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Nature's Role in Young Children's Everyday Science Learning: A Case Study

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Abstract
To help address the lack of research in early science learning, this exploratory case study investigated a 7-year-old girl's conceptions of what counts as science in an everyday context. Abigail's view of science was fuelled by discovering interesting things during daily mundane activities. Her mom supported learning with a "sense-making" approach as an alternative to "correcting" Abigail's underdeveloped ideas. Interestingly, nature afforded many science learning opportunities that were often a result of the changing natural environment. Results from this study suggest ways to begin dismantling narrow ideas of science in which textbooks and teachers are the authority.

Keywords: informal science learning, nature-based learning, young children, emergent science, parents as educators

Introduction

The purpose of science is to provide useful models of reality that help us understand the natural world. Porter (2008) suggested, "Science is science when it asks and answers questions, when it uses observations and experiments to understand and explore the world around us" (p. 178). "Fundamentally, science is about using established lines of evidence to develop or refine explanations using theories, models, hypotheses, measurements, and observations" (NRC, 2007, p. 18)—something young children often undertake in everyday life.

Young children actively construct naive scientific theories to account for biological, psychological, physical, and geological events (Wellman & Gelman, 1998) and likely practice scientific thinking many years before starting school (Crowley & Galco, 2001). Young children's deep curiosities drive early science learning and are often the motivation behind "why" questions (Callanan & Oakes, 1992). This way of engaging the world is scientist-like in that it mirrors the explanatory thinking of scientists (Simon, 2001). Some children are so deeply driven in particular areas of wonderment that they are described as "experts" in domains related to science (Johnson et al., 2004).

For young children, developing science skill and knowledge happens by navigating the natural world through everyday learning (NRC, 2009). Everyday learning takes place in the context of family learning and is one of the most important environments where children learn about the world (NAEYC, 2013). Parents play a key role in supporting children's science learning in the home (Legare et al., 2017; NRC, 2009). In fact, some researchers contend parent interactions positively contribute to science learning, perhaps, more than practitioner intervention in the classroom (Lloyd et al., 2017). In other words, parents are a child's first teacher. Family learning is an adult-guided mode of learning in which a parent closely monitors the child's participation in ways that can lead to scientific exploration and the construction of scientific knowledge (Crowley & Jacobs, 2002; Goodwin, 2007).

Family experiences produce a range of learning opportunities from maintaining a family and household to enjoying hobbies or recreation and are said to be organized around "funds of knowledge" that pertain to a household's functioning and wellbeing (Gonzalez et al., 2005; Moll et al., 1992). Funds of knowledge recognizes knowledge that is not generally found in sanctioned learning and conceptualizes family experiences as a rich learning environment where children, to varying degrees, establish and consistently develop scientific knowledge. Routine activities include knowledge exploration and patterns of interactions that have the potential to support scientific practices (Ochs & Taylor, 1992; Ochs et al., 1992).

The way in which a parent engages a child within the zone of proximal development parallels the collaborative process that is central to how scientists do science (Vygotsky, 1978). Parents scaffold experiences to allow a child to achieve a goal that would otherwise be beyond his or her unassisted efforts (Wood et al., 1976). Scaffolding includes a range of efforts like coordinating organized recreational activities in which a child participates such as fishing, playing at the park, or skiing, to explaining things or experiences in a child's environment. Modeling of metacognition, prompting, and questioning through exploratory talk is a parent's cultural and cognitive tool for enabling conceptual change (Mercer & Howe, 2012). Through parent-child interactions and conversations, children actively make sense of their environment and while parents infrequently offer complex explanations, conversations between parent and child lay the groundwork for developing scientific literacy (Callanan & Jipson, 2001).

As a result, parent-child interactions have the potential to contain rich science learning that forms a foundation for children to work with abstract and general ideas, concepts, or mechanisms (e.g., Crowley & Jacobs, 2002). This type of parent-child interaction is sophisticated and refutes outdated views about the limitations of young children's thinking that are still prevalent within the education system (Akerson et al., 2011; Campbell et al., 2016; Metz, 1995).

In addition to scaffolding, parents act as gatekeepers in establishing a connection to the natural world. Nature is important to a child's development across domains, cognitively, socially, emotionally, and physically as nature stimulates development in a variety of ways (Kellert, 2005). However, for children to benefit from nature, parents have to be able and willing to connect them to nature.

Young children's development is positively influenced by direct contact with nature (Dankiw et al., 2020). Learning in nature often increases levels of intrinsic motivation (Skinner et al., 2012) because being outdoors generally fosters a greater interest in learning about one's surroundings (e.g., Ernst & Stanek, 2006; Thorp, 2006). Interest increases for previously uninterested children (Truong et al., 2016) and disadvantaged children experience a positive emotional effect when learning in the natural world (McCree et al., 2018). Nature also encourages cooperative learning (Bell & Dyment, 2006). Children who play together in nature have more positive feelings toward one another (Moore, 1996).

Children's cognitive abilities are enhanced if they experience problem solving in natural settings as opposed to maintained settings (Charles, 2009). Moreover, cognitive development is positively supported in nature because children have opportunities to be creative and employ problem-solving skills as they negotiate elements of the natural world (Kellert, 2005). Nature provides young children with opportunities to experience phenomena that contribute to meaning-making because individuals and the environment influence and are influenced by one another in a context-bound process (Bronfenbrenner, 1999).

Research Purpose

Over one's lifetime, more learning happens out-of-school (NRC, 2009). Therefore, the purpose of this research is to discover how everyday learning in a family environment may contribute to a young child's ability to recognize and participate in science. Even though researchers contend most science learning is experienced outside of the classroom through everyday experiences (Gerber et al., 2001), there continues to be a lack of research exploring early childhood science learning (Gelman & Brenneman, 2012; McNerney & Hall, 2017).

Another purpose of researching this type of informal learning is to influence early childhood classroom instruction. Everyday learning is a valuable resource but our school-centric culture undervalues informal learning or simply views it as a natural process by which learning happens (Lave, 1982). This conception biases views of learning toward in-classroom academic learning, and as a result, informal learning outcomes do not generally inform curriculum design or instructional practice.

Additionally, this investigation echoes the Nature-Based Learning Collaborative Research Network's proclamation that qualitative results may suggest how various settings with nature afford different opportunities for learning, which may lead to different outcomes (Jordan & Chawla, 2019). Researchers commonly investigate family science learning in informal contexts where elements of nature are present such as zoos (Worch & Haney, 2011), botanical gardens (Eberbach & Crowley, 2017), and nature centers (McClain & Zimmerman, 2014). Each of these learning spaces include some element of nature but are *designed spaces* with the goal of increasing science engagement. In contrast to a designed learning space, nature's role in learning at home might be different, which requires the need to understand nature's influence on informal learning in a broader context.

Theoretical Framework

I adopted sociocultural theory and situated cognition as my investigative framework because I view early childhood learning as participatory, in which the formation of skills and abilities are a part of everyday experiences (Lave & Wenger, 1991; Rogoff & Lave, 1984). Consequently, activity is directly shaped by social, physical, and cultural factors. For children, learning, in this case science, is situated within social interactions with parents (Rogoff, 1990; Vygotsky, 1978). Sociocultural theory reasons that learning and development as originated in the social plane are a result of an "interactive process" between the parent and child (Cole & Wertsch, 1996; Litowitz, 1993; Vygotsky, 1978). The parent is the knowledgeable other that provides scaffolding within the child's zone of proximal development (Vygotsky, 1978).

Situated cognition views science as a process of participation in a part of a larger network of participants and institutions (Lehrer & Schauble, 2007). The acquisition of knowledge is situated in a particular context. In school, a child is viewed as a recipient in learning, in contrast to family learning experiences in which the child is generally an active participant (NRC, 2009; Wellman & Gelman, 1998). Knowledge and skills acquired within family learning are transferable into other contexts such as the classroom, provided the classroom positions the child in the learning process similar to where the child existed in the learning process within family learning experiences (Hedegaard, 1995).

While it is important to understand children's learning as conceptual change in either a domain-specific (Carey, 2000) or general manner (Case & Griffin, 1990; Inhelder & Piaget, 1958), it is equally important to understand the process of how children participate and learn through interactions with family and in everyday experiences (Rogoff, 1990; Vygotsky, 1978). By viewing learning as developmental, I can specify the kind of experiences that produce learning outcomes (Müller &

Liben, 2017).

Methods

Qualitative results have the potential to provide descriptions that are important for understanding and applying results or identifying potential causal mechanisms that underlie learning. Qualitative results also have the potential to suggest how settings with and without nature afford different opportunities for teaching and learning, which may lead to different outcomes. These outcomes can then be tested in more controlled ways through experimental designs (Jordan & Chawla, 2019).

Accordingly, I applied a qualitative case study method, which values specific and highly textured details within a unique context instead of representativeness of the case (Yin, 2003; Stake, 1995). The goal of the case study is to use the focal child as a telling case. This telling case will illustrate what counts as science to a young child learning in a family context, how parents may support science learning, and nature's role in family science learning. By describing the research process in detail, readers can decide whether the results are transferrable to another setting.

Research Questions

My original research questions were "What does a young child count as science in everyday learning?" and "How do parents support science learning?" After several cycles of coding, I also included an additional question "What is nature's role in family science learning?"

Participants and Setting

I obtained Institutional Review Board approval and a combination of convenience sampling (short travel distance to the participants' house) and purposeful sampling (the family's active engagement of the focal child in science) was used to identify the participant by conducting a voluntary parent survey in the local area. My primary participant was Abigail, a 7-year-old attending the second grade in a public school located in a small rural town in upstate New York. She lived with her mother, father, and a younger sister. Both parents had a college education; her father was Caucasian and a self-employed lawyer, and her mother, Dee, was Caucasian-Hispanic and worked remotely in marketing.

Data Collection and Analysis

I applied multiple data collection methods to gain a diverse perspective into the life of my participant. Multiple vantage points supported my effort to triangulate data and achieve dependability (Yin, 2003). Over a six-month period, I conducted five interviews that included one parent-child (60 minutes), one parent-only (45 minutes), and three child-only (30 minutes each) interviews. The parent-child interview was facilitated using an adapted version of the Science Activity Task instrument (SAT) (Zimmerman & Bell, 2014; see Appendix), while subsequent interviews were conducted using researcher-generated questions that were refined as data collection progressed. All interviews were audio-recorded and transcribed into text. In addition to interviewing, Abigail maintained a digital photo journal to represent "when" she was doing or saw science in her daily life. Her journal included 33 entries. Similarly, her mom kept a journal about how she supported

Abigail's interests. Finally, I engaged in participant observation as I spent time with the family before and after each interview. Observations were handwritten as field notes and all artifacts were recorded as a digital file and printed.

To generate codes that addressed each research question, I started data analysis with open coding that culminated into different categories (Strauss & Corbin, 1994). In the second and subsequent cycles of coding, I established clear links between my research questions and findings by applying a holistic coding method as a way to categorize chunks of data that eventually culminated into themes (as cited by Saldana, 2013). I validated the findings through member checking and peer debriefing.

Instruments

The SAT is a tool for developing a grounded understanding for the meaning of science and can be used to find connections that youth see to science. The SAT reveals the science children see in their daily activities by adopting McDermott and Webber's (1998) "when is science" approach. Reframing the question "what is science" to "when is science" is important because asking young children directly "what is science" is not developmentally appropriate as the question is not embedded in the context of "doing science." Even though children may have limitations in verbalizing ideas, they are likely able to express their views when they see themselves participating in science-related activities because "doing science" is intimately connected to the sophisticated science abilities of young children (Metz, 2008; Wellman & Gelman, 1998).

Equally important, the "when is science" approach also acknowledges that children's development of science skill and knowledge is not linear, nor is it one-dimensional. In this way, the "when is science" approach represents the shift in thinking about the development of academic science competencies as exclusive to the classroom, to including other environments where students use disciplinary core ideas; crosscut concepts with scientific practices to explore, examine, and explain how and why phenomena occur; and design solutions to problems. These three dimensions are the foundation of the National Research Council's (2012) *Framework for K-12 Science Education*; even though this framework does not discuss informal settings for science education, the council notes, "[informal settings] provide many opportunities for learning science that complement and extend students' experiences in school" (p. 241).

Findings

Table 1 summarizes activities that Abigail counted as science. Column 1 presents activities based on how closely she identified an activity as being related to science. Column 2 presents her frequency of engagement of each activity within each of the three categories.

Table 1. SAT: Abigail's assessment of activities in relation to science and frequency of engagement

Closely Related to Science	Frequency of Engagement
Reading books about true events (non-fiction)	A lot
Observing things in school science*	A lot
Talking about science in your school classroom*	A lot
Doing experiments or playing around with things at home	Sometimes
Going to a museum, zoo, science center	Sometimes
Conducting experiments in school*	Does not do
Somewhat Related to Science	
Doing math in school	A lot
Talking with friends	A lot
Using books in school (textbooks)	A lot
Playing on the playground	A lot
Doing social studies in school	A lot
Reading stories or comics (fiction)	A lot
Reading magazines or newspapers	Does not do
Playing a musical instrument or singing	A lot
Using a Kindle or iPad	A lot
Doing homework	A lot
Watching cartoons or a comedy on TV	A lot
Going to an afterschool program or club	Sometimes
Going to places of worship	Sometimes
Watching a movie at home or in a theater	Sometimes
Taking care of pets (feeding, walking)	Sometimes
Taking photographs, making movies, computer art	Sometimes
Cooking at home	Sometimes
Going to summer programs (camp, school, or community)	Sometimes
Mixing things together at home	Sometimes
Watching animal shows on TV	Sometimes
Playing videos games	Sometimes
Talking with parents and family	Sometimes
Playing board games	Sometimes
Fishing, camping, snorkeling, hiking, boating	Sometimes
Does Not Relate to Science	
Building things with magnets, Legos, or other toy and tools	Sometimes
Listening to music on the radio, computer, mp3s,	A lot
Playing soccer, basketball, football, other sports,	Sometimes
Making origami, stars, airplanes, paper folding	Sometimes
Drawing, knitting, painting, crocheting	Sometimes
Watching a show on tv like *Sid the Science Kid*, *The Magic School Bus*, or *MythBusters*	Does not do

*activities related to school science

Abigail unequivocally associated science with "school science" activities. Examples of school science activities Abigail reported as "closely related" to science were observing things, talking about science, and conducting experiments in school. However, she also closely associated a variety of activities with science that went beyond school science. Abigail reported reading books about true events; doing experiments or playing around with things at home; and going to a museum, zoo, science center, or aquarium, as "closely related" to science.

Interestingly, Abigail saw *most* activities as "somewhat related" to science. Examples of activities she reported as "somewhat related" to science were doing math in school, talking with friends, playing on the playground, reading stories or comics, reading magazines or newspapers, playing a musical instrument or singing, watching animal shows on TV, playing video games, and outdoor activities like fishing, hiking, and boating. When deciding whether "talking with friends" was related, she replied, "No, well kind of, depends what you would talk about!" She acknowledged that talking about science is doing science but only when the content of conversation is science. However, she implicitly viewed science as a collaborative process in the way she was eager to share her discoveries of science phenomena like a decaying frog, sap on a flower, and inchworms making silk.

While she generally saw most activities as "somewhat related," activities she deemed as "not related" to science were generally not of interest to her but were viewed as closely related by her mom. For example, watching *MythBusters* (a popular television show about science investigation) or *Science! KIDS* (a popular website with child-friendly science videos), as illustrated by the following interaction:

> *Dee: Even though you don't watch them, would you think that watching those shows is science related?*
> *Abigail: No.*
> *Dee: You don't think so, like the* Science Kids*?*
> *Abigail: No, no it is not.*
> *(a while later…)*
> *Abigail: Building things with magnets, Legos, or other toy and tools. No, no.*
> *Dee: You don't think that is science?*
> *Abigail: Fine, I'll do this (she picks up a yellow piece)*
> *Dee: No, you don't have to.*
> *Abigail: No. (she placed it back on to the table instead of the board)*

Just as Dee challenged Abigail's thinking about *MythBusters* in the episode above, Dee challenged Abigail's description of a decomposing frog. Abigail captured the remains of a snake and frog (Figure 1). She said the snake's skin was science because a snake was growing bigger and had to leave the skin behind. Similarly, she talked about how the frog was growing too but she knew the frog was no longer living like the snake. She was not exactly sure why it was getting "as big as a house," but knew it had something to do with science. Dee challenged Abigail's description of the frog and asked her to think of ways she could measure the frog. Abigail decided she could use the flowers with long stems to measure the frog.

Figure 1. Abigail's photo journal entries of once living things: snake and a decomposing frog

Dee often let disagreement exist when Abigail's thinking was not aligned with Dee's thinking. Dee also seemed okay with allowing Abigail's ideas to be underdeveloped or incomplete as demonstrated in the discussion of *MythBusters*. Most of the time she did not attempt to correct Abigail but she often tried to influence Abigail to think about things in a different way. She tried to influence Abigail's thinking by asking questions or directing her attention as she did in the case of Abigail's description of the frog.

Abigail captured images of a centipede, butterfly, and snails (Figure 2). She discovered a centipede while taking a walk through a sculpture park near her home. She was afraid to touch the centipede and asked Dee to hold it so she could take a picture because she knew it was science even though she did not want to touch it.

Figure 2. Abigail's photo journal entries of living things: centipede, butterfly, and snails

She also captured plant life that she enjoyed observing (Figure 3). She discovered something known as the "spittlebug" one day while investigating some white matter on a plant near her home. After wondering what she saw on the plant, Abigail and Dee used the internet to research what they had observed.

Figure 3. Abigail's photo journal entries of plant life: flowers, grass, and a "spittlebug"

All of the photos in Figures 1, 2, and 3, as was the case for most of the photos in her journal, were taken when Abigail interacted with nature while playing or walking near her rural home or in the local community. Consequently, Abigail occasionally developed an interest by accident. For example, while walking her dog she discovered a berry bush. In the following excerpt, Dee reflected on Abigail's discovery of and interest in the berries near their home:

> *Yeah, like the berries, we found wild berries—the black berries. We—well, underneath the overpass where they frequently walk the dog, we pulled over there the other day so she could just go and pick the berries. And if she doesn't come with me to walk the dog, she says, 'can you bring me back some berries?'*

After discovering the berries, Abigail made it a point to visit the bush to enjoy the fruit and liked to observe how it changed during different seasons.

The photos included here are a representation of Abigail's photo journal, as it mostly depicted living or dead animals but also included some plant life. Dee's journal focused on facilitating Abigail's science experiences and the rich conversation that happened when Dee and Abigail were engaged in meaningful conversations during daily activities. Abigail observed, sometimes tasted, and wanted to know more even when she was scared to touch.

Discussion

Based on a synthesis of the results of this study, informal learning positively contributes to a child's idea of what counts as science, and parent scaffolding plays an important role in that informal learning. Additionally, the natural world plays an important role in creating a rich context for learning about science.

This study contributes to the growing body of research exploring young children's natural curiosity about the world by illustrating what counts as science to a young child. Abigail's view of science was fuelled by discovering interesting things during daily mundane activities. Her conception of science was fluid, as demonstrated by her categorizing the majority of activities on the SAT as "somewhat related" to science. Direct experience was essential to viewing something as science-related, as demonstrated by her assessment of *MythBusters*. Abigail's inability to recognize activities that she does not do as science might indicate her inability to separate activity of the self and activity of the external world, a feature of the preoperational stage of cognitive development (Piaget, 1951). Piaget suggested that direct interaction was essential to the development of thinking. Similarly, emphasis on direct experience is echoed in the NRC's description of meaningful science education, in which "Students cannot comprehend scientific practices, nor fully appreciate the nature of scientific knowledge itself, without directly experiencing those practices for themselves" (NRC, 2012, p. 29).

Abigail's case adds to the literature on young children's ability to engage in a wide range of subtle and complex reasoning about the world (Akerson et al., 2011; Gelman & Kalish, 2005; Metz, 1995; NRC, 1999). Her desire to talk about her experiences provided an opportunity for her to share her ideas and in turn make sense of the world around her through conversation. Conversation with her mom became a resource for understanding and language was a tool used to support her thinking. Dee used language as a tool for learning by prompting or questioning during brief exchanges of information. While fragmented episodes of dialogue only provided bits and pieces of complex ideas, brief conversation accommodates a young child's cognitive load and thus might be more beneficial to emergent thinking (Callanan & Jipson, 2001).

Explanation episodes afforded Abigail the opportunity to increase her knowledge and to practice exchanging ideas in a way that embodies three-dimensional science learning (NRC, 2012). For example, knowledge exploration occurred when Dee and Abigail talked about Abigail's interests in living things. Abigail was able to construct and revise her ideas about natural phenomena during conversations with her mom as in the exchange about the size of the frog. Dee attempted to influence Abigail's thinking about the size of the decomposing frog by prompting her to think a different way about size, encouraging exploration through the use of dialogue, and by asking questions. Measuring the frog with stems seemed to capture the length of the frog rather than the bloating of the frog, which is what Abigail was comparing to a house. Nonetheless, dialogue allowed Dee to support Abigail's thinking but Dee's approach in this exchange is critical to Abigail's conceptions of science.

Dee's approach gave Abigail space to reason on her own, which illustrates what Campbell and colleagues (2016) refer to as "sense-making." Sense-making is an alternative approach to "correcting" a child's underdeveloped ideas. Researchers argue that misconceptions or ideas that are inconsistent with science ought to be viewed as a resource rather than a deficit that threatens the development of scientific reasoning in young children. Resources include partial understandings, nonstandard ideas, everyday experiences and ways of talking. Abigail's misconception of the frog provided a basis for her mom to help her explore measurement. Dee could have easily viewed Abigail's "big as a house" analogy as wrong and could have "corrected" her by explaining how things are measured. Instead, Dee tried to help Abagail make sense of the frog's size but was only able to do so by starting where Abigail was in her thinking about the size of the frog. If Dee had chosen to "correct" Abigail, Abigail would have learned that her ideas may not be a resource for learning and that her incorrect thinking needs to be replaced with "right" ideas (Campbell et al., 2016).

Finally, and perhaps one of the most interesting aspects of Abigail's case, is that nature afforded many science learning opportunities as demonstrated by her photo journal. Her photo journal captured the richness of her family learning with nature. Larimore (2018) states learning with nature is "when the learning is a direct result of moments provided by the natural world" (p. 36). Abigail's photo journal supports evidence that nature is a direct and important part of learning (Jordan & Chawla, 2019; Kuo et al., 2019).

For Abigail, nature-based learning is a result of ordinary practices within her family's culture that represents an uncomplicated definition of authentic learning (Brown et al., 1989) and includes opportunities for free-choice learning (Falk, 2001). Research indicates that exploration in nature offers many opportunities for free-choice learning (Chawla et al., 2014). Additionally, her mom's support of Abigail's free-choice learning enabled direct experience with the natural world when Abigail was afraid but wanted to investigate, as in the case of touching the centipede.

Many of Abigail's teachable moments were by chance and a result of the changing natural environment. These teachable moments could only be achieved by consistent exposure to the natural world, which is different than occasional exposure to science phenomena in a designed informal learning experience. For example, Abigail developed an interest in berries by accident while out walking her dog. Subsequently, she then frequented the berry bush to enjoy the fruit and to observe its changing form during different seasons. Even when she was unable to walk the dog, she would ask her mom to return with some berries when the bush was in season.

Abigail's concrete experiences within nature led to observation, application of knowledge, opportunity for reflection, investigation, and sharing of ideas. Learning with nature, in nature, and about nature in a family context broadened Abigail's view of science and ideas of collaboration in science, which are in contrast to school science that often reinforces narrow ideas of science and authority of textbooks and teachers (Duschl, 2008). Participating in family activities that overlap with scientific practice created a recognition that there are many tools, methods, and interpretations in science. Her conception of science might solidify with more concrete experiences in school by recognizing her learning of science out of school.

Implications for Teachers

Researchers continue to argue that classroom science practices should connect children's everyday experiences to scientific concepts (Gomes & Fleer, 2018). Everyday science learning has much to offer when thinking about how teachers might support the three dimensions of science learning outlined in the National Research Council's (2012) *Framework for K-12 Science Education*. The three dimensions represent practices, cross-cutting concepts, and disciplinary core ideas. These dimensions are derived from what is known about the nature of learning science and include young children's capacity to learn science, the development of understanding over time, the consideration both of knowledge and practice, the linkage of science education to informal learning, and the promotion of equity.

To facilitate more equitable science instruction, teachers need to first broaden the idea of what counts as science in classroom instruction (Larimore, 2020). This is accomplished by understanding what children see as science in their everyday lives and then by taking these conceptions seriously. One way to do so is to explore misconceptions or underdeveloped ideas through a "sense-making" approach rather than a "correcting" approach.

When young children's ideas about science are taken seriously, educators recognize that everyday phenomena offer potential science content, which enables educators to begin to build on what children already know and can do (Gomes & Fleer, 2018). In this way, teachers have the unique ability to remove barriers that exist between a child's learning in the classroom and a child's everyday learning. Although what happens in a classroom is significantly affected by several governing entities, "classroom teachers in the lower grades may have some latitude in how they use instructional time to meet district and state mandates" (NRC, 2012, p. 245).

If meaningful science learning takes place in the natural world, then teachers need to adopt methods of instruction that increase a child's proximity to the natural world and leverage natural phenomena in academic science learning. Integrating principles of a nature-based approach into teaching practice is one way to do so during instructional hours. Educators need to be able to understand how to facilitate learning with, in, and about nature in programs that are not necessarily nature-based or even nature-inclined. "While it is impractical to transform all preschools into nature-based ones, it is reasonable for early childhood providers to consider the fundamental principles of nature-based preschools and integrate them into their teaching practice" (Larimore, 2018, p. 35).

I believe there is value in trying to influence small changes in established non-nature-based programs as a strategy to bring about a shift in a traditional model of instruction that is unlikely to adopt new ideas unless directed by state or federal governments. The goal is to influence teachers directly at the classroom level by providing them with relatively simple ways of adopting a learning with nature approach even if the entire program does not support or is not designed for such an approach. Larimore (2018) describes a continuum of practice from no nature to nature-based instruction and then outlines practical tips for integrating nature into any early childhood program.

Implications for Families

Parents remain a powerful influence on young children's learning and have the unique ability to support their child because of the intimate knowledge of their interests, motivations, and background knowledge. Parents should be encouraged to contribute to conversations with teachers about how to integrate the natural world into the classroom by talking about the things they do at home. Designing parent outreach programs that recognize and communicate the power of this influence is one way to begin dismantling narrow ideas of science in which textbooks and teachers are the authority.

An effective outreach program will encourage families to share real-life examples of the rich science learning embedded in daily life, which can then be integrated into classroom learning. An effective outreach program will also build upon parenting practices that may already be present by reinforcing ways in which parents play an essential role in science learning. For example, encouraging parents to recognize that a child's how and why questions are an expression of curiosity, that asking how or why questions have the potential to invite a child's curiosity, and that prompting their child to think differently about something while also giving the space for that thinking to be incorrect or incomplete is essential for more disciplined science engagement later in life.

Additionally, researchers designing outreach programs can identify valuable "missed" opportunities that emerge from case studies and use these experiences to build specific activities that facilitate parent-child science exploration in the everyday world. For example, after studying Abigail's case, an interesting question that might be asked is, "how could two things, one alive and one dead, be 'growing'?" These opportunities are only missed if we fail to reflect on them and use them to identify what could have been. Sharing and building on rich examples from cases in research further dismantles narrow ideas of science by using real people and real experiences in a way that will help both parents and educators recognize everyday learning as a necessary building block in science competency.

Limitations and Future Research Directions

The family that participated in this study reported a high level of science engagement in the survey used to recruit participants. Abigail's family was selected because the goal of this research was to focus on specific characteristics of science learning in a family context. This sampling approach is particularly useful in exploratory qualitative research (Palys, 2008), however, it results in a limited representation of the wider population. Nonetheless, these limitations also represent future research directions to expand the ideas presented in this study. Suggested future directions include exploring science learning experiences of young children that are similar or different from Abigail in terms of various characteristics like culture, race, gender, socioeconomic status, family composition, and geographic location.

Conclusion

Family learning offers a snapshot into foundational science learning that takes place during everyday activities when a child is in proximity to nature. For science instruction in school to be meaningful, the curriculum must consider a student's informal learning experiences. Likewise, for a child to be ready for disciplined science engagement, they must have opportunities to engage in informal science learning to form the building blocks of knowledge. The reciprocity between these two spheres demands science instruction "explicitly draw upon participants' cultural practices, including everyday language, linguistic practices, and common cultural experiences" (NRC, 2009, p. 236). Inclusion of family learning increases the likelihood that curriculum is culturally sensitive because outcomes of academic learning is derived directly from experiences that represent a child's frame of reference (Hedegaard, 2003).

On a special note, the COVID-19 pandemic presented one of the biggest challenges to classroom learning in the history of our education system as academic learning was physically displaced from many schools across the nation. As a result, we were reminded of the need to seriously integrate everyday and nature-based learning into instruction. The irony of teaching and learning during the pandemic is that leveraging informal learning or the natural world was available but, I suspect, underused because it was not well understood or integrated into teaching practice pre-pandemic. I would argue that teachers who had already integrated informal and/or nature-based learning into their instruction were more likely to know how to facilitate continuous learning opportunities during the pandemic because their idea of "real" learning would have already included learning outside of the classroom or learning that leveraged the natural world. Meaningful teaching and learning is not limited to a particular place with a preconceived set of learning experiences, and the construction of knowledge is anything but linear or one-dimensional.

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Appendix A. Science Activity Task

Phase One – Relative to Science

Phase Two – Frequency of Participation