

What Do We Mean by Ready? A Review of Research on Nature-Based Early Childhood Programs

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Abstract

This article puts nature-based early childhood initiatives in context, outlining some of the research on the long-term effects of preschool and kindergarten education. As well, David Sobel differentiates between academic/didactic oriented early childhood education and play-based early childhood education. He closes with recent research that compares nature-based early childhood education to high-quality traditional early childhood education.

Keywords: ecopedagogy, digitalization, indoorification, academification

Prior to the pandemic, the emergence of nature preschools and forest kindergartens in North America generated much interest amongst parents and educators who were concerned about the changing nature of childhood in the 21st century. The disturbing trends they saw in the lives of pre-K thru 3rd grade children are:

1. The **“digitalization”** of children’s lives. Young children spend eight hours a day engaged with screens, (television, electronic media, cell phones) and ½ hour per day outdoors. This translates into less social interaction with other children, less physical movement and the erosion of connectedness with the natural world. (Rideout, Foehr, & Roberts, 2010). Since most of the screens that children are interacting with are inside buildings, this leads to...

2. The **“indoorification”** of early childhood both at home and in school. Children are indoors in confined spaces more of the time, and outside in natural play and learning settings less of the time. This translates into more seat time, less free or guided play, and the decrease in opportunities for gross and fine motor development (Louv, 2010; Rideout, Foehr, & Roberts, 2010). Both of these trends are amplified by...

3. The **“academification”** of early childhood programming. Kindergarten is the new first grade. Preschool is the new kindergarten. This translates into less emphasis on social emotional school readiness and more emphasis on early literacy and numeracy (Almon & Miller, 2009).

The pandemic exaggerated all these trends and concerns. Early on, it became clear that transmission of the virus in closed, indoor spaces was much more likely than outside in the open air. The lack of good ventilation systems indoors facilitated exposure to the virus; outdoor spaciousness facilitated dispersal of the virus, and allowed children to socially distance [themselves]. In the summer of 2020, many early childhood programs and elementary schools across New England and the United States realized that one solution to keeping schools open during the 2020-21 school year was to move classrooms outside as much as possible. This would preserve equal access for all children, rather than just the children with technology and a good internet connection. Educating outside was one part of the solution to the diversity, equity and inclusivity challenges of the pandemic.

The composite effect of the indoorification of early childhood and the pandemic is that we’re raising a

generation of young couch potatoes. Our young children are too creeped out to touch earthworms, they don't know where their food comes from, and as they get older, they're afraid to walk in the forest alone. Or, if they are walking in the forest, they can't see the forest with their iPhones.

In response, parents are attracted to nature-based early childhood education. They like the appeal of children skipping gaily through the forest, jumping in leaf piles, sloshing in puddles, and cuddling bunnies. Parents are interested in the greater emphasis on physical development and social emotional growth that appears to be occurring in nature-based early childhood programs. The school district of Sooke, (near Victoria) British Columbia started a public school Nature Kindergarten program in 2012. In the fall of 2013, when it was evident that there was going to be competition for the limited number of places in the Nature Kindergarten program, parents camped out overnight in the registration line to get their children into the program—clearly an indication of parental satisfaction with this new approach.

Similarly, when the administrators in a public school district in Michigan, announced the opening of one section of Nature Kindergarten in one of the district's elementary schools, the parental response was so great that three sections of Nature Kindergarten had to be created. (Becker Klein, R., Larimore, R., and Sobel, D., 2016b.) A similar interest in Forest Days (one day a week in the woods in Vermont public schools Kindergartens) has led to the creation, prior to the pandemic, of more than 50 such programs throughout Vermont in the past eight years. Parents and teachers are voting with their feet in support of this new approach to early childhood education.

During the pandemic, early childhood teachers challenged themselves to move outdoors, Iris Ponte, director and teacher at the Henry Frost Children's Program in Belmont, Massachusetts, reflected, *"As a preschool educator, I used to think 30 degrees was cold. Not anymore. Our school has opened in 17 degrees, multiple times. We have learned to layer, eat warm foods in Thermoses, and keep moving. I was not trained to be an outdoor educator, but I have learned to embrace it. In fact, I do not think I will ever be able to work with children again without prioritizing the outdoors."*

Ponte discovered what teachers at more than 500 nature preschools had been advocating for before the pandemic:

early childhood education outdoors makes children healthier, happier and smarter.

Ponte continues, *"The children have adapted and adjusted in ways we could never have imagined. They cheer when we have ice rain, and they cannot wait to see how the snow transforms our play spaces. Our curriculum has taken on a whole new dimension, as we push away the boundaries of our school walls and play yard fence, and explore beyond. We have learned that weather is to be embraced, the seasons to be understood, and for the first time in my life, I have been teaching young children completely outdoors for five hours a day."*

The neighborhood becomes the classroom, the children develop all the requisite literacy and math skills, and they are healthier and stronger because they are walking miles a day.

In spite of all this enthusiasm, one persistent question rises to the surface in relation to nature preschools and nature kindergarten initiatives. Parents are impressed by children's enthusiasm for school, their physical development, the sparkle in their eyes, but they still wonder, *"If we put our children in a nature preschool or a forest kindergarten, will they be ready for Kindergarten and/or First Grade?"*

Ah, but perhaps the real question is, *"What do we mean by **ready**?"* Readiness for school means lots of things to lots of people, but there are at least two definitive camps or schools of thought. Academic readiness, as in children know their letters and numbers, vs. social/emotional readiness, as in children have good working memories, inhibitory control, social interaction skills. Let's explore what we know about these two different versions of **ready**.

To understand this debate, it's useful to put nature-based early childhood initiatives in context. First, it's important to understand some of the research on the long-term effects of preschool and kindergarten education. Second, it's important to differentiate between academic/didactic oriented early childhood education and play-based early childhood education. Finally, I'll share some of the recent research that compares nature-based early childhood education to high-quality traditional early childhood education.

Longitudinal Effects of Preschool Education.

Much research exists to support the long-lasting value of preschool education. The much publicized *Lifetime Effects: The High Scope Perry Preschool Study Through Age 40* (Schweinhart et al, 2005) study compared the longitudinal effects of a high quality preschool program vs. no preschool experience at all. *“Three and four year old children were randomly divided into a program group that received a high-quality preschool program based on High Scope’s participatory learning approach and a comparison group who received no preschool program. In the study’s most recent phase, 97% of the study participants still living were interviewed at age 40. Additional data were gathered from the subjects’ school, social services, and arrest records. The study found that adults at age 40 who had the preschool program had higher earnings, were more likely to hold a job, had committed fewer crimes, and were more likely to have graduated from high school than adults who did not have preschool.”* This research has been used to justify the substantial social benefits of publicly funded preschool programs.

There’s a similar litany of other research that supports the longitudinal benefits of preschool education on students that shows the rate of return on educational investment is greatest between 0 and 5 years. For instance, a report called *The Business Case for Early Childhood Investments* by ReadyNation says that, *“An overview of 56 studies across 23 countries in Europe, Asia, African and Central and South America found impacts of early childhood programs on health, IQ and emotional development.”* (ReadyNation, Council for a Strong America, 2017.) This is the rationale behind the national Headstart program and the reason why many states are starting to mandate preschool for four years within the public school.

Impacts of Play-Based Preschool on School Performance

Assuming then that preschool experience is valuable, what makes for the most effective approach to preschool education? Researchers have asked whether academically oriented vs. play-based preschool programs are more effective. Writing in the *International Journal of Environmental Research and Public Health* in an article titled, *Risky Play and Children’s Safety: Balancing Priorities for Optimal Child Development*, Dr. Brussoni and other public health physicians cite a US study in which sixty-eight

disadvantaged children (ages three to four) were randomly assigned to participate in one of three preschool programs.

“Two of the classes included at least 21% free play and a child-initiated activity component. The third class focused on direct instruction of academic skills and allowed for only 2% of free play activities. When tested at age 15, children in the latter class were significantly more likely than the other classes to experience misconduct, and less likely to participate in active sports or contribute to their family or community. Furthermore, at age 23, problems worsened with significantly higher levels of work suspensions and arrests (Weikart, 1998). These findings underline that free play is fundamental to healthy child development, and that restriction of free play in the preschool years might potentially have lifelong repercussions.” (Brussoni, 2012)

This emphasis on the benefits of free play and child-initiated activity aligns with the core conviction that self-directed nature play and child-initiated activity are integral components of nature-based early childhood programs. Since it appears that play-based early childhood has long-term impacts on healthy child development and the development of adult social skills, researchers have gone on to question the impact of play-based early childhood programs on academic success in the elementary grades.

Rebecca Marcon at the University of North Florida conducted research, *“to examine the influence of three different preschool models on later school success.... The study examined report card grades, retention rates, and special education placement of 160 children at the end of their fifth year in school (after 3rd grade) and 183 children at the end of their sixth year (after 4th grade) in school. The sample was 96% African American and 54% female, with 75% of the children qualifying for subsidized school lunch and 73% living in single-parent families....*

By the end of children’s fifth year in school, there were no significant differences in academic performance of children who had experienced three different preschool models. By the end of their sixth year in school, children whose preschool experiences had been academically directed earned significantly lower grades compared to children who had attended child-initiated preschool classes. Children’s later school success appears to have been enhanced by more active, child-initiated early learning experiences. Their

progress may have been slowed by overly academic preschool experiences that introduced formalized learning experiences too early for most children's developmental status".

In other words, through the end of third grade, there was no difference in academic success as a function of being in a more play-based preschool program. But, by the end of fourth grade, the children from a more play-based preschool program were performing better than the children from more direct instruction preschools. How could this be? Marcon speculates that,

"Beginning in fourth grade, children are reading to learn; comprehension is critical. ...Fourth-grade teachers expect children to be more independent in the learning process, to assume more responsibility for their learning, and to show greater initiative. Perhaps teachers foster this independence by stepping back somewhat and shifting their instructional approach to be less didactic. It is at this point that motivation and self-initiated learning become crucial for children's later school success. This is the point at which Elkind (1986) and Zigler (1987) worried that short-term academic gains produced by overly didactic, formal instructional practices for young children would be offset by long-term stifling of children's motivation. Important lessons about independence and self-initiative are being learned in the early childhood years. Overly teacher-directed approaches that tell young children what to do, when to do it, and how to do it most likely curtail development of initiative during the preschool years."(Marcon, 2002)

Marcon is suggesting an important point here. Perhaps the fostering of independence and self-initiative are more important in preschool than the early teaching of academic skills. Moreover, perhaps this early teaching stifles children's motivation and does them a disservice in the long term.

This concept of "disservice" is addressed in a press release by the Gesell Institute in New Haven, CT in which then Executive Director Marcy Guddemi summarizes the problem of an undue emphasis on early academics.

"Good quality early childhood programs for age 3 to grade 3 are essential because they provide the proper experiences and exploration which allows a child to access his or her greatest potential, relative to the developmental level they are at. These programs are not to help children learn more letters earlier or faster, but to learn to negotiate and

problem solve with peers and engage in the work of making sense of their world alongside teachers who are experienced, patient and creative role models. Unfortunately, in an effort to close achievement gaps, both schools and parents endorse the "earlier is better myth," believing that by "learning" academic skills earlier, developmental success will follow. Gesell's recent data proves the opposite-- that developmental abilities must emerge before an academic curriculum has meaning for the child and that it stimulates a corresponding motivation to learn."

(Gesell Institute, 2012)

The report entitled *Crisis in the Kindergarten: Why Children Need to Play in School* produced by the Alliance for Childhood cites a German study with similar findings. (Almon and Miller, 2009)

Long-term research casts doubt on the assumption that starting earlier on the teaching of phonics and other discrete skills leads to better results. For example, most of the play-based kindergartens in Germany were changed into centers for cognitive achievement during a wave of educational "reform" in the 1970s. But research comparing 50 play-based classes with 50 early-learning centers found that by age ten the children who had played in kindergarten excelled over the others in a host of ways. They were more advanced in reading and mathematics and they were better adjusted socially and emotionally in school. They excelled in creativity and intelligence, oral expression, and "industry." As a result of this study German kindergartens returned to being play-based again.

The crux, therefore, is that play-based programs which help children learn to negotiate, problem solve and engage in making sense of the world are more important than learning more letters and numbers faster.

Nature-based Early Childhood Programs Compared to High Quality Traditional Early Childhood Programs

Assuming that we now understand that play-based programs are more effective than academic programs at getting children "ready" for kindergarten/first grade, the question then becomes, "Is there any advantage to a nature-based program vs. a traditional program if both programs are play-based?" First, let's define what we mean by nature-based programs.

In a chapter by Rachel Larimore and David Sobel from the *Research Handbook on Childhood Nature*, these parameters are provided,

Nature-based early childhood education (NbECE) is a broad term that encompasses any program model that provides young children ages 0–8 extensive daily outdoor time over the course of a school year, and the curriculum’s organizing concept is nature (Larimore, 2016; Sobel, 2014). Under this larger umbrella of NbECE are programs such as nature-based preschools, forest preschools, forest kindergartens, and nature kindergartens. For this study we defined nature-based preschools as high-quality, licensed early childhood programs for 3–5-year-olds, with at least 25–50% of the class day held outside each day, including time beyond the designated play area, nature infused into the indoor spaces, and with nature as the driving theme of the curriculum (Bailie, 2010; Green Hearts, 2014; Larimore, 2011a, b; Moore, 2014). We distinguish this program model from forest preschools, sometimes referred to as forest kindergartens, by their longer periods of time outdoors (70–100%) and very limited use, if any, of indoor space (Larimore, 2016, Sobel, 2014).

(Larimore and Sobel, 2018)

To translate this back to parental decision-making, this leads us to the next question of, “*Will my child be just as ready if I send her to a nature preschool or kindergarten where she’s playing and learning in the woods (for part of the day) compared to a program where she’s playing and learning indoors most of the day in the drama and arts corner in the classroom.*” This comment from the new superintendent in the Michigan school district with Nature Kindergarten is illustrative of this question. He describes his own parental choice about whether his children should participate in the Nature Kindergarten is his district saying,

“(When it started) I was dour towards nature-based. My own kids, who are now in 1st and 3rd grade—we could have put them in the Nature Kindergarten. Instead we chose the traditional approach. Now, I regret that decision. If I could meet with parents considering Kindergarten, I would try to convince them that there are lots of positives in that approach. If I knew then, what I know now, I’d put my own kids in Nature Kindergarten.” (Becker-Klein, Larimore and Sobel, 2016)

Qualitative research conducted in preschools and kindergartens in Michigan have found five areas in which

parents, teachers and administrators report that children in nature preschool and kindergarten seem to be equivalently or more ready than children in traditional programs. Nature preschool and kindergarten programs appear to,

- a. provide opportunities for a full range of **physical development** through regularly scheduled hikes and through play in naturalized play areas,
- b. increase students’ **motivation and enthusiasm** for school through program design that aligns with children’s interests,
- c. create the foundation for **STEM (Science, Technology, Math, Engineering) learning** through providing opportunities for problem-solving and sustained inquiry,
- d. enhance **language development** through grounding literacy in natural learning experiences, and
- e. develop **executive functions** (working memory, cognitive flexibility, inhibitory control and self-regulation) through thoughtfully designed outdoor activities and challenges (Becker Klein, R., Larimore, R., and Sobel, D., 2016).

First, I’m going to discuss some quantitative findings about physical development, motivation and enthusiasm, and STEM learning. Then, I’m going to bring you up to date on recent research on language development and executive function. The focus on language development and executive function is my way of addressing these two conceptions of readiness—the academic preparedness represented by language development and social/emotional preparedness as represented by executive function.

Physical Development

There’s not much American quantitative research on physical development, but there are a few studies from Europe and Canada. This is reflective of the European emphasis being less on academic achievement and more on how nature-based programming develops children’s physical and social skills. In a report on Swedish Forest Schools, Juliet Robertson (2008) summarizes some of the findings based on comparisons of forest kindergartens with conventional (more indoors) early childhood programs. She indicates that at the I Ur och Skur nursery (a forest kindergarten): a. he sickness/absence rate was 5% less than at the traditional nursery, b. the children had better concentration, c. the children had better motor functions, and d. the children

played more imaginatively and for longer sustained periods.

Conversely, at the traditional nursery: a. the dominant outdoor activity was cycling and play seldom got to a stage where roles and action had a lot of scope, b. play was interrupted either by other children who disturbed it or by the staff, and c. staff stepped in more to intervene when conflict arose.

Some of these findings are reinforced by studies of Swedish children (Fjortoft, I. 2001) with access to forest areas for nature play vs. children with only access to a conventional playground. The abstract for this study states,

In a study that looked at the physical development of kindergarten children in Sweden, children that played in a natural forest area one to two hours per day were compared with children that played in a typical playground for the same amount of time. The motor development of the group that played in the natural area improved significantly more over a period of nine months than did the other group in all areas of motor development except flexibility, but particularly better in balance and coordination abilities.

The improvements in motor development were objectively assessed through beginning and end of the year administrations of the Euro Fit Motor Fitness Test—a standardized measure of children’s physical fitness that measures balance, strength, endurance and speed. All the children with access to uneven ground, natural climbing and balancing challenges in the natural play settings developed greater physical competence through their self-directed play.

Similarly, researchers at the University of Victoria in British Columbia compared growth in physical development in nature-based and conventional Kindergarten programs in the Sooke, BC public schools. The Nature Kindergarten children spent most of every morning in a forest area adjacent to the school grounds. The researchers found that children in the Nature Kindergarten group had significantly more locomotor skills growth over the course of the year than children in the conventional Kindergarten as measured on the Test of Gross Motor Development-2 standardized assessment. (Temple, V. et.al, 2015).

Motivation and Enthusiasm

There’s an interesting resonance between two qualitative studies conducted in Michigan and Vermont that

independently found recurrent comments about children’s enthusiasm for school as a function of nature-based programming. For the case study entitled *Nature Cements the New Learning*, (Becker-Klein, Larimore and Sobel, 2016), we interviewed parents, teachers and administrators about the impact of the Nature Kindergarten program implemented in fall 2012 and the Nature First Grade program implemented in fall 2015 in a Michigan public school district. These programs were implemented in the public schools in part because of parent enthusiasm about a nature preschool located in the same community. Administrators and teachers also recognized that the increase in prescriptive curriculum and increased amounts of seatwork in Kindergarten was doing a disservice to their five-year old children. This comment below from a parent suggests the general sentiment we found.

“My son is in Nature K right now. My daughter loved it (three years ago.) For both of my kids, it lets them still have that creativity, where usually (the curriculum is) so structured. Nature K brings that out in them. I don’t see that it is distracting from learning. My son loves the outside, so his ability to talk about nature is phenomenal.

It was quite a difference when my daughter transitioned into 1st grade. That was tough! They sat there all day, and she honestly did not like school that much in the 1st grade ... (Now, it’s) great to know that next year my son will have Nature 1st grade as well.”

Due to similar parent advocacy, Nature First Grade was implemented three years after Nature Kindergarten began. Parents saw the difference in the school experience for their kindergartners and wanted the experience to continue for their 1st graders. This motivation for school is reflected in attendance records as well. In 2012-13 school year, the first year of Nature Kindergarten, K attendance was 88%. In 2013-14 the attendance rate was 95%—a significant increase. If children are enthusiastic about school, they’re less likely to find reasons to be absent.

Similarly, the Forest Days Case Studies research project of three different Forest Days programs in Vermont and New Hampshire by Amy Powers of PEER Associates (2017) identified similar comments from parents, teachers and administrators. Forest Days are one day a week in the woods in public school Kindergarten classrooms. In the section of the reports on crosscutting findings, Powers reported that,

“Students at all sites showed evidence of an enhanced enthusiasm for going to school. Examples offered included students at multiple sites proudly bringing visitors on weekends or after school to see their outdoor classroom, students laying out clothes the night before in anticipation of the forest day, and higher attendance rates on forest days.”

At one of the sites, Mt. Lebanon Elementary in Lebanon, NH, the teacher noted,

“The most significant benefit to kids I’ve seen has been their enjoyment of school -- enjoyment of school in its purest form. When we’re up there they show just total joy at being outside. Even in the trickiness of a cold or wet day, they are overwhelmingly asking to go outside. When we have choice time, kids ask, can we go outside instead? If it’s motivating kids to come to school, to enjoy being in school, that’s huge.”

A father of a child at this school related the common story of asking his children, *“What did you do today at school?”* and getting the reply *“Nothing.”* But, he said, on Wednesdays (the forest day) it’s always an enthusiastic sharing of the day’s doings. He values a newsletter that comes home with pictures and stories of the day, and says his son *“circles his picture, tells about what they’re doing, reminds him to do a tick check. He’s always really proud to tell me what he did that day.”*

The story of a little boy who was reluctant to make the transition to kindergarten weaves together the benefits--academic, social, physical, and enthusiasm for school--described here by the kindergarten teacher:

“One boy who was frequently absent, and hadn’t gone to preschool, didn’t want to come to school most days, but always comes on Wednesdays. He has this ongoing fort-building project. It’s the center of what he does every week--he uses certain materials, and he has set it up with his friends so everyone is clear that this space is ongoing. By contrast, one of the rules on the playground is that forts can’t stay. If there’s a fort up, anyone is allowed to take it down. In the forest, we allow the ownership--that’s how deeper play is--he’s allowed to keep going back to this one thing that he really, really loves. He rarely writes or draws about anything else--his drawings are about what happened with his fort each week.

As a result, though this child often resisted going to school, he never missed a Wednesday. These resonant findings between Michigan and Vermont suggest that nature-based programming is increasing children’s enthusiasm for school. If nothing else, shouldn’t preschool and kindergarten create a foundation of liking school and learning?

STEM Learning

In our qualitative studies of nature preschool, kindergarten and first grade in Michigan, parents and early childhood professionals who visit the program consistently comment on the striking examples of problem-solving and self-directed inquiry that they observe. In the current atmosphere of concern for encouraging a disposition to science, technology, engineering and math learning, it makes sense to look at how those dispositions are cultivated in early childhood programs.

In the film *“School’s Out: Lessons from a Swiss Forest Kindergarten,”* there’s a scene where a group of children are trying to design a pathway so a ball will travel a curved path down a hill, rather than run straight down the hill. The underlying question is: *How can we change the direction of travel so the ball follows the curve to our desired destination?* What an excellent engineering challenge! The boys scavenge branches from the surrounding woods to create barriers to deflect the path of the ball. The ball hops over the barrier. They need to figure out how to slow the speed of the ball and create higher barriers. The boys are deeply invested in solving this very real world problem.

Two related observations of children of preschoolers suggest similar problem-solving experiences. One visiting early childhood administrator made a comparison between what she saw at the nature-based program versus other early childhood programs.

“There could be more inquiry-based language outside, and a greater length of engagement of outdoor play (at the nature-based program) compared to indoor programs. They are examining under a rock for 30 minutes. In high quality programs inside and out we have open-ended activities, but the nature-based children appear to do more problem solving. They are trying to figure out how to move rocks. How do we move these rocks? I wonder what rope might do? We can tie rope to the rock. It’s not moving, what else could we do? It’s problem solving, it’s inquiry, it’s

hypothesis. I don't see as much testing inside the classroom, it is more pretend play."

Whereas the above experience was self-directed, the teachers at the nature-based program also create experiences that lead to inquiry. It's been a regular activity for teachers to have a road-killed deer carcass placed in the woods so they could observe what happens to it with the children. They visit it regularly and also set up a motion sensor trail camera to record visitations to the carcass. The teachers describe,

"Right after the deer was dumped, we saw it was newly dead, and we visited it about once a week to see what it looked like as it decomposed. They were asking many questions. Why is it disappearing? What's eating it? We watched it all the way down to a pile of fur and bones strewn through the woods. They got to see coyotes dragging it away, scavengers like hawks and skunks pecking at it.

This process opens up the dialogue. We don't have a (predetermined) word list. Instead the words emerge out of the process. We use technical terms like decomposition, decomposers, predators, prey—all scientific words that usually don't come up till 5th or 6th grade. And the children start to understand cycles because they've seen them. They're developing their own definitions based on those experiences."

(Larimore and Sobel, 2018)

This combination of self-directed and teacher-initiated scientific inquiry lays the foundation for an interest in STEM learning in the elementary grades.

Language Development and Executive Function

Whereas the findings above emerge from mostly qualitative studies, the next two sections focus on trying to translate qualitative findings into quantitative metrics.

Language Development Studies

Though the findings are still thin and much of the research is primarily qualitative and anecdotal, there seems to be emergent agreement that nature-based early childhood programs are perhaps more effective than traditional programs in encouraging physical development, generating enthusiasm for school and providing opportunities for problem-solving with concrete materials that creates a

disposition to STEM learning. These factors appeal to parents, but there's still that niggling question about readiness for school. Parents still say, *"Well yes, that's all well and good, but will my child be academically ready for kindergarten or first grade?"* And early childhood professionals still want to know if children's executive functions are being developed in these settings. To answer these questions, a number of different research projects have been conducted in the past few years.

In Michigan. Our previous studies identified recurrent comments about the increase in children's science vocabularies in nature preschool and kindergarten. One public school kindergarten teacher commented,

"I'm surprised at the amount of their vocabulary—it's amazing—and they're just getting this at school. Bears going thru torpor, frogs brumating. insects—it's not just a bug—they know the body parts, and the functions of the body parts. Then this relates back to writing. In winter, when we're reading the All About Book, the children are recalling body parts and then they don't just talk about it, they write about it."

This greater scientific vocabulary includes words such as hibernation, vernal pools, talons, abdomen, thorax, decomposition, carcass, exoskeleton, metamorphosis.

On the basis of these previous studies, we designed a study to determine if we could quantify some of the qualitative findings (Larimore, R, Pikus, A, Skibbe, L. and Sobel, D, 2017). The purpose of this study was to compare development in children attending a nature-based preschool versus children attending a traditional university preschool using measures of language and literacy, reasoning and executive function. To accomplish these goals, we conducted direct assessment of child outcomes in the fall and spring of the 2016-2017 school year.

Both of these Michigan-based preschools received 5-star ratings as part of Michigan's Quality Rating Improvement System. The nature-based preschool had extensive outdoor time and integration of nature indoors. In the traditional preschool, most instruction occurred indoors, but children also had access to a playground several times during the day. Children in both settings showed relatively similar growth in language and literacy skills over the course of the school year. They also demonstrated similar gains on a reasoning

task, called the Mouse House task (Sodian, Zaitchik, & Carey, 1991), where children were asked to problem solve in order to figure out where certain mice could live, based on their relative size. All of these findings show the promise of nature-based education in promoting children's skills during preschool.

The findings related to gains in executive function were more mixed. For some areas, including attention and working memory, children at both sites showed equivalent gains. However, for the integration of skills related to executive function -- sometimes called behavioral self-regulation -- children at the traditional school developed more skills over the course of the year.

In a follow up study of comparing children in nature kindergarten and nature first grade classrooms with children in traditional kindergarten and first grade classrooms in a Michigan public school district, similar results were found. (Larimore, Pikus, Skibbe, and Sobel, (2019). Here, on three different measures of language development ----in K these were letter name, letter word sound and auditory vocabulary-- children in both nature and traditional groups showed equivalent development. On three different assessments of math knowledge, the nature and traditional groups showed equivalent development in two sub-tests and the traditional group showed slightly greater development on one of the subtests. In summary, on five out of six subtests in literacy and math, the nature and traditional students showed equivalent growth.

In Ohio

A parallel study conducted at the same time in a Cleveland, Ohio independent school for girls resonates interestingly with the Michigan findings. (Cordiano, et. al. 2019). The objectives of the current study were to better understand the learning process that occurs in a nature-based pre-primary program and to compare the experience of a nature-based pre-primary program with that of a high quality, traditional pre-primary program. Both preschool programs were located in the same school and drew students from the same community, ensuring that the groups were matched. on important variables such as location, socioeconomic status, and parents' levels of education.

Faculty at Case Western Reserve conducted the research and the study subjects were 26 half-day preschool children

at the independent school in Cleveland. Parents and teachers were asked to complete forms in the beginning and ends of the year using six different assessment measures including the Penn Interactive Peer Play Scale, the Preschool and Kindergarten Behavior Scales, the Pretend Play Scale, Kindergarten Readiness Measures, Children's Attitudes Toward School, and Children's Attitudes Toward Nature. The Kindergarten Readiness

Measure used is most analogous to the AimswebPlus assessment used in the Michigan study described above.

"The researchers found that, "children in both types of preschool programs achieved expected developmental gains in their behavior, early academic skills, and social-emotional functioning over the year prior to kindergarten. In most areas and generally overall, the two groups ended the year with equal levels of preparedness for kindergarten in the domains of social-emotional functioning, academic readiness, and pretend play....This information should help parents and educators choose high-quality, nature-based preschool programs with confidence, knowing that the learning that takes place outdoors provides similar academic and social-emotional benefits as the learning that takes place in a traditional setting."

(Cordiano, et. al, 2019)

In summary, the results from these studies in Michigan and Ohio find that,

1. Growth in language and literacy skills is comparable in both nature and traditional classroom settings.
2. Children develop reasoning skills at similar rates in both nature and traditional classroom settings.
3. Children showed similar growth in two out of three math assessments in both settings.
4. In most aspects of executive function examined in Michigan and Ohio children showed statistically equivalent growth in both nature and traditional settings.

What do we make of these results with a focus on literacy development? In response to the original question, *"If we put our children in a nature preschool, will they be ready for*

the academic and social challenges of Kindergarten?” The answer appears to be a qualified yes. Let’s unpack the concept of “ready.” For the parents who ask whether their children will be academically ready—will they know their ABC’s, will they have early literacy skills, will they be able to differentiate sounds, the answer is “yes.” The results on the early literacy measures all indicate that children in the nature preschool develop these **early literacy skills** at the same rate as the children in the high quality traditional preschool. It’s important to see this measure within the context of the number of hours of preschool/week in the Michigan preschool study. The nature-based children were in their program 6-12 hours per week depending on the particular session in which they are enrolled. The traditional preschool children attend school from 6 to 50 hours a week, although at one of the two sites, most children attended school for approximately 22 hours per week.

Therefore, even though the average amount of time in the program at the nature-based preschool was less than at the traditional preschool, the increase in early literacy skills was essentially the same. This is in addition to the greater opportunities for physical development, exploration in the natural world, and exposure to bracing fresh air available in the nature preschool setting.

The development in **reasoning skills**, as measured with the Mouse House task indicated no significant difference between the nature-based preschool children and the traditional preschool children. We were a bit surprised that the nature-based preschool children’s scores didn’t increase more because we hypothesized that nature-based preschool children would show even greater growth. However, we weren’t entirely pleased with the assessment itself and we are interested in seeking out other assessments of science thinking and reasoning with very young children.

Executive Function Studies

Let’s step back for a moment and examine the construct of executive function and translate the somewhat jargon-y academic terms into something we can all understand. Much research over the past few decades points to the development of executive functioning in young children as a more important and productive goal than the development of early literacy and numeracy skills. Executive function, it turns out, appears to be a better predictor of long-term academic and social success than early reading and writing. Therefore, focusing on the development of these executive

function skills—working memory, cognitive flexibility, inhibitory control, and self-regulation—may be just as important early childhood program goals as learning letters and numbers.

Since these are squirmy concepts to wrap one’s head around, let’s define these subcomponents and translate them into illustrative childhood games.

Working memory is the ability to briefly hold information in mind for the purpose of completing a task. Think of the children’s game Concentration as an illustration of working memory. You have to remember where the picture of the ant was when you turned it over a couple of turns ago to match it with the other ant picture you now have in your hand.

Inhibitory control (sometimes referred to as **self-regulation**) is the ability to stop thoughts and actions at the appropriate time, set priorities, and generally have a considered response rather than give in to impulses. Think of the children’s game Simon Says as an illustration of inhibitory control and self-regulation. When the leader says, touch your nose, and also touches her nose without saying, “Simon Says,” the child has to inhibit his mimetic response and not touch his nose. In that case, he has self-regulated.

Cognitive flexibility is the ability to respond appropriately to changing situations and apply different rules in different settings. Let’s use the children’s game, Head-Toes-Knees, Shoulders, (HTKS) which has been adapted as an EF measure, to illustrate cognitive flexibility. The children’s game is straightforward. When the leader says touch your head, and models that gesture, the child touches her head. When the leader says, touch your toes, the child does the same. In the EF assessment, children are first taught the above instructions and then told they will play a silly version of the game. The leader says, “When I say touch your head, I want you to touch your toes.” And vice versa. Then the knees-shoulders pair is taught, and reversed. The child has to keep both pairs in mind and remember to do the opposite of what is asked in response to each command. This ability to learn one set of rules and then switch to another set of rules is an illustration of cognitive flexibility.

(D’Amore et. al. 2015)

Executive function changes rapidly from 3 to 6 years old and disadvantaged children notably show lower than average scores in EF for their age. Some early childhood programs,

such as Tools of the Mind, have been shown to help remediate EF deficiencies through a carefully planned curriculum that scaffolds extensive dramatic play

In wondering whether any aspects of the curriculum in nature-based programs might address EF intentionally, we asked Chippewa Nature Preschool teachers for examples of EF instruction. We asked, **“Can you give us explicit examples of activities that you conduct that actively help children develop the subcomponents of working memory, inhibitory control, and cognitive flexibility?”** We were surprised at the array of very specific activities that clearly target these skills. Here’s a sample below.

Code Word. (Working memory and inhibitory control) Every day the teachers develop a code word to release the children from the circle to go to the gate. This occurs after a group meeting as a transition to go on the hike. They choose a science word, like “insect,” and then they say a variety of words that sound like the word, but aren’t the word. The children can only leave when they hear “Ready, set, insect.” First the teacher says, “Ready, set, go,” and the children have to restrain the impulse to get up. Then, “Ready, set, ant” which also doesn’t count because ants are insects, but the code word here is the actual word. Then the teachers will use a word that sounds a lot like the code word. “Ready, set, inside,” or, more subtly, “Ready, set, inspect.” The children have to attend to the subtle distinction between the sound of “inspect” and “insect.” Kids start suggesting words--sometimes it’s unrelated like “pizza,”--but other times it rhymes, which suggests that they’re developing language differentiation skills.

Freeze Song. (Cognitive flexibility) The teachers play a game called “Freeze Song” while outside. They play music from a portable music device. When the music plays the children dance and when the music stops, they freeze. It’s like the movement pattern in Musical Chairs. Then the teachers switch the pattern. (In executive function terms this is known as rule switching.) When music is playing, children have to freeze. When the music is silent, they dance.

Goodbye Song. (Working memory and cognitive flexibility) The nature-based preschool has a program-wide goodbye song that is sung every day at the end of the class sessions. There are a number of verses that are taught in a very specific order and there are hand gestures that go with each verse. Once the children know all the verses, the teachers start to change it up. Teachers will say, *“This time we’re*

going to switch the butterfly and ladybug verses.” Or, *“This time we’re going to sing all of the verses backwards.”* Or, *“This time we’re going to do it silently and just do the hand gestures.”* Or, *“This time make sure you do a different hand gesture than the normal one for that verse.”* They ask the children to come up with variations as well and all the rule changing requires the children to develop cognitive flexibility.

Trail Walks. (Inhibitory control) The teachers described a great deal of inhibition control that occurs on the trail. When children see a squirrel, their first impulse is to run after it. Rather, the teachers explain that if the children want to get close to see the squirrel, then they have to get really quiet and walk very, very slowly towards the squirrel. Similarly, the teachers often have children play Red Light, Green Light on the trail. Or they will challenge the children in a game like Blind Cat. The cat stands with eyes closed in the center of the circle in a part of the woods filled with fallen, crunchy leaves. The children try to creep forward as silently as possible (inhibitory control) to get close enough to pet the cat. If the cat hears a noise, she points in the direction of the child making the noise, who then has to return to the circle and start again (Larimore and Sobel, 2018).

On the basis of these descriptions, and comparable elements at programs around the country, researchers have speculated that nature-based programs may be particularly effective at helping children develop executive function. Therefore, our inclusion of EF assessments in the Michigan study and the rationale behind the following study.

In Minnesota. A recent Minnesota study focused on comparing executive function in nature preschool and traditional preschool children in Duluth area programs. The research, conducted by Julie Ernst and Jenna Zamzow at the University of Minnesota, Duluth was designed similarly to the Michigan study in that children in four nature preschool programs were compared with children in two non-nature preschool programs. Age, demographics, and quality of preschool were all similar. The instrument used for comparison was the Minnesota Executive Function Scale developed by Stephanie Carlson at the University of Minnesota. It is conducted on an iPad and requires that children sort items on the screen using changing, and increasingly more challenging, sets of rules. It’s similar to other executive function measures, but the scoring is built into the program and the researcher doesn’t need to score

the children's sometimes confusing responses as in some other assessments. It only takes about 5 to 10 minutes to administer the assessment.

I'll spare you all the statistical details and provide the summary from the master's project currently being finalized. The author, Jenna Zamzow says,

"Collectively, the results of these comparisons suggest that preschool participation, whether that be in nature or non-nature preschools, can support the development of executive function skills beyond what is typically seen in growth from cognitive maturation. All four nature preschools showed greater growth than what would be expected through cognitive maturation. One of the two control preschools showed greater growth than would be expected. (The other showed growth comparable to the expected maturational growth.) Thus, these findings lend practical significance to the statistically significant growth found in each of the four nature preschools."

(Zamzow, 2018)

A follow up study using the same instrument was designed and begun in a suburban public school district a half hour south of the Twin Cities in Minnesota. This district has an extensive public preschool program with both nature-based and traditional teachers and methods--an excellent setting for a research study. The MEFS instrument pre-assessment was implemented with about 200 children in autumn 2019, but then, due to pandemic, the end of the year post assessment couldn't be implemented. The venue for this study has been changed and during the current school year, 2021-22, the MEFS instrument is being used to compare the growth in executive function skills in Head Start preschool classrooms--some with a nature-based orientation and some traditional.

In the intervening year. During the height of the pandemic, Julie Ernst and Hannah Juckett implemented a similar study of the development of resilience factors in children during the pandemic school year of 2020-21 using The Devereaux Early Childhood Assessment for Preschoolers (DECA-P2). Resilience is defined as the capacity of individuals to cope successfully with significant change, adversity or risk. This is measured by asking parents and teachers about a child's **initiative**--the child's ability to use independent thought and

action to meet his or her needs, **self-regulation**--the child's ability to express emotions and manage behavior in healthy ways and **attachment/relationships**--the child's ability to promote and maintain mutual positive connections with other children and adults. (LeBuffe and Naglieri, 2021)

It should be clear that even though executive function and resilience are distinct features of the child's cognitive and social make-up, there is at least overlap in the area of self-regulation and perhaps in the area of initiative. Therefore, the findings from this study resonant with Ernst's earlier findings regarding nature-based preschool's effect on increasing the development of executive function skills.

In the resilience study comparing students in nature-based vs. traditional preschool classrooms, the conclusions were that nature-based and blended classrooms (half nature/half traditional) had greater impact on the development of resilience factors than traditional classrooms. *"Thus, when goals for young children include fostering the protective factors children can draw upon in times of adversity, the incorporation of nature-based practices and experiences into preschool programming appears to be an effective approach."* (Ernst, Juckett, Sobel, 2021). This is a particularly striking finding during a pandemic year of schooling in which children faced multiple adversities.

What do we make of these studies of growth in academic skills and executive function?

In regard to the original Will My Child Be Ready question, we can answer a somewhat more assured, but still qualified, Yes. From the perspective of academics and reading readiness, the Michigan and Ohio studies suggest that children attending a high quality nature-based early childhood program will be just as ready as children in a high quality traditional early childhood program. From the perspective of social/emotional readiness and executive function, the Minnesota studies suggest that nature preschool children will be more ready as children in comparable traditional early childhood programs.

Place these findings within the context of the qualitative findings. A significant majority of parents, teachers and administrators report that children enjoy substantial physical development, elevated enthusiasm for school, and positive inclinations towards STEM learning. Moreover, we've overlooked one of the significant goals of all these programs--laying the foundation for bonding with nature

that hopefully leads to environmental behaviors and ethics later in life. There is a significant body of literature that suggests that nature play is a contributor to environmental behaviors. As Chawla and Derr say in their landmark chapter, *The Development of Conservation Behaviors in Childhood and Youth*,

“Research has linked a background of childhood play in nature with every form of care for the environment: informed citizen action, volunteerism, public support for pro-environmental policies, environmental career choices, and private-sphere behaviors like buying green products, conserving energy, and recycling.”

(Chawla and Derr, 2012)

A recent study in Finland titled, *More Time Children Spend in Nature During Preschool Is Associated with a Greater Sense of Responsibility for Nature*, (Savolainen, 2021) compared 150 children spending 13 hours a week in nature vs. children spending 1.7 hours a week in nature. The study found that, *“Regular nature visits during preschool were associated with a higher sense of responsibility for nature, suggesting that offering children regular nature experiences in preschool age could be beneficial for the development of responsibility toward nature.*

In environmental circles, many folks could care less about early literacy readiness. They believe in nature preschools because they are convinced that nature play and learning experiences are making children citizens of the planet. I confess that I’m of this mindset as well.

But, if nature-based early childhood is going to appeal to the masses, if we want to run it up the flagpole in Peoria to see if people will salute, we need to address these conventional school aspirations. We’re comfortably on the path to being able to say that nature-based early childhood does a whole lot of good for kids and they’ll be just as ready for kindergarten and first grade as their peers in traditional programs. And I like harking back to Charlie Schwedler, the Michigan superintendent under whose watch a public school Nature Kindergarten program was started. In response to our quest for data he said:

I don’t care what you guys say, I know that there is more to things than testing and this is so good for these kids and they are not outside enough and this puts them outside.

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David Sobel is a trailblazing environmental educator who raised his children in the heart of nature. His story shows other parents how they can counter today's pervasive 'nature deficit'.