in all teams. In general, teams have formal plans for promotion of equality and prevention of bullying. Fostering social skills among the children through for example *friendship rules, being a good friend, active involvement in solving conflicts* is mentioned as a core of the pedagogical work. This dimension is approached from a basic values perspective where *equality* is key. All children's participation regardless of age, gender, ethnicity, language or ability is underlined. Some teams explicitly stress that they strive to *see and hear all children in the group* and to *meet their individual needs*.

Multicultural education is mainly implemented through stories and toys that reflect diversity. Some groups also celebrate the feasts of several cultures. A general pattern is that language, culture, and religion is discussed according to what is represented in the group of children. Gender is mainly addressed through fostering an *attitude of openness* and critique towards stereotyped play or clothing. Some teams mention gender sensitivity and gender education as their approaches. The diversity of families is mostly addressed by means of a *respectful atmosphere* and the explicit support of respectful approaches. Some teams describe that they bring up discussions concerning the fact that families are different or live differently but still have the same value. This dimension of sustainability education is in general approached thoroughly and with reference to specific underlying values, which implies that ECEC teaching practice settings are well equipped to support student teachers in working in this field.

Economic sustainability work is to take responsibility for the use of resources

The teams address economic sustainability mainly as a matter of being mindful and modest in use of resources. Teams involve children in discussions about being grateful and understanding the economic value of for example toys and materials. Co-use of toys and tools between several teams within one setting is widespread. Teams mention that they foster children to be careful with toys and books and that they strive to repair broken items. Arts and crafts are arenas for re-use of all sorts of materials and for use of materials from nature. Recycling and sorting of materials are also mentioned. Some teams describe how organizational structures hinder a more active sustainability education. Municipal bureaucracy is perceived as an obstacle that limit their influence when toys, tools or materials are to be bought.

Food is a prominent issue within this dimension and most teams aim at reducing leftovers by letting children help themselves at the table. As children learn to take responsibility for their own hunger/satiety they also learn to estimate what amount of food is suitable at each meal. Many settings occasionally serve vegetarian food and some

serve locally produced or organic food. Health is an issue that is actively addressed by many teams through the daily routines of movement, food, play, and rest. Several teams mention the importance of discussing with children on why these habits support wellbeing and why they are an important part of sustainability at the individual level. Overall, this dimension of sustainability work is focused on the daily life of the setting, rather than understanding the life of the setting as related to a broader picture of economic sustainability on the municipal or even national or global level.

Quantitative data illustrate qualitative data

The results from the quantitative data are in line with results from the qualitative data. However, whilst the metanarratives are composed of content from all teams, some of the variation between teams is made visible by the quantitative data. Descriptive statistics illustrate that the scores on all dimensions and aspects are between 'minimal' and 'good' (Table 2) and that there is considerable variation between teams and between aspects as individual teams may score higher or lower on specific aspects. In the ecological dimension the median is 'good' for 1A (To understand oneself as part of the ecosystem), 1B (To have a respectful relationship with nature) and 1C (To enjoy, play and learn in nature), but lower on the rest. The medians of the social and cultural dimension vary with slightly higher scores on subscales 2A (To develop social and emotional skills and prevent bullying) and 2B (To promote equality and address individual needs) and lower on the rest. The medians are lower for the economic dimension than for the other two dimensions, except for the subscale 3E (To develop a healthy lifestyle and physical and mental health) where the score is 'good'.

Table 2
Dimensions and aspects of sustainability ($n=32$)

Dimensions and aspects	<i>Md (M)</i>	<i>SD</i>	Min-Max	Levels
Ecological (sum)	4.0 (4.0)	.97	1.00-5.80	minimal
1A	5.0 (4.2)	1.50	1-7	good
1B	5.0 (4.7)	1.35	1-7	good
1C	5.0 (4.4)	1.48	1-7	good
1D	3.0 (3.8)	1.32	1-5	minimal
1E	3.0 (2.7)	1.35	1-5	minimal
Social and cultural (sum)	4.1 (4.2)	1.00	2.20-6.60	minimal
2A	5.0 (5.5)	1.24	3-7	good
2B	5.0 (4.6)	1.07	3-7	good
2C	3.0 (3.6)	1.63	1-7	minimal
2D	3.0 (4.0)	1.25	3-7	minimal
2E	3.0 (3.5)	1.76	1-7	minimal
Economic (sum)	3.4 (3.4)	1.01	1.00-5.00	minimal
3A	3.0 (3.0)	1.52	1-5	minimal
3B	3.0 (3.3)	1.69	1-7	minimal
3C	3.0 (3.0)	1.17	1-5	minimal
3D	3.0 (3.4)	1.32	1-7	minimal
3E	5.0 (4.4)	1.39	1-7	good

To sum up, the results show that sustainability is understood and implemented variably by the participating teams. Both quantitative and qualitative data show that sustainability work is generally implemented predominantly in a teacher-dominated way. Both scores and answers to open questions indicate that most settings perceive their sustainability work in terms of levels 'minimal' to 'good'. As a consequence, student teachers in ECEC teaching practice are encountering highly variable pedagogies and practices in terms of sustainability work.

While some teams explicitly mention their basic values or pedagogical goals, others just briefly mention specific activities that they include in their daily practice such as outdoor education, collecting waste, using recycled materials, or supporting gender neutral play with toys. Although there are some examples of teams with integrated and systematic approaches from values to practices, most teams address sustainability item by item. By and large, the teams rely on practical and pedagogical approaches that express sustainability as a matter of individual choices (in line with the prevailing consumer culture) rather than a matter of integrated values or global citizenship. This is in line with recent research Ginsburg & Audley (2020) on sustainability education in early childhood in the US.

Further, the three dimensions of sustainability are addressed as separate entities. Although some teams are working actively with several aspects of all three dimensions of sustainability, a general pattern is that the social/cultural dimension is addressed more in depth than the ecological and economic dimensions respectively. These findings are in line with Årlemalm-Hagsér, Berg and Sandberg (2018).

With respect to prevailing worldviews, anthropocentrism is far more common than a biocentrism although there are some traces of post-humanistic perspectives (e.g. Taylor, 2017; Weldemariam & Wals, 2020). Teams describe their approach to sustainability by referring to contents and materials, while descriptions of pedagogical thinking are less common. Six teams report that at least one member of their staff is a certified eco-supporter³, who has been educated to promote ecological awareness in the workplace. Two teams report that they implement the Swedish Skogsmulle approach⁴ and hence also work intentionally on several aspects of ecological sustainability. In the data, there are no visible common pedagogical practices to implement sustainability. Examples of what values, attitudes, knowledge, or skills staff strive to support among children are scarce. Only a few teams explicitly describe their practice in terms of their view of both children and early learning. However, some teams use verbs such as *teach*, *tell*, *discuss*, *reflect* or *listen to children* in order to support sustainability to describe sustainability related activities. Some teams underline that they *play* or *create* together with the children. Others *observe*, *explore*, *investigate*, *experiment*. These differences in descriptions reflect the varying child views and possibilities of children to actively participate in and influence how sustainability issues are addressed (Pramling Samuelsson & Park, 2017).

Generally, staff emphasize themselves as role models, which indicates that the shift towards a sustainability education where children's active participation is still under way (Huggins & Evans, 2018). The results indicate that the overall pedagogical pattern is still one where staff initiate actions or routines that make it possible for children to develop habits related to sustainability issues. However, some teams have integrated themes and approaches into both their daily practice and their pedagogy. They create opportunities for children's learning related to specific contexts (place-based or time-based). There are some instances of how staff support children's play-based or arts-based paths to exploration of sustainability matters. This enables various forms of experiential learning which include bodily and emotional aspects in line with (Emilson & Johansson, 2017). There are occasional instances of reflection and discussion, but these are not described as preferred pedagogical approaches to sustainability education.

In conclusion, the results from this study are in line with previous research which show that uncertainty prevails in terms of how sustainability education can be turned into a living practice in early years education (Huggins & Evans, 2018). Values and attitudes are in general not explicitly expressed by the teams and sustainability work is only occasionally described as integrated into a pedagogical framework around contemporary views of children,

³ The eco-support system was developed in the city of Helsinki in 2006 and has since then spread to other municipalities in the Helsinki Metropolitan area. More information about the can be found at <https://www.ekotuki.fi/en/activity>.

⁴ This approach to outdoor education for the early years which was developed in Sweden in the 1950ies by Gösta Frohm. It is currently practiced in all parts of Scandinavia. The aim of the approach is to support children's nature connectedness and pro-environmental behavior through outdoor education. The approach has some similarities with Forest kindergartens and it is described in English by Rose Joyce in her (2012) *Outdoor Learning: Past and Present*.

knowledge, and learning. Neither is children's agency stated as part of the sustainability work in the participating teaching practice settings. This is in sharp contradiction to contemporary theoretical foundation of sustainability education in the early years (Elliott, Ärlemalm-Hagsér & Davis, 2020; Huggins & Evans, 2018; Somerville & Williams, 2015).

Discussion

This study has directed focus towards the sustainability work of ECEC teams in teaching practice settings in Finland. Based upon the findings of the study, student teachers are not in an equal position when it comes to developing their capacities for sustainability work during their practice. There is considerable variability among teaching practice settings regarding how sustainability is understood and addressed. The study indicates that there is currently no common knowledge basis or praxis in terms of how sustainability could be addressed pedagogically in the early years. These results are in line with the results of the national evaluation of ECEC settings by Repo et al. (2018; 2019) and previous studies of how sustainability education policy is implemented in practice in Finnish ECEC (Furu, forthcoming). It can also be understood as a knowledge-practice or rhetoric-reality gap among practitioners (Ärlemalm-Hagsér & Elliott, 2020). Further, there seems to be a lack of vocabulary related to sustainability issues among staff in ECEC settings. As language and communicative practices are vital parts of the organizational culture and crucial in all educational processes, these silences in the data are troublesome with respect to further development of sustainability within ECEC settings. Although tacit knowledge is valuable, the development of a professional language for sustainability education in the early years might be one of the keys to promoting sustainability work in ECEC.

The findings of the study also raise questions about the need for opportunities for both staff and student teachers to develop their capacities for transformative sustainability education. Most settings are not yet fully integrating sustainability into their daily practices and their pedagogy. To some extent, this might be related to the fact that part of the staff is either un-educated or not pedagogically educated. This highlights the importance of professional development for entire teams, independently of background education or role in the team. According to Tomas et al. (2017) the attitudes of student teachers to sustainability education are of importance and that praxis-oriented forms of education are perceived to contribute to the overall capacity to engage in sustainability education. Another issue that is raised by the results of the study is the crucial role of both leaders and center directors as they are in a key position in promoting educational transformation. Furthermore, attention needs to be directed to what resources settings can utilize when turning (new) policy into practice. These aspects become even more urgent in the teaching practice settings as there is overall uncertainty prevailing in the field and new teachers might be a driving force in strengthening sustainability work as they enter their first workplace.

There are some methodological issues that need to be commented upon here. Naturally, the PROSUS cannot fully represent how sustainability is understood or addressed, as some aspects of it might be a form of tacit knowledge. Further, the procedure of responding to the PROSUS may have varied slightly between settings and across teams and it is not possible to determine if – and to what extent – all members of staff have been involved in the process. Comparisons between qualitative and quantitative data indicate that there might be tendencies to underrate/overrate when scoring sustainability work in the team. Furthermore, the sample of this study is limited and cannot be generalized. Thus, further studies are needed to confirm these findings and explore this issue in more detail.

Altogether, we argue that in order to genuinely promote ECEC student teachers' learning in terms of sustainability issues, sustainability work needs to be an integrated aspect of the daily practices and the pedagogy in ECEC teaching practice settings. To this end, it should be a both visible and verbalized aspect of the working culture. It still remains unclear whether or not sustainability is an established part of collegial reflection and discussion and to what extent municipal leadership in ECEC and center directors support bringing sustainability issues to the fore. In this respect, tools like the PROSUS might encourage both leaders in ECEC as well as center directors to promote reflection and discussion among staff.

The findings of this study indicate that the learning environment as a whole as well as the pedagogical atmosphere in ECEC teacher training settings are not yet permeated by sustainability and that sustainability education for staff and student teachers is urgently needed. There is no doubt about the magnitude of the sustainability crisis and the need for rapid transformation. Further research is needed to deepen our understanding of how different aspects – from values to daily habits – of the working culture in ECEC teaching practice settings can enhance sustainability work and education among young children and thus support transformation towards a sustainable world.

Disclosure statement

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Gearing up for sustainability education in Finnish early childhood education and care (ECEC): Exploring practices and pedagogies by means of collegial reflection and discussion

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ABSTRACT

Finnish legislation and policy on early childhood education and care (ECEC) express sustainability as a basic value. The national core curricula state that, during their years in ECEC, all children have the right to develop necessary values, knowledge and skills for living a sustainable life. Furthermore, early years education should be permeated by the principles of sustainability. However, research suggests that there is unclarity concerning how sustainability can be implemented in practice and pedagogy (Repo et al., 2018; 2019; Furu, forthcoming). Hence, the aim of this study was to explore how sustainability is currently done in ECEC settings in Finland. Further, we wanted to look into how the use of the recently developed *Assessment Tool for Promotion of Sustainability in ECEC* (PROSUS) by Furu and Valkonen (2020) might enhance sustainability work among teams (n=15) in ECEC settings in Finland. Based upon the findings, sustainability education is understood and implemented variably by the teams. This indicates that children are provided unequal opportunities for developing the basic capacities needed for leading a sustainable life. The study also makes visible how the PROSUS might enhance collegial learning regarding sustainability work and underlines the importance of collaborative practices in developing sustainability education in the early years' context.

Keywords: early childhood education and care, continuous professional development, organization culture, sustainability

During the past few decades, matters of sustainability have gained increasing attention in both policy and research within the ECEC context. Loss of biodiversity, climate change, pollution of air and water, and population growth are but a few examples of the multiple crises that are rapidly unfolding in the front of our eyes and threatening the future of our children. We are, in fact, living in times of “planetary emergency” as Alden Meyer, the director of strategy and policy at the Union of Concerned Scientists, stated in December 2018 at the Climate Summit in Katowice, Poland (Sutton, 2018). It is evident that rapid changes are needed in order to secure a sustainable future for both people and planet.

Since the 1970s, there has been general agreement that there is an ongoing sustainability crisis and that humanity has to embark on a new path in order not to destroy the prerequisites for a good life for all, within the capacity of the Planet. It has also been stated that education has an important part to play in the enhancement of sustainability at all levels in our societies and communities. This also applies to ECEC as the first part of the life-long learning path. However, by and large, policy has not yet resulted in practice and little progress have been made in terms of transforming our societies towards sustainability in the long term (United Nations, 2019).

In recent years, focus has increasingly been put on how the challenges we are facing might adversely affect the lives of children across our globe (Clark et al., 2020; WHO, 2017). It is widely acknowledged that children are likely to suffer most from the challenges ahead (Siraj-Blatchford, Mogharreban & Park, 2016; United Nations 2019). Thus, children must get the chance to develop necessary awareness, values, knowledge and capacity in order to be capable to live a sustainable life (e.g. UNESCO, 2014). International agreements, such as the Agenda 2030 (United Nations, 2015), emphasize that children and young people are important agents in the pursuit of sustainability. Hence, they must be included as active participants and change makers in societal transformation both within education and in the wider society. In line with work by James and Prout (1997), young children's civic participation has been acknowledged during the past few decades and Hart (1997) underlined children's right to participation in environmental matters. Children's participation has also been identified as a vital part of resilience (Sanson, Van Hoorn & Burke, 2019) i.e. the shared capacity to constructively meet challenges and adversities in life (Masten & Barnes, 2018). Consequently, ECEC has an important part to play in developing sustainability and supporting resilience among children and communities (Elliott, Årlemalm-Hagsér & Davis, 2020; Huggins & Evans, 2018).

Against this background, this article looks into how the above related matters can be promoted, by reporting a study situated in the Finnish ECEC context. Sustainability was introduced in the 2015 *Act on early childhood education and care*. It is also mentioned in the *National Core Curriculum for Early Childhood Education and Care 2016* (Finnish National Agency for Education, 2018) as well as the *National Core Curriculum for Pre-primary Education 2014* (Finnish National Agency for Education, 2016). Both legislation and current national core curricula state that all children have the right to develop the prerequisites of a sustainable lifestyle. However, research on how policy is implemented in practice is scarce. Existing studies indicate that it is currently integrated into educational practices with great variability (Furu, Wolff & Suomela, 2018; Wolff & Furu, 2018; Furu, forthcoming). According to the national core curricula, sustainability should also be an inherent aspect of the organizational culture of ECEC, but there is still limited research on whether this is realized. In a recent study, Furu and Heilala (accepted) state that there is great variability in how sustainability work is understood and conducted by ECEC teams and that organizational cultures must be developed in order to support sustainability education.

Hence, the aim of this study was to explore how sustainability is currently done in ECEC settings in Finland. Further, we wanted to look into how sustainability might be facilitated the recently developed *Assessment Tool for Promotion of Sustainability in ECEC* (PROSUS) by Furu and Valkonen (2020) in the participating teams. The study was guided by two research questions:

1. What practices and pedagogies are made visible by staff in ECEC?
2. Does the PROSUS tool promote collegial professional development? If so, how?

In the following, we first provide an overview of some core concepts of the study, relevant previous research and theoretical underpinnings regarding sustainability education in ECEC. Thereafter, we present the methodological framework of the study. In the following section we discuss the core concepts of the study. We also present some of the previous research related to sustainability work within the ECEC context. Lastly, we outline the theoretical underpinnings of sustainability education in Finnish ECEC.

Theoretical foundation

In this article, the concepts *sustainability* and *sustainable development* both occur. The concept *sustainable development* stems from the Brundtland Report *Our Common Future* (WCED, 1987) which stated that a sustainable development must guarantee a good life also for future generations. The concept was also used in the *The Agenda 2030* (United Nations, 2015), which is currently the main international agreement aiming concerning global sustainable development. During the past few years, this agreement has increasingly been addressed in sustainability education as well as ECEC policy (eg. Elliott, Årlemalm-Hagsér & Davis, 2020). Although the concept sustainable development is still widely used in both policy and research, it has increasingly been criticized for its linkage to a neoliberalistic paradigm based on economic growth (Wolff, Sjöblom, Hofman-Bergholm & Palmberg,

2017; Ideland, 2019). We therefore prefer to use the concept sustainability, as it lacks these linkages. Instead, sustainability refers to a condition where human life that does not hurt any life (human or non-human) on Earth today or in the future (Wolff & Furu, 2018). Sustainability thereby includes the protection of ecological diversity as well as a fair distribution of resources among people. Further, in this article we use the overarching expression *sustainability work* to refer to both daily practices and goal oriented pedagogies that are conducted by staff in ECEC in order to promote sustainability in the form of values, knowledge, and skills in the learning community consisting of both children and adults.

The term *continuous professional development (CPD)* is central to our article. We use it to denote the collegial learning processes that are based on reflection and discussion among staff. In their literature review, Bove et al. (2018) underlined that CPD is an issue not only about the enhancement of individual knowledge or skills, but rather it encompasses a community of practice where critical reflection as well as political understanding of how issues of social injustice can be addressed through ECEC. Therefore, in our article CPD refers to processes involving not only individual teachers or leaders, but to the entire staff which is viewed as a learning community. This idea fits well in the enhancement-led evaluation which forms the frame of reference of national and local quality evaluation in Finnish ECEC (Vlasov et al., 2019).

Previous research on sustainability education in the ECEC context

During the last decade there has been a rapid increase in research concerning sustainability in the ECEC context (Elliot, Årlemalm-Hagsér & Davis, 2020). In the past few years, research has increasingly included post-humanist and post-colonial perspectives as well as Deleuzian rhizomatic methodologies. A review by Wolff, Skarstein and Skarstein (2020) stated that four ideas seem to drive sustainability education in the early years *outdoor play and learning, competent child and agency, practice architecture, and posthumanistic approaches*.

Pramling Samuelsson & Park (2017) suggested that sustainability education in ECEC is a value related issue, including educators' views of both children and learning whilst Bautista et al. (2018) underlined the need for dialogic approaches where staff create opportunities for children to have their voices heard on topics related to sustainability issues and where staff position themselves as co-constructors of knowledge. Knowledge has to be grounded in bodies and feelings (Emilson & Johansson, 2017). Children, as well as staff and students, need opportunities to make meaning of their own experiences (Furu & Kaihoviirta, 2020; Furu, 2019). When children can create their own meaning, knowledge becomes integrated with their emotions and children own that knowledge (Pramling Samuelsson & Park, 2017). Taylor (2017) and Wals (2017) underlined that a shift is needed in terms of supporting an understanding of humans as part of nature, capable of caring and supporting the web of life. In this sense, nature contact is at the core. These perspectives require professionalism and a willingness to embrace new pedagogical practices from staff.

Corcoran, Weakland and Wals (2017) argued that, in order to meet the challenges of our day, education – in every phase of our life – has to be truly transformative or even transgressive. Elliot, Årlemalm-Hagsér & Davis (2020) underlined the need for ECEC to challenge prevailing understandings of sustainability within the field of ECEC. These efforts are tightly related to work with policy and research as well as to the practices and pedagogies of each team. Rather than being a matter of developing individual interest or knowledge, sustainability is therefore a matter of learning communities, organizational cultures, and relational leadership. As such, it is dependent on processes of collegial learning and continuous professional development in the team or in the entire ECEC setting. However, as Huggins and Evans (2018) pointed out, many educators are not yet engaging in transformation of their practice. As the transition towards critical reflection and discussion is perceived uncertain, there is a risk that sustainability work is not perceived as a common educational responsibility, but rather as the individual pursuit of an expert, enthusiast, or eco-warrior. Hence, in order to enhance sustainability work in the ECEC context, focus needs to be directed towards professional development at the team level.

Årlemalm-Hagsér and Elliot (2017) underlined that further research is needed to explore how sustainability is understood and enacted in the daily activities in ECEC. OMEP conducted an international research and development collaboration during 2010-2013 (Siraj-Blatchford, Mogharreban & Park, 2016). This collaboration resulted in a tool

for assessment of sustainability practices in early childhood care and education, the *OMEP Environmental Rating Scale for Sustainable Development in Early Childhood* (ESD Rating Scale). ESD Rating Scale has now been translated into some ten languages and a second edition was published in 2019. The ESD Rating Scale was developed as a tool for enhancing ECEC quality with special focus on sustainability issues. As a result of the projects, the researchers underline the importance of raising the focus towards holistic solutions to the world's problems (Siraj-Blatchford, Mogharreban & Park, 2016).

In this study, the view of sustainability work is built on a relational ontology, which views humans as relational beings whose growth is dependent on mutual, respectful, and caring relations (Buber, 1958). Further, humans are considered as inseparable from the entire web of life (e.g. Taylor, 2017; Wals, 2017). Development and learning are thus understood as inherently relational processes (Bingham & Sidorkin, 2010; Papatheodorou & Moyles, 2009). As Weldemeriam and Wals (2020) pointed out, each child is relationally entangled with the world and the pedagogical focus within ECEC should therefore recognize diverse ways of knowing; intellectual, emotional, bodily, and social. Further, they argue that a pedagogical reorientation is necessary and suggest a move towards a relational pedagogy (or pedagogy of entanglement) where sustainability in ECEC recognizes the vibrancy nature of learning processes where sustainability emerges in encounters in the web of connections between humans and non-humans. As a consequence, we state that there is no "single child" or "single adult" in ECEC, but only humans who are deeply interrelated and intertwined with their fellow humans (children and adults) and their natural and socio-cultural environments. Human and non-human life is entangled in a web of life which provides rich opportunities for learning and development within the learning community.

Moreover, processes of transformation and transgression (development and learning) happen in rhizomatic, often unpredictable ways. Affordances which provide disorienting dilemmas (Mezirow, 2009) and have the capacity to promote new understandings or practices are therefore desirable. Hence, sustainability work relies on the shared understandings and practices of the team, as well as their capacities to collaboratively develop pedagogical practices that make the processes mentioned above possible.

Sustainability work in Finnish ECEC

Against the background of the multiple sustainability crises we are facing, sustainability work is receiving increasing attention in Finnish ECEC. According to the 2015 *Act on early childhood education and care* as well as the national core curricula for ECEC (0-5 yrs) and pre-primary education (6 yrs), all children have the right to develop the prerequisites for a sustainable life during their time in early years education (Finnish National Agency for Education, 2016; 2018). Sustainability in four dimensions (ecological, social, cultural, and economic) is part of the educational framework.

The entire organizational culture is supposed to build upon the principles of sustainability, but few specific instructions are given concerning how these principles and objectives are to be realized in daily work. Staff is in a key position to make change come about, but there are only a few studies on how staff in Finnish ECEC understand and/or address sustainability issues (Reunamo & Suomela, 2013; Salonen & Tast, 2013; Salonen & Hakari, 2018). These studies show that staff are finding sustainability an urgent matter, yet at the same time they do not implement it holistically in their work. As these studies were empirically conducted in 2012 they might not reflect the current situation. Current reports show that staff in ECEC perceive uncertainty concerning how sustainability can be addressed in relation to young children (Repo et al., 2018). Further, in some settings sustainability is even viewed as a form of alternative pedagogy (Repo et al., 2019). This might be due to the fact that sustainability can be considered an overlooked issue in ECEC teacher education until recently (Wolff & Furu, 2018; Furu, Wolff & Suomela, 2018). Although ECEC in Finland has a long tradition of addressing a variety of matters related to various dimensions of sustainability, such as supporting nature contact, protecting the environment, enhancing social equality and diversity, sustainability education is conceptually a relatively new entity. Current national development work does not deal with sustainability as a quality indicator and hence it is not a focus for evaluation per se (Vlasov et al., 2019). Therefore, it has been suggested that incorporating the principles of sustainability into ECEC requires assessment and, if found necessary, change of the organizational culture (Furu & Heilala, accepted).

Finnish ECEC builds on collaboration in multi-professional teams. According to the Act, it is recommended that each team is built from either two teachers and one child carer or one teacher, one social pedagogue, and one child carer. The teacher has the overall pedagogical responsibility, but all members contribute with their knowledge and skills. Collegial collaboration is considered a natural prerequisite for quality education (Finnish National Agency for Education, 2016; 2018, Repo et al., 2018; 2019). When it comes to development of practices and pedagogy, and continuous professional development at the team level, collegial learning becomes a key issue.

In order to enhance collegial development, research by Vandebroek et al. (2016) has proven CPD through research-based enquiry or action research to effectively promote staff's reflection on their ongoing practice and therefore promote the development of it. Contextualizing CPD is a key to meeting local needs and thereby enhancing the development of new and sustainable practices (Bove et al., 2018). Sustainability and flexibility can be enhanced in a multi-level CPD, where both the social, the local, and the wider societal contextual factors are considered. In line with this, Peleman et al. (2018) put forth that initiatives with active engagement from staff, for example through peer exchange based on a shared scientific framework, is productive form of CPD.

Previous research shows that in order to enhance professional learning, creating opportunities to view and reflect upon taken for granted aspects of one's professional life is valuable (Nolan & Molla, 2019). In this respect, making visible aspects of the daily practice and pedagogy in a trusting collegial environment, such as the team, is of importance. Bove et al. (2018) state that regular team-based reflection is a cornerstone in innovative CPD and they highlight the role of leaders collaborating with practitioners. In the same vein, Georgeson (2018) underlines the importance of involving all team members and leaders in sustainability work. Thus, a combination of bottom-up and top-down approaches enhance innovative developmental work through CPD.

Methodological framework

The study was conducted within a framework of qualitative research with a focus on the experiences of staff in ECEC. Hence, the epistemological point of departure was guided by phenomenological hermeneutics (van Manen, 1990).

Research context and participants

The study was conducted during September 2019 to March 2020 in teams (n=15) in ECEC settings (n=7) in various parts of Finland. It was our explicit intention to include a variety of settings in the pilot study. Thus, ECEC settings in urban and rural areas, geographically covering municipalities in Southern, Western, Central, and Northern Finland. Participating settings were invited through the networks of the University of Helsinki. Prospective participants were informed about the development of the questionnaire and the possibility to contribute to the piloting processes by giving response on the functionality of the questionnaire. Altogether, 15 ECEC teams participated in the study. Of these, seven were teams in municipal ECEC settings, six were teams in private ECEC settings, and two teams were from day care clubs arranged by the Evangelical-Lutheran church of Finland. Both Swedish-speaking settings (n=7) and Finnish-speaking settings (n=8) participated.

The PROSUS tool

The *Assessment Tool for Promoting Sustainability in ECEC* (PROSUS) by Furu and Valkonen, (2020) was adopted to explore how sustainability is enacted in the daily life of the ECEC setting. The tool is a revised and adapted version of the above mentioned *OMEP Environmental Rating Scale for Sustainable Development in Early Childhood* (ESD Rating Scale) which has been used in research reported by Siraj-Blatchford, Mogharreban and Park (2016). The ESD Rating Scale is based on the three dimensions put forward by the Brundtland Report (WCED, 1987) and follows the logic of the ECERS Early Childhood Environment Rating Scale (Harms, Clifford & Cryer, 1998) and ECERS-E (Sylva, Siraj-Blatchford & Taggart, 2006).

The PROSUS tool has the form of a questionnaire. It covers the dimensions of sustainability in line with the Brundtland definition, which is also the base for how sustainability is described in the Finnish curricula. Each

dimension contains five aspects of sustainability (see Table 1). These aspects are based on the Finnish curricula as well as on contemporary research on how sustainability could/should be integrated into ECEC.

Table 1
The three dimensions and respective five aspects (A-E)

<p>1 Ecological sustainability</p> <p>1A To understand oneself as part of the ecosystem 1B To have a respectful relationship with nature 1C To enjoy, play and learn in nature 1D To take responsibility for the environment 1E To prevent and mitigate environmental problems</p>
<p>2 Social and cultural sustainability</p> <p>2A To develop social and emotional skills and prevent bullying 2B To promote equality and address individual needs 2C To respect multiculturalism 2D To promote gender equality and to conduct gender sensitive education 2E To address the diversity of families</p>
<p>3 Economic sustainability</p> <p>3A To learn modesty and economy 3B To make responsible acquisitions and use materials and resources in a sustainable manner 3C To use energy and water in a sustainable way 3D To develop a conscious approach to food 3E To develop a healthy life style and physical and mental health</p>

In accordance with each aspect the relevant Sustainable Development Goals from Agenda 2030 are mentioned. Activities related to each aspect are described by teams in their own words as open answers to questions following the same form: “In what ways do you currently address (...) in your daily practice?” and in the pilot version of PROSUS each team rated their work based on a 7-point rating scale for each aspect with descriptive indicators based on general principles as follows:

1 (inadequate) indicates that the issue is not addressed or only sporadically or seldom

3 (minimal) indicates that the issue is addressed to some extent, but mainly from a teacher perspective

5 (good) indicates that the issue is explored and discussed on a regular basis in versatile ways where children are active participants engaging in playful and arts-based learning and critical reflection

7 (excellent) indicates that the issue is addressed systematically in a goal-oriented manner that involves external actors from the local community and pays regard to global perspectives

Each aspect could be rated from 1 (insufficient) to 7 (excellent) in line with provided indicators. In the final digital version, the rating is replaced by a multiple choice between the four options, and no numerical data is collected. Thus, all in all, 15 aspects were been brought to the fore. For every dimension, there is an open question, following the model: "What ideas do you have for developing (...) sustainability in your daily practice?" where teams can put forth any suggestions and ideas. The tool also contains an overview over the numerical results.

Teams were invited to complete the PROSUS through reflection and discussion of each aspect of the three dimensions together within their team. First, all team members were asked to go through the questionnaire individually. Second, team leaders were asked to facilitate collegial discussion and fill out the tool, which was then sent back to the researchers either digitally or on paper. The teams were asked to first reflect on and describe the sustainability practices aligned to each indicator on the rating scale and thereafter rate themselves on the scoring system. In addition, the respondents in our study filled out a questionnaire concerning the functionality of the tool (see Appendix 1). The time recommended for participating in the study was about one month, but additional time was allowed to some teams due to organizational challenges.

In this article, we first report findings based on the responses to the PROSUS questionnaire regarding the sustainability practices and pedagogies they adopt in their daily work. Second, we look into how the teams describe how they perceived the use of the tool. Since the number of participating teams in this cohort is small, we are reporting only qualitative data. The research materials were analyzed through thematic content analysis (Denzin & Lincoln, 2018) and narrative analysis (Clandinin et al., 2016) guided by the two research questions of the study.

Ethics

The study follows the ethical principles of research issued by the Finnish National Board on Research Integrity (TENK, 2019). All teams were informed of the aim and methods of the study by phone and/or e-mail. Informed consent was obtained by all participants via e-mail and from municipal authorities if needed.

Results

The aim of this study was to explore how sustainability is currently done in ECEC settings in Finland. Further, we wanted to look into how sustainability might be facilitated the recently developed *Assessment Tool for Promotion of Sustainability in ECEC* (PROSUS) by Furu and Valkonen (2020). In this section we report the findings following the structure of the two research questions that guided the study. Descriptions of patterns in the responses are exemplified by quotes and discussed in the light of the Finnish national core curricula and contemporary research.

Sustainability in practice and pedagogy

The responses to the PROSUS questionnaire made visible that sustainability education was conducted with great variability in the participating teams. Some teams responded with only single words to the open-ended questions about each aspect in each dimension of the PROSUS, while others provided long and rich descriptions regarding each aspect.

Ecological dimension. The *ecological dimension* of sustainability was predominantly addressed in a nature-oriented way. Paying visits to the forest or to urban parks was part of the weekly routine in all teams. However, only one team provided an explicit view of the pedagogical thinking associated with these visits:

"We make visits to the forest, where we address children's interests and questions as well as direct their attention to species and phenomena." (T6)

Using nature materials and recycled materials in arts and crafts was another common approach to the ecological dimension. The pedagogical motive for the work conducted in everyday routines was seldom mentioned, but some teams stated that they strive to promote an attitude of being both careful and mindful with resources, as well as learning to respect plants and animals. These responses suggested that traditional environmental education from an anthropocentric perspective was the prevailing guiding framework for approaching the ecological dimension of sustainability education.

According to the responses, addressing environmental problems with young children seemed to evoke some resistance. Several teams emphasized that children should not be worried by global issues in this way:

"Young children aged 3 to 4 should not be burdened with global environmental problems. They have the right to be children! To feel safe!" (T3)

While the above response can be understood as a claim not to address environmental issues at all in ECEC, another team provided an alternative approach to the phenomenon:

"We do not discuss environmental problems. We try to be environmentally positive and friendly, to plant an attitude." (T1)

To sum up, the dominating approach was one where staff act as role models, instruct and teach children by example and routines. Playful, explorative or dialogically framed learning experiences were mentioned only sparsely. Only a few descriptions indicated that the pedagogy was based on children's experiences and/or active participation.

Social and cultural dimension. The *social-cultural dimension* of sustainability was given most attention by the teams. The descriptions were thicker and the language was more elaborated. We understand this as a sign that this dimension of sustainability were most familiar to staff. There were frequent examples of daily practices that support social and emotional skills such as working with emotions, learning problems solving skills, or adopting specific programs to prevent bullying.

However, some aspects of cultural sustainability were perceived as distant or challenging by some teams. Multicultural education was not viewed as a prioritized area by some teams:

"...the group of children is culturally very homogenous, but we accept multiculturalism" (T2)

Although basic values related to cultural sustainability seemed to be embraced by the teams in some way, one team suggested gender sensitive education is not even an issue relevant for young children:

"We would not include this question (aspect 2D) in the tool at all." (T9)

In general, teams underlined practices that provide versatile ways for all children to be active participants in the day to day life, in accordance with their age, maturity or capacities. Some of the teams mentioned that they critically examine and challenge norms regarding boys/girls, family background, or ethnicity through discussions with the children.

All in all, the social and cultural aspects of sustainability were addressed in all teams and the answers to the PROSUS indicated that these dimensions of sustainability were embraced by teams from the perspective of the basic values in the national core curricula for Finnish ECEC and pre-primary education. However, there was a stronger focus on the social aspects than the cultural aspects, which might reflect that multicultural issues have only recently been raised in the early years discourse in Finland.

Economic dimension. The *economic dimension* was strongly tied to daily habits such as saving energy or water, as well as being careful with resources like materials for arts and crafts or food. No team stated that they strived to discuss issues around money explicitly, but rather to foster an overall attitude of being mindful with money and

careful with resources. Toys and tools were repaired, there were instances of teams who took the group with them to the municipal library to borrow books, toys, or games. Food was a recurring theme in the answers and staff occasionally mentioned that they have vegetarian or locally resourced, ecological food. Most teams however stated that the decisions that affect the economic aspects of sustainability were taken in some other part of the organization and that they had little or no influence of them. In sum, this dimension of sustainability was perceived to be partly restricted by general rules and organizational factors that only leaders in the municipality can change.

A feature that must be made visible is the fact that side by side with the above presented results there were some “silences” in the data. These silences were materialized in absences, non-existing or very brief answers to open-ended questions. In general, very little was said about issues like biodiversity, nature connectedness, or global consequences of local actions. Further, few teams mentioned specific pedagogical approaches to sustainability education, nor were there linkages made between the three dimensions of sustainability. In general, the results were in line with those of another cohort in the piloting of the PROSUS tool (Furu & Heilala, accepted), where the respondents were teams in ECEC teaching practice settings.

The PROSUS as a promotor of professional development

A majority of the teams (n=13) responded positively and stated that working with the PROSUS tool had enhanced reflection and discussion around sustainability issues in their team. There were, however two exceptions to this pattern. One of the teams perceived that they already had a lively discussion going on because of their engagement in the Green Flag program:

“Not really. We already have so much discussion about it because of Green Flag.” (T12).

Another team had apparently departed from the instructions and worked with the tool in their own way due to lack of time. Thus, each team member separately had checked out the tool and suggested suitable scores for the aspects in each dimension (by marking that indicator with a cross) without any common discussion. The response from this team included verbal descriptions for only three of the fifteen aspects, and therefore included mainly numerical information. However, this team had provided answers to the open questions about suggestions for future work in each dimension. In their response, they stated that they had not discussed the various aspects in depth: *“We haven’t had time to discuss all dimensions/aspects yet.” (T5)*. The latter case made visible the importance of clear instructions, as well as the needed frames in terms of time to collectively work with the tool.

In order to better understand how the PROSUS stimulated collegial reflection and discussion, we looked into the responses more specifically. They revealed that the tool had facilitated shared collegial learning processes regarding sustainability work by contributing to development of both awareness, knowledge, as well as pedagogical and practical approaches in the teams. Overall, the teams perceived that the tool had helped to raise awareness and supported development in the group, which is visible in the following quotes:

“The tool increased awareness within the group and brought forward new ideas for development or ideas and developmental opportunities in our work started to emerge.” (T9)

The tool also seemed to have brought up new perspectives and angles to the issue of sustainability work in ECEC:

“Many times we thought we had done ok when we read the titles (of each aspect) but the criteria/indicators gave new perspectives that we had not thought of previously, so we got some new ideas to progress with.” (T6)

In one team the PROSUS stimulated work within the entire group of staff, including the sector leader:

“All staff (not just teachers) took part in the discussions, the leader for child sector, too. All had had time to read and reflect over all aspects. Some found it a good basis, others had anxiety because you do bad choices (in general in life)”. (T7)

This response highlighted the importance of involving all team members and leaders (Georgeson, 2018) and the holistic character of sustainability education, where both cognitive, emotional and social aspects are central (Furu, Wolff & Suomela, 2018).

Altogether, the PROSUS was considered to be a tool that catalyzes development of sustainability work at the team level. The tool served as a common point of focus for collegial reflection and discussion. Depending on previous experiences and the knowledge basis of the team members, it afforded both positive recognition and inspiration for change. Teams could position their daily work in a broader sustainability education context and all team members could participate in both describing the current state and envisioning necessary development for future work.

Discussion

All in all, the findings from this study suggest that the PROSUS can contribute to collegial reflection and discussion. Whilst working with the tool, staff can both address values and feelings related to sustainability issues and enrich their knowledge basis and practical as well as pedagogical approaches to sustainability education. This is in line with previous research by Bove et al. (2018). However, a prerequisite for this collegial learning process to come about is that the team has sufficient resources and that the instructions for using the tool are followed.

The findings of the study are in line with other studies that make visible the variability in how teams address sustainability issues in the Finnish early years context (Furu, forthcoming; Furu & Heilala, accepted). Staff put forward conflicting views on whether environmental problems should be addressed in the early years context at all, which has also been shown to be the case in the U.S. (Ginsburg & Audley, 2020). This might be due to a lacking pedagogical framework for sustainability education in ECEC as well as to a gap concerning how policy and research can be translated into practice. Further, there seems to be a lack of professional language regarding sustainability work in ECEC. It also raises questions about how the national core curricula serve as a conceptual framework for implementing sustainability in the ECEC context. We argue that in-service and pre-service professional development concerning sustainability education is urgently needed. Further, we think that sustainability should be part of the national criteria for measuring quality in ECEC, since a sustainable way of living and its social, cultural, economic and ecological dimensions are stressed in the national core curricula. The responses also highlight that a discussion within the professional field is needed around *why* ECEC is valuable in contributing to transformation of current destructive discourses and *how* it can be part of making necessary changes come about. Some of the responses call attention to children's role in change making as well as contemporary views of children as global citizens capable of active participation in matters of sustainability. This relates strongly to views of children as *beings* not *becomings* (James & Prout, 2015). Further, the findings make visible the need to develop practices and pedagogies suitable for toddlers, as the tool is perceived somewhat difficult to use in the context of those who work with aged 0-3 yrs.

Working with the PROSUS requires both structural and processual frames in terms of sufficient time and background knowledge as well as well-functioning interpersonal communication in the team. This highlights the role of the team leader and underlines relational and distributed forms of leadership where team members feel safe and supported to genuinely participate in the process. This is in line with research by Bove et al. (2018) and Georgeson (2018). Further, it is important that leaders explicitly allow time and space for collegial reflection and support developmental work at the organizational level.

Methodologically, the tool itself can provide rich information about sustainability work in ECEC, as long as instructions are followed and teams are engaged in promoting sustainability. The response questionnaire serves well in order to make the experiences of participating teams visible and provides a solid ground for digitalizing the tool and further development of the regimen around using it. The number of participating teams in this study is limited, and the results can thus not be generalized. However, the results are in line with the findings in another cohort of the pilot study (Furu & Heilala, accepted) in which 34 teams from teaching practice settings participated. Further studies, with larger samples and interviews, are planned in order to provide in-depth insight into the nature of the collegial learning processes catalyzed by the PROSUS tool.

This study shows that the PROSUS tool sheds light on both current practices and ideas for future sustainability work and hence can be of value for raising awareness, strengthening the knowledge basis, and developing pedagogy and practice in ECEC settings. It can also provide valuable information for policy makers, researcher, and teacher educators within the ECEC context. In order to meet the sustainability challenges in times of rapid and unpredictable change, ECEC needs to embark on innovative and sometimes bold educational projects. Staff in ECEC are key agents for change as they can provide children with rich pedagogies and practices to develop sustainable lifestyles. By encouraging their collaborative professional development gearing up is possible. There is no time to lose.

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Engaging Children and Families in Active, Environmental Science Learning through Digital Media

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ABSTRACT

An independent evaluation of an environmental science program that combined digital media with hands-on activities (called *Plum Landing*) was conducted in 2020. The study included 32 families with six- to eight-year-old children. The evaluation assessed the extent to which the program was successful at promoting connectedness to nature, specifically through teaching environmental science content and encouraging active nature exploration among participating families. The evaluation found that families spent more time outdoors exploring nature and more time being physically active as a result of using Plum Landing. In addition, children's environmental science content knowledge increased, and parents reported an increase in children's nature-related habits of mind (i.e., questions you need to ask when investigating an ecosystem) after using Plum Landing. Children's interest and attitudes towards outdoor activities were moderate to high at pre-test and did not change over time. Overall, families were very positive about their Plum Landing experience and reported they would continue to use the program and recommend it to other families. This study provided evidence that digital media accompanied by hands-on activities has the potential to support families in learning about and becoming more connected to nature while together at home.

Keywords: media, family, environmental science, STEM learning, family science

All across the globe, communities are grappling with the need to prepare for and respond to climate change. The United Nations calls climate change "the defining issue of our time," and the Intergovernmental Panel on Climate Change points to shifting weather patterns, rising sea levels, and melting ice caps as evidence of a profound environmental upheaval that is threatening ecosystems from the Amazon rainforest to the Arctic tundra (Qin, 2013). Acknowledging that children are the next generation of change agents, it is imperative to instill in them an understanding of the workings of our natural environment, as well as a sense of stewardship, if we hope to chart a new course.

Nature connectedness is good for children and for the planet

Recent research has demonstrated that positive experiences with nature, both structured and unstructured, can build children's environmental knowledge and skills and provide opportunities for positive emotional experiences that foster a sense of connection with the environment (Ballard, Dixon, & Harris, 2017; Clayton et al., 2011). This sense of environmental connectedness can, in turn, establish children's behaviors related to environmental

stewardship for improving ecological health (Barrable & Booth, 2020). Recent research also reveals that environmental connectedness is likely a much more powerful predictor of stewardship than environmental knowledge alone (Otto & Pensini, 2017).

At the same time, research shows that spending time in nature can contribute to children's health and well-being. Benefits of time spent outdoors include reduction in obesity, anxiety, ADHD symptoms, and stress, and increases in immune system functioning (Cleland et al., 2008; Taylor & Kuo, 2011; Park et al., 2009; Li et al., 2007; Li et al., 2009). Nature connectedness is also generally linked with a decline in behavioral and emotional issues in children (Barrable, 2019).

Thus, for both environmental health and child health reasons, it is vitally important to provide our children and youth with opportunities to spend more time outdoors engaging in educational, nature-based activities.

Nature connectedness can start at home

Nature-based, environmental science activities may be effectively provided by schools, nature programs, and other out-of-school-time organizations (Paulsen & Andrews, 2019; Paulsen, 2013). However, parents and children also have an opportunity to learn together at home. At-home learning is especially salient at the time of this writing—during the COVID-19 pandemic when most families around the world are facing an extended period of sheltering-in-place and virtual schooling.

Prior research indicates that family engagement in at-home STEM activities can promote joint exploration of core disciplinary ideas and practices (Lavigne et al., 2020; Silander et al., 2019). Having a parent teach or facilitate learning at home can be powerful, as it lays the necessary educational groundwork for a child's confidence and proficiency in other settings such as classrooms (McClure et al., 2017). Moreover, recent studies have demonstrated that parents' own nature connectedness is a more significant predictor of nature connectedness in their children, even more so than access to or time spent exploring nature (Barrable & Booth, 2020; Passmore, Martin, Richardson, White, Hunt, & Pahl, 2020).

Media may help support parents in facilitating nature connectedness at home

Despite the potential for joint exploration, many parents are not confident in teaching their children science. Research suggests that parents are more supportive of children's reading and math skills than science, due to their personal perception and self-efficacy regarding science (Cardoso & Solomon, 2002; Solomon, 2003). Studies have also found that parents from low-income communities in particular cite lack of ideas and resources as a barrier to doing science with their children (Stiles & Silander, 2020; Goldstein et al., 2018).

Media can play a critical role in giving parents ideas and structure for exploring STEM with their children, and helping parents develop the confidence they need to teach their children. A recent study by Sheehan et al. (2018) compared learning among young children with parents who had STEM careers versus parents who did not, and found that educational media connected families to information and activities that they would not otherwise have access to, and supplemented their child's knowledge of math and science, regardless of the parent's understanding of STEM. Additional studies have found that learning programs that include enjoyable and interactive educational media can augment a child's learning experience by keeping both parent and child engaged (Lavigne et al., 2019; Lavigne et al., 2020). Interactive technologies like digital games and mobile apps may play a unique role in enriching cognitive development and encouraging the growth of skills like problem-solving and nature connectedness in young children: because they often provide opportunities for parent and child to collaborate, these technologies encourage the child to discuss and share what they have learned. Additionally, instructional apps tailored to families can not only provide education for children, but can benefit parents by providing background on STEM content and highlighting strategies for engaging their children (Kucirkova & Falloon, 2016; Silander et al., 2018).

Plum Landing

One media-based project developed to teach young children about nature and inspire them to take care of their environment is Plum Landing. Plum Landing is a digital media PBS Kids series that is funded by the National Science Foundation. The project uses videos, games, apps, and hands-on activities to motivate six- to eight-year-old children to investigate the natural world. Over the last several years, content developers from WGBH Boston and researchers from the Education Development Center (EDC) used an iterative research and design process, during which the project team went through multiple cycles of implementation and revision, to create the Plum Landing Explore Outdoors Toolkit (Goldstein et al., 2018). The Toolkit includes digital media resources (animated stories, live-action videos, an online badging system, a digital game, and an app for families), hands-on science activities, and support materials for parents, caregivers, educators, and program directors—all developed to help urban children reap some of the educational, mental, and physical health benefits of actively exploring nature. In 2020, Concord Evaluation Group (CEG) conducted an independent evaluation of Plum Landing. The evaluation included a self-directed, at-home study, which is the focus of this article.

Methods

Study Objectives

CEG conducted an independent evaluation of the Plum Landing Explore Outdoors Toolkit in the spring and summer of 2020. The evaluation was designed to assess the extent to which an at-home family exploration program using the Plum Landing Toolkit (Plum Landing) materials contributed to children's overall feeling of connectedness to nature, defined for the purposes of this study as observing enhanced children's environmental habits of mind (i.e. questions you need to ask when investigating an ecosystem); motivation to explore the environment; improved attitudes about nature; and increases in environmental science knowledge. This definition of connectedness used for this study builds upon and expands the definition of connectedness used in other studies in that it acknowledges the importance of affective, cognitive, and behavioural aspects of connectedness, while, within this framework, highlighting the importance of motivation and environmental knowledge (Barrable & Booth, 2020; Otto & Pensini, 2017). Our definition of nature connectedness, for the purposes of this study, includes the experiential aspect of enhancing children's environmental habits of mind (i.e. questions you need to ask when investigating an ecosystem); the affective aspects of motivation to explore the environment and improving attitudes about nature; and the cognitive aspect of increasing environmental science knowledge. In addition, CEG investigated the extent to which Plum Landing supported parents in spending more time exploring nature with their children.

Study Design

The study was designed to collect data from a sample of 32 families who used Plum Landing over a period of two to four weeks. Upon enrollment in the study, parent-child dyads (hereafter referred to as "families") participated in video conference calls with a CEG senior researcher who conducted a pre-test interview with each family. After conducting the pre-test interview, CEG instructed families to explore Plum Landing with specific program instructions about which activities and media to use (all materials were publicly available at no cost from the Plum Landing website). The program instructions asked parents to begin by watching a two-minute video about how to explore nature with their children and a one-minute video designed to introduce them to the Plum Landing story and characters. Next, CEG encouraged parents to review a series of training tips for parents available via video or downloadable PDF. Families were then asked to try out five different explorations (each consisting of an introductory animated video and follow-up outdoor activity) over the course of the study. Finally, families were also encouraged to use a digital game highlighting nature in the city, a mobile app designed to build the habit of active outdoor nature exploration, and a badging activity in which families complete outdoor missions in order to receive digital rewards (collectable, virtual "badges").

When families were done with the program, they contacted CEG. At this point, parents completed an online survey and scheduled their final family interviews. The final family interview enabled CEG to compare responses across time and look for trends in their children's environmental science-related habits of mind, motivation, attitudes, and

content knowledge, as well as the parent's motivation, comfort, and time spent exploring nature with their children. In addition, the final interview enabled CEG to gather evaluative feedback on the Plum Landing resources.

Instruments

Although measures have been developed to assess the affective, cognitive, and behavioral aspects of nature connectedness among adults (e.g., Nisbet, Zelenski, & Murphy, 2009), fewer measures have been developed for children, and those that we found focused primarily on the affective dimension (e.g., Cheng & Monroe, 2012; Richardson et al., 2019). To ensure that our assessment covered all aspects, and to ensure that the assessment was aligned to the intervention, we decided to develop custom measures for the evaluation.

The pre-test interviews were semi-structured interviews designed to capture data on children's baseline environmental habits of mind (parent-reported), motivation to explore the environment (self-reported), attitudes about nature (self-reported), and environmental science knowledge (objective measure of content knowledge developed specifically for the current study).

The post-test interviews were also semi-structured interviews designed to capture the same data collected in the pre-test interviews, plus, parents were asked about how they implemented the program components and families were asked to evaluate their experience using the program materials.

Recruitment

CEG reached out to over 2,000 families nationwide who have previously indicated an interest in participating in a research study with CEG to let them know about the upcoming study. Families that were interested in participating completed a screening survey online to determine their eligibility. Participants were qualified for the study if they had: (1) At least one child between the ages of six and eight years old, (2) access to the internet, and, (3) the ability to communicate in English for the purposes of participating in video conference interviews. Families were offered an incentive of \$100 to participate in the study. Parents provided informed consent for their family's participation in the study. The study plans and procedures were reviewed and approved by an independent institutional review board.

Participants' Backgrounds

A total of 32 families participated in the study (see Table 1). Participants were from 19 different states and all regions of the country. Children's ages ranged from six years old to eight years old, with 13 six-year-old participants, 12 seven-year-old participants, and seven eight-year-old participants. Fourteen of the participants were female, and 18 of the participants were male. Six of the families reported their household income as low income, 14 of the families reported low to middle incomes, and 12 of the families reported they had middle incomes (we allowed families to define income levels in comparison to other families they know, rather than using strict numeric criteria).

Of the **children's** ethnicities, 13 were white or Caucasian, seven were Black or African American, two were Asian, two were Indian or Middle Eastern, two were Latino/a, and three parents preferred not to respond to this optional question. Of the **parents'** ethnicities, 11 were white or Caucasian, nine were Black or African American, four were Latino/a, one was Asian, one was Indian or Middle Eastern, and five parents preferred not to respond to this optional question.

Table 1
Family Background and Demographic Characteristics (n=32)

Characteristics	n
<i>Child Age</i>	
6 years old	13 (40.6%)
7 years old	12 (37.5%)
8 years old	7 (21.9%)
<i>Child Sex</i>	
Male	18 (56.2%)
Female	14 (43.8%)
<i>Child Race/Ethnicity</i>	
White or Caucasian	13 (40.6%)
Black or African-American	7 (21.9%)
Asian	2 (6.3%)
Indian or Middle Eastern	2 (6.3%)
Latino/a	2 (6.3%)
Prefer not to respond	3 (9.4%)
<i>Parent Race/Ethnicity</i>	
White or Caucasian	11 (34.4%)
Black or African-American	9 (28.1%)
Latino/a	4 (12.5%)
Asian	1 (3.1%)
Indian or Middle Eastern	1 (3.1%)
Prefer not to respond	5 (15.6%)
<i>Self-reported Household Income Status</i>	
Low to middle income	14 (43.8%)
Middle income	12 (37.5%)
Low income	6 (18.8%)

* Parents could choose more than one race or ethnicity so the totals may be greater than 100%.

Family Science and Nature Experience

During recruitment, most families reported having only some to little science activity experience: 23 of the 32 families (72%) said that they only did “some” science activities together; six reported that they did not do any science activities together at all (19%), and only three families reported that they did “lots” of science activities together (9%).

In addition, all 32 parents (100%) reported that they had access to at least some form of nature in their neighborhood, anything from small gardens, trees, and plants to parks or trails. Five parents reported that their children were not always able to play outdoors due to fears that their children might get hurt (16%). Three parents (one each) indicated that the following were obstacles for their children: nature was uncomfortable for them, gangs or crime made outdoors dangerous, and health reasons. Other reasons cited by parents included: the current pandemic emergency and weather.

Analyses

Analyses of quantitative data mainly consisted of descriptive statistical analyses such as measures of central tendency. When applicable, inferential statistical analyses were performed. For example, a t-test was performed to analyze differences in environmental science content knowledge at post-test versus pre-test. Finally, open-ended responses were analyzed by reviewing the data using thematic analysis.

Program Implementation

How Families Used Plum Landing

We asked parents to report how they accessed the Plum Landing resources and incorporated them into their daily routines (hereafter, when we use the term “Plum Landing,” we are including all the components of the Plum Landing Explore Outdoors Toolkit—the introductory videos, parent tips, animated stories, outdoor activities, app, badging feature, and game that families were directed to use at the beginning of the study). We also asked parents to report what devices they used to access Plum Landing throughout the study. Twenty-five (78%) reported using a computer or laptop, 22 (69%) reported using a smartphone, and eight (25%) reported using a tablet. Parents could report more than one device.

All but one of the families (97%) reported that when they watched the videos, they did so indoors. Conversely, all but one of the families (97%) reported that when they did the hands-on activities, they did so outdoors, as intended. One parent reported that their child was not interested in going outdoors to do the activities, so they did the activities that could be done indoors in their home.

Families reporting engaging with Plum Landing in various ways. For example, some families made it part of their daily routine during the study, following roughly the same schedule each day (e.g., trying Plum activities after breakfast or lunch or during a sibling’s naptime). Other families took a less structured approach, doing Plum activities only when they had time. Some parents and children read through the resources independently before trying the activities together while other families read through the resources together. Some families let their children drive the engagement with Plum, including explaining it to other family members, while other families relied on parents to drive the activities with children in a more passive role.

Program Fidelity

Families demonstrated high levels of program fidelity or adherence to the study instructions, with families trying at least four of the five outdoor activities together and each of the activities being tried by 74% to 96% of family dyads. Interesting to note was that a couple of families occasionally let their children do the outdoor activities alone despite being specifically instructed and encouraged to do them together. These were usually cases of children wanting to

do them alone or an unplanned interruption from a sibling that took the parents' attention elsewhere. But, these instances were rare. In addition, two parents reported doing the activities alone because they wanted to test them out, but never ended up doing them with the children for various reasons (usually lack of time).

With respect to co-viewing of the media, not surprisingly, all the parents and children watched the short video intended to introduce the Plum Landing characters together, while parents were more likely to watch the additional introductory material geared toward parents alone or with their children. Most families reported watching the content-related videos together. Each of the videos was viewed by 80% to 96% of family dyads.

Slightly more than half of the sample reported that they tried out the additional, optional media, including the app, badging feature, and the game. Between 77% and 88% of families used these media together, rather than just the child alone or the parent alone.

Results

Children's Habits of Mind

We asked parents to rate the extent to which they had observed habits of mind related to science and nature learning (i.e., questions you need to ask when investigating an ecosystem) in their own children before and after using Plum Landing, as outlined in Table 2. At pre-test, parents rated whether they observed their children using environmental science habits of mind on a scale of 1 (strongly disagree) to 5 (strongly agree). On average, parents reported moderate levels of agreement between 3.34 and 3.97 (out of 5.00) with respect to whether their children exhibited environmental science habits of mind. Parents were most likely to report that their children exhibited an interest in going outside than other habits of mind. Parents were least likely to report that their children were showing curiosity about nature or asking questions about nature.

At post-test, we asked parents whether their children were exhibiting these habits less than, as much as, or more than before using Plum Landing. We did not ask them to use the rating scale again; we only asked them to report changes, if any. After using Plum Landing, most parents reported increases in their children's environmental science habits of mind. Many reported their children showed an increased curiosity about nature (66%) and an increased desire to share new information and ideas about nature (78%). Approximately half of parents reported that their children were now asking more questions about nature (47%), noticing things about nature (53%), and expressing more of a desire to go outside (56%).

Children's Motivation and Attitudes

One way that we assessed children's motivations and attitudes related to science and nature was to ask them to indicate the degree to which they enjoyed general science and nature activities—with a "thumbs-up" if they enjoyed each activity, a "thumbs-down" if they did not enjoy it, or a "thumbs in the middle" if they were neutral about an activity (see Table 3).

We found no appreciable change in reported enjoyment levels across a number of activities from pre-test to post-test. At pre-test, the average proportion of positive (thumbs-up) responses across all activities was 71%. The activities with the most positive responses were playing outdoor games (89%) and playing sports (89%). The activity that got the least positive response from participants was collecting rocks and leaves (46%). Most activities were reportedly enjoyed by more than half of the children who participated. It should be noted that a total of 28 out of 32 children answered this question as some of them were too shy or too distracted during our pre-test interview. At post-test, the average proportion of positive responses was still 71%. The activities rated highest were still playing outdoor games (88%) and playing sports (75%). The activity rated lowest was still collecting rocks and leaves, though more children reported enjoying this activity at post-test than at pre-test (53% versus 46%).

Table 2
Children's Habits of Mind Before and After Plum Landing (n=32)

Habit	Pre-Test Average (sd)	Children doing this a little more at post-test Count (%)	Children doing this a lot more at post-test Count (%)
Asking questions about nature (e.g., "What animals and plants live here?" or "How did this plant start growing here?")	3.41 (0.71)	11 (34.4%)	4 (12.5%)
Noticing things about nature (e.g., that bees are usually found near flowers, or that puddles in the sun dry up faster than puddles in the shade)	3.53 (0.57)	10 (31.3%)	7 (21.9%)
Showing curiosity about nature (e.g., asking why certain animals and plants look the way they do, or following an ant to see where it goes)	3.34 (0.70)	17 (53.1%)	4 (12.5%)
A desire to share new information and ideas about nature (e.g., telling me something he or she learned in school, or describing an interesting thing they saw in nature)	3.72 (0.52)	19 (59.4%)	6 (18.8%)
Asking to go outside a lot	3.97 (1.00)	12 (37.5%)	6 (18.8%)

Table 3
Children's Attitudes towards Various Activities Before and After Plum Landing

Activity	Thumbs-Up Pre-Test Count (%) n = 28	Thumbs-Up Post-Test Count (%) n = 32
Play outdoor games like hide and seek or tag	25 (89.3%)	28 (87.5%)
Look for small animals and birds	23 (82.1%)	26 (81.2%)
Learn about animals, plants, weather, or water	23 (82.1%)	26 (81.2%)
Play a game indoors*	20 (71.4%)	25 (78.1%)
Play sports	25 (89.3%)	24 (75.0%)

Take a walk outdoors	20 (80.8%)	24 (75.0%)
Look at trees, plants, flowers	20 (71.4%)	24 (75.0%)
Take pictures of nature	15 (53.6%)	19 (59.4%)
Read a book*	17 (60.7%)	18 (56.2%)
Look for bugs	14 (50.0%)	18 (56.2%)
Collect rocks or leaves	13 (46.4%)	17 (53.1%)

*We included indoor or location neutral activities so that children who weren't interested in outdoor activities would have something positive to respond to.

To further assess children's attitudes about nature, we asked children to use one word to complete the following sentence, "When I am outdoors in nature, I feel ____." Before using Plum Landing, 26 out of 28 (93%) of the words children used to complete the sentence were positive words such as "happy" or "good." After using Plum Landing, 30 out of 32 (94%) of the words children used were positive. This was a non-significant improvement, but already most of the children were positive at pre-test so there was little room for growth.

To assess children's attitudes towards science at both the pre-test and post-test, we asked children to tell us whether they liked science. Even though there was an increase in the proportion of children who replied in the affirmative at post-test, the differences were not statistically significant.¹ At pre-test, 21 out of 28 (75%) of children reported that they liked learning about science. At post-test, 26 out of 32 (81%) reported that they liked learning about science.

To further explore the question of whether Plum Landing helped children develop more positive attitudes towards nature, we looked for evidence that the program helped children feel more connected to the outdoors and gave them ideas of new things and places they could explore in nature. So, at post-test we asked children, "Did Plum Landing help you think of new things you can do outside?" and "Did Plum Landing help you think of new places you could explore in your neighborhood?" and "Did Plum Landing make you feel more or less like learning about science?"

When asked if Plum Landing influenced their ideas of what they could do outside in nature, 22 children out of the total of 30 (73%) said that it did, and five of these children (23%) stated that they wanted to do some of the Plum Landing activities again. Three of these children said that they were starting to look at nature differently now that they had watched the videos and done the activities. Only five children stated that Plum Landing did not give them new ideas, and three were unsure if the program helped them think of new things to do outside.

When asked if Plum Landing helped them think of new places to explore, 22 out of 29 children (76%) said yes. Their answers ranged from very small locations, like under rocks or in trees, to larger areas like the park, the forest, and even space (likely inspired by the main character, Plum, being an alien). Only three children said no, while four were unsure if Plum Landing helped them find new places to explore.

¹ We converted responses to ordinal values ("yes" = 2, "depends" = 1, and "no" = 0) and compared children's pre-test and post-test responses using a paired samples t-test. The difference was not statistically significant ($t_{(df=27)} = -0.441, p = .663$).

When asked if Plum Landing helped them feel more or less like learning about science, 23 out of 26 children (88%) who answered this question said that it helped them feel more excited about science. As one child described, “Plum Landing is like a friend and teacher for me. I like the cartoon characters shown in the videos. I feel like I am with them doing those activities.” Only two children said Plum Landing made them feel less like learning about science. Only one was neutral, saying they already liked science a lot, and one was unsure of how Plum Landing affected their excitement about science.

Children’s Content Knowledge

We asked children six content questions designed to assess their knowledge of a set of environmental science constructs addressed in the Plum Landing program. These included questions about animals, plants, seeds, and plant/animal interdependence (for example, “What do animals need to survive and be healthy?” and “How do plants spread their seeds far and wide?”) The children’s answers to these questions were scored and children earned either zero, one, or two points for a possible total content score of between zero and 12. Table 4 explains how the responses were scored.

Table 4
Scoring Children’s Responses to Science Questions

Score	Reasoning and Description
0	Answer is incorrect, child is unsure of answer, and/or child did not respond to question
1	Child on the right track to correct answer, and/or child only answered part of the question
2	Answer is correct

Four children were too shy or distracted at pre-test to complete the science content questions adequately and their data were incomplete, so these data are not included in this analysis. At pre-test, children’s total content scores ranged from zero to 11, with a mean of 5.43. At post-test, children’s total content scores ranged from one to 12, with a mean of 7.82 (Table 5). This was a statistically significant difference between the children’s knowledge scores before and after using Plum Landing. For example, at post-test children were more able to identify at least three wild animals that lived near them (e.g., squirrels, wild dogs, birds) versus at pre-test when many could only identify one or two or they included imaginary animals (e.g., unicorns). One question where children demonstrated growth was about how plants spread their seeds. At pre-test, most children responded, “I don’t know.” By post-test, they included responses such as “Bees help to spread them.” Or “Birds help to drop them.”

Table 5
Children’s Content Knowledge Scores Before and After Plum Landing (n = 28)

Pre-Test Average (sd)	Post-Test Average (sd)	Statistically Significant Difference?
5.43 (2.52)	7.82 (2.54)	t _(df = 27) = -5.892, p = .000

To further assess content knowledge gains after using Plum Landing, we asked parents “Did you or your child learn anything from the activity that you or your child didn’t know before?” All 32 parents reported that their children learned by watching Plum Landing videos and doing the activities. Many parents mentioned that their children learned science content. Though children had some familiarity with the environmental science topics addressed in

the program, parents reported that their children still were interested and were able to expand their knowledge when doing the activities. Several reported that their children learned about new ways that animals, plants, and people can support one another.

Nine parents said that Plum helped them and their children look at nature a bit differently and made them more observant of the world around them. One parent explained, “My husband’s family has a dairy farm. [The children] go down there every day because they never thought of it as nature. We never talked about how the plants help the animals until this activity... It was a good activity for us. We’re around nature and animals all the time, but we don’t talk about it.”

In addition to reporting on their children’s learning, thirteen parents said that they also learned something from the videos and activities themselves. One parent said, “I didn’t know about the way bees communicate. So that was new.” Another parent adding onto this by saying, “I’m doing a lot more Googling and researching than I ever did before.”

Family Behaviors

At pre-test and post-test, parents reported how much time their families generally spent together outdoors exploring nature (see Table 6). Data collection took place at the start of the COVID-19 pandemic, so the responses may not reflect typical family behaviors prior to the stay-at-home orders but this is the best information that could be gathered. At pre-test, most parents either reported their families spent less than four hours exploring nature together per week (41%) or more than six hours weekly (53%). By post-test, 88% reported spending more than four hours together exploring nature on a weekly basis. We asked parents whether this was less, the same, or more time than prior to the Plum Landing study and 14 parents (44%) reported that they were spending more time together as a family exploring nature than before the study began. The remainder reported that they were spending the same amount of time as before. The number of hours reported by parents was statistically higher after using Plum Landing. We converted responses to ordinal values (“less than 2 hrs” = 1, “2-4 hrs” = 2, “4-6 hrs” = 3, and “more than 6 hrs” = 4) and compared pre-test and post-test responses using a paired samples t-test. The difference was statistically significant ($t_{(df=29)} = -2.443, p = .021$).

Table 6
Families’ Weekly Nature Exploration in Hours Before and After Plum Landing

Total Time per Week	Pre-Test Count (%)	Post-Test Count (%)
Less than 2 hours per week	3 (9.4%)	1 (3.1%)
2-4 hours per week	10 (31.3%)	3 (9.4%)
4-6 hours per week	0 (0.0%)	8 (25.0%)
More than 6 hours per week	17 (53.1%)	20 (62.5%)
Unknown	2 (6.3%)	0 (0.0%)

At post-test, we asked children, "Did Plum Landing make you feel more or less like spending time outdoors exploring nature?" Twenty-one out of 32 children (66%) reported that Plum made them want to spend more time outside. Many stated that they began to notice new things about nature and enjoyed learning new things while going outside. Two children were neutral, as they felt they already went outside a lot. One child said, "I play outside plenty, but if people don't play outside a lot [Plum Landing] would be good to encourage them to." Five children did not think that Plum made them want to go outside more. Three were unsure of how Plum made them feel about going outside.

We also asked parents "Do you think your experience with Plum Landing will change the kinds of outdoor activities your family will do in the future?" Twenty out of 24 parents (83%) reported that they believed their experience will change what activities their families will do. One parent explained, "I think the template of watching videos indoors and then learning about it more outdoors, I think it's a good combination... We might do more of that." The parents who said yes described how they liked that Plum had influenced their children's curiosity and excitement about learning with minimal tools and special materials necessary. One parent said, "After looking at the parent videos and then seeing honestly how simple the activities were, before reading all that stuff I thought it was going to take a lot more planning to do. But I realized as far as the material, it's stuff that we really already had in the house." Another parent added onto this by saying, "I realized that it's not that hard to include science. So I thought this would be so much fun. We've never collected rocks before. So I thought, 'Well, maybe I can take them to like a different park and see what rocks they can find there.' Yeah. So yeah, it just seemed like science. A lot of those things are free... It's just knowing what to do."

Most of the parents (30 out of 32 or 94%) had a very positive response to Plum Landing and plan to use what they experienced while trying Plum Landing to change how they talk about science and nature with their children. Two parents said that Plum Landing will not change the activities they do with their children. Two parents were unsure if the program would change the kinds of activities they would do with their children.

In addition, we asked parents "One of the goals of Plum Landing is to encourage children to be physically active while investigating the outdoors. Did you feel that Plum Landing helped your child be physically active? Please explain." Twenty-three out of 28 parents (82%) said that Plum Landing helped their children be more active outdoors. One parent described how they used Plum Landing to encourage their child to be excited about going outside, saying, "It's hard to get her to go outside and run around when she can't play with other children because of everything going on. So this was the incentive. Hey, we need to go tell Plum." One parent suggested turning the Plum Landing activities into a club, explaining, "These kinds of platforms are really helpful to gain knowledge and...proving the mental ability to think differently and question sessions, we can arrange with multiple children. If it is arranged by a club... then it, it can be helpful if children participate [with] their parents and ask questions [to] each other."

Evaluation of Plum Landing

When asked to describe their overall experience with Plum Landing, all but one parent (31 out of 32 or 97%) reported that they enjoyed Plum Landing. One parent was neutral about their experience. We asked parents whether they would recommend Plum Landing to other families. All parents (100%) reported that they would recommend it.

We asked parents whether they planned to continue using Plum Landing. Nearly all (97%) reported that they "might" or "definitely" would continue using Plum Landing.

We asked parents to rate how easy or difficult it was to integrate Plum Landing into their everyday lives on a scale of 1 (Extremely difficult) to 5 (Extremely easy). The average rating parents gave Plum Landing was 4.25 (sd = 0.76), thus, on average parents found it very easy to integrate Plum Landing into their everyday lives. Two parents reported that, while Plum Landing was easy to integrate, the pandemic made it more challenging for them, given how much screen time their children were getting with virtual school or the stress of social distancing.

Discussion

The research and development team's central conjecture in researching, developing, and assessing the Plum Landing Explore Outdoors Toolkit was that active, outdoor nature exploration can increase children's environmental science habits of mind (i.e., questions you need to ask when investigating an ecosystem) and content knowledge, and can have an impact the kinds of activities that families do together, ultimately leading to an enhanced sense of connectedness with nature. In this section, we'll first discuss the evidence of success in achieving these outcomes, and then we'll consider the factors that may have contributed to successes and challenges.

Evidence of Success

This study provided evidence that use of the Plum Landing Explore Outdoors Toolkit led to increases in children's environmental science **habits of mind**, particularly around curiosity about nature and the desire to share new information and ideas about nature. Children also increased their **environmental science content knowledge** as a result of using Plum Landing, scoring higher on average from pre to post on a set of constructs that address ideas related to animals, plants, seeds, and plant/animal interdependence. In addition, all parents (100%) reported that their children learned at least a little bit by using the Plum Landing resources. Though some children already had familiarity with the topics, parents reported that their children were still interested and were able to expand their knowledge.

Families also changed their **behavior in nature** as a result of using Plum Landing: the amount of time they spent outdoors together exploring nature was significantly higher from pre to post, and most parents reported that Plum Landing helped their children be more active outdoors. In addition, a majority of participating parents said that they believe the experience will have an impact on the kinds of activities they do outdoors together in the future. Children expressed similar thoughts: when asked if Plum Landing influenced their ideas of what they could do outside in nature, 22 out of 26 children (85%) said that it did. Children reported that Plum Landing helped them think of new places to explore, from very small locations, like under rocks or in trees, to larger areas parks and forests.

Factors Leading to Success

To better understand families' context and motivation for using Plum Landing, researchers at CEG analyzed families' responses to open-ended questions about their opinions on the materials, successes and challenges in using them, and how they differ from other resources used by families. Their answers provided a clearer understanding about how different elements of Plum Landing contributed to families' use of the materials and supported their engagement in outdoor nature exploration. This information complemented previous iterative research on the Toolkit that had been conducted with educators and children in informal learning settings, such as afterschool programs and education programs based at nature centers.

Active, outdoor science exploration can be done close to home and doesn't need special tools or equipment. All families were able to engage with the Plum Landing materials, even while living under the restrictions of the current health pandemic. For some, this meant a full lockdown for the duration of the study; for other families, it meant alternating periods of imposing and lifting of restrictions. Families did articulate some obstacles, such as fears about safety or challenges coping with the stress of social distancing. However, all families, regardless of where they were living, were able to use the materials to explore nature. One parent commented, "The app and the activities are great and easy to follow. Good activities for children around my son's age to get engaged in even with little supervision." Another said, "The activities required minimum supplies. We were able to make it family fun and it never seemed like 'work.'"

Parents appreciate materials that provide structure and guidance for exploring nature. Parents felt comfortable overall in their ability to lead outdoor science activities, but appreciated elements of Plum Landing that enhanced their ability to do so. All of the parent reported that they checked out the videos and printable "tips" for parents, which were designed to support parents in exploring science outdoors. In addition, in response to open-ended questions about the Toolkit, several parents said they liked how the Plum Landing materials provided ideas and

guided instructions for exploring nature and having fun outside. One parent commented on how the directions that outlined the learning goal for each activity enhanced its educational value. “It kind of gave the activity a purpose because a lot of the times we're doing things that it seems like they're not really learning... It kind of guides me or it's like a segue between fun and learning.”

Parents value materials that are easy to integrate into families' everyday lives. In talking about what they liked and didn't like about Plum Landing, several parents said that it offered new ways to teach their children about nature or added more to what they were already doing with their children. For example, one parent reported that Plum Landing “gave us new activities to do with our daily outside time.” Another said, “the videos and activities gave us talking points on our daily walks. The children notice things in nature that they didn't notice before, which initiated great conversations.”

Parents liked that the materials supported the participation of the entire family. The vast majority of the materials—including the videos, activities, badging feature, and online game—were explored by both the parent and child together. One parent specifically mentioned that they liked how Plum Landing got the entire family involved in the lessons it teaches, encouraging parents and siblings to do activities together. Other parents also mentioned using it with siblings. One reported, “We went out and did the corresponding activities... sometimes just the two of us and sometimes with other siblings.”

Parents appreciated that the materials reflected their own values for their children. In addition to meeting their expectations for teaching about nature, parents also appreciated that Plum Landing met their other priorities and values that they hold for their children. Several parents said that Plum Landing worked well with how their children learned and how their families preferred to have their children learn, saying that they felt that Plum Landing (and PBS) felt age-appropriate, easy to use, and safe for their children to explore on their own. One parent added onto this by explaining how they appreciated the diversity of the characters, saying that Plum Landing “seems to be a diverse platform for each and everyone.”

The characters and media were motivating for children. When asked what they liked and didn't like about Plum Landing, many of the children reported having positive experiences with Plum Landing. Several children who responded said they really enjoyed the videos, many saying they liked the characters and the concepts taught in each episode. For example, one child reported, “Plum Landing is like a friend and teacher for me. I like the cartoon characters shown in the videos. I feel like I am with them doing those activities.” Parents agreed that the videos were motivating for the children. One reported, “The video was short, to the point, and interesting. [My child] watched the videos and was interested in the information.”

Parents appreciated the affordances offered by technology. While previous research suggested that some educator-led nature programs pride themselves on not using technology, and prefer to keep it that way, families in this study were very receptive to the idea of using technology to motivate and enhance nature exploration. Parents used the materials in different ways (printing activities vs accessing on devices, watching videos indoors or outdoors, watching together vs separately) and seemed to appreciate that different resources offered different ways to engage. A couple of parents mentioned being mindful about screen time, but were still able to adapt how they used the resources to complete the study.

Study Limitations

This study had several limitations. First, the sample size was small and did not allow for more inferential statistics to be used. Second, the families that self-selected to be a part of the study may have been more motivated to engage in the program simply because they were more interested than the general public in research, generally, or in environmental science in particular. Third, the lack of a control or comparison group means that we aren't able to know what families might do in the absence of the program and whether changes we observed in children's behaviors, for example, are due to the program itself or some external factor.

Areas for Further Research

This evaluation study provided evidence that digital media could be used effectively to encourage children and their families to explore nature together. The findings also raised some additional research questions that are worth exploring. For instance, it would be informative to know whether these findings could be replicated with a sample of children who do not hold such positive attitudes about nature and the environment as the children in the sample. Also, it would be useful to explore whether digital media can be used equally as effectively by families in much more rural locations than the ones targeted by this project. Finally, it would be interesting to follow-up with the families in the study to assess the extent to which they actually continued using Plum Landing and the factors that contribute to long-term use or non-use and whether families' interest in nature exploration persists long-term after using a digital media program like Plum Landing.

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CHILDREN'S BOOKS AND RESOURCES REVIEW

Carla Gull

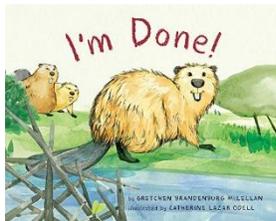
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Animal Architects

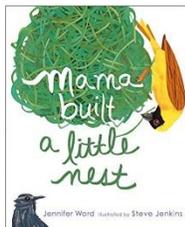
Children are fascinated by animals! Learning about animals can assist in developing empathy, wonder, and a sense of awe. Real life observational experiences are ideal; however, we can also learn about character traits through fiction and non-fiction books about animals. Here are a few books to get started, along with additional articles and resources around connecting children and animals and architecture.

I'm Done! By Gretchen Brandenburg McLellan



A young, playful beaver gives minimal effort on his building chores before he is “done” and goes off to play with his animal friends. His parents called him back, inspected his work, and encouraged him to do better. As he eventually puts in the effort for a successful dam, he is proud of his work and is really done, at least for now. Great onomatopoeia words make for a fun read aloud!

Mama Built a Little Nest by Jennifer Ward



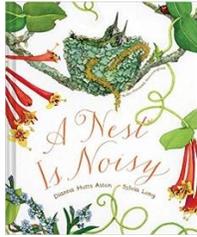
This rhyming book examines different ways birds make nests or a temporary home for their eggs and babies. Nests highlighted include a cavity in a tree, a tiny cobweb nest for hummingbirds, the birds who lay eggs in someone else’s nest, a scrape on a ledge, burrows in the ground, a floating nest, sturdy nests, and more. The textures and details on these cut paper illustrations are stunning.

We Build our Homes: Small stories of Incredible Animal Architects by Laura Knowles



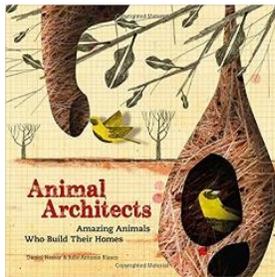
Many animals build homes beyond humans. In this book, learn about 26 different animals with unique homes made of snow, mud, webs, sticks, and other natural materials. Learn about animals around the world and how they are incredible architects. The animals tell their own factual stories. Emphasis on materials and collaboration is essential in each of the stories.

A Nest is Noisy by Dianna Hutts Aston



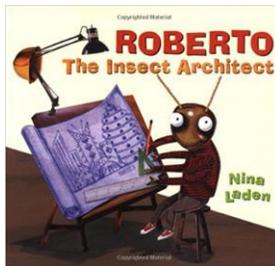
Detailed illustrations of a variety of animal nests, coupled with poetic verse, labels, and scientific information, help the reader understand the magical world of nests. Moving beyond just birds, reptile, insect, fish, mammal, and amphibian nests are also included. The highly visual book is a welcome non-fiction introduction to a variety of nests, along with a literary wonder using poetry and onomatopoeia to keep attention.

Animal Architects: Amazing Animals Who Build their Homes by Daniel Nassar and Julio Antonio Blasco



With each 2 and 1/3 page spread (pages fold out), this non-fiction book looks at an animal, what type of home it has, how it is built, pictures of materials used, building plans, and characteristics of the animals. The book uses drawings, photos, and sketches for a unique design, including insects, birds, amphibians, arachnids, and mammals. Fourteen animals are highlighted with “home” names of a mobile residence, a foamy refuge, a treetop attic, and a suspension bridge. Geared for ages 7 and above, though I often share a particular animal with younger children.

Roberto: The Insect Architect by Nina Laden



Rather than eating wood, Roberto wants to build with wood! However, his reputation as a termite makes others wary of his skills. He finds insect needs and problems all over the big city and decides to do something about it. He finds an abandoned city block full of junk and anonymously begins building homes to fill those needs. He eventually becomes a famous architect inspiring and helping many.

Seaver the Weaver by Paul Czajak



Follow Seaver, an orb weaver, as he is inspired to build his webs by the patterns of the night sky stars. His siblings make round, empty webs, while Seaver makes triangular, square, and hexagonal webs, which catch mosquitoes. Despite the pressure to fit in with circular webs, Seaver finds he likes his webs as they are unique. His siblings like them as they find patterns in the marvelous shapes and catch many bugs.

Articles and Other Resources:

Regarding Animals: A Perspective on the Importance of Animals in Early Childhood Environmental Education by Patty Born

In this research article, Patty Born explores how children interact (both directly and indirectly) with animals in early childhood environments. The author encourages us to reflect on our practice as educators and support child to animal relationships in our environments. Children and animals can be an integral aspect of child development. She recognizes different ways of connection with animals--about, for, and with—encouraging us to move beyond just learning about to allowing children to enjoy being with animals and develop ethics and care for animals as we look at environmental and interspecies connectedness.

https://naturalstart.org/sites/default/files/journal/8_born.pdf

Connecting Children to Animals by Carla Gull, Loose Parts Nature Play

This podcast episode looks at legal, practical, and playful issues and opportunities around connecting children and animals. Investigate ways to enhance habitat, apps, tools, resources, and helpful articles.

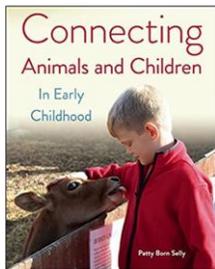
<https://loosepartsnatureplay.libsyn.com/connecting-children-to-animals>

Architecture by Carla Gull, Loose Parts Nature Play

A podcast episode dedicated to children and humans investigating architecture. Ideas, quotes, book options, and explorations are included in this 20-minute listen.

<https://loosepartsnatureplay.libsyn.com/architecture>

Connecting Animals and Children in Early Childhood by Patty Born Selly



An excellent resource that examines why children and animals should be connected, along with the ethics, practical ideas, and a variety of ways to connect with life animals. Topics include the foundations of why children are so interested in animals, how animal encounters might align with child development, how and where children interact with animals in their lives, how to create moments of authenticity with animals, and including animals in classrooms.

If you have ideas or would like to contribute book or resource reviews, please contact Dr. Gull at Carla.Gull@phoenix.edu.

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

Information for Authors

The journal has two broad visions:

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