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Growing Up Green: Naturalization as a Health Promotion Strategy in Early Childhood Outdoor Learning Environments

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Abstract

Using a socio-bio-ecological, "one health" conceptual framework, Preventing Obesity by Design (POD) is presented as a system-wide health promotion strategy for North Carolina childcare centers, applying a cost-effective naturalization approach to improve the quality of the outdoor learning environment (OLE). A pre-post, action-research orientation generates sufficient data to guide program development, create an evidence base, and support scientific publication. Results demonstrate an association between OLE quality, increased time outdoors, and improved levels of physical activity, which together with hands-on gardening represent a primary health promotion strategy. The seven-step POD process engages the local community and center staff in a collaborative process with the Natural Learning Initiative to create a schematic design to be implemented in increments as local resources and funding permit. Professional development of state regulatory staff is essential to successful POD implementation. Best practice indicators, using a four-point scale, provide a new OLE quality measurement tool.

Keywords: early childhood, childcare center, outdoor learning environment, naturalization, participatory design, best practice, gardening, physical activity, health promotion, obesity prevention

One Health

The World Health Organization report, *Ecosystems and Human Well-Being* (Corvalan, Hales and McMichael 2005) underscores a growing understanding among policymakers that the health of humankind, animals, and the biosphere is interwoven in a single, interdependent system—a reality that global climate change dramatically underscores. “One health” has emerged as a descriptive term (Barrett and Osofsky 2013) for a concept dating back to the 1986 *Ottawa Charter for Health Promotion* (WHO 1986; 2009), which includes “strengthen community actions” and “create supportive environments” as two of five “essential health promotion actions” (2). Further, peace, social justice, and equity are recognized as fundamental prerequisites of health. The “Manhattan Principles” (Wildlife Conservation Society 2004) include as the twelfth and final principle:

Invest in educating and raising awareness among the world's people and in influencing the policy process to increase recognition that we must better understand the relationships between health and ecosystem integrity to succeed in improving prospects for a healthier planet (3).

The socio-bio-ecological model situates life-as-lived within an interactive system of community, national, and international influences (Schnieder and Stokols 2008) and offers a framework for conceptualizing intentional change to environment and associated behavior. Here, the model considers the youngest of our own species in the context of policy to ensure optimum quality of habitat conditions for healthy development and well-being.

The Childcare Center as a Community-Based Healthy Ecosystem

Approximately one in five children are overweight or obese by the time they reach their sixth birthday. Searching for solutions, the White House Task Force on Childhood Obesity (White House 2011, 1-2) suggests: “reducing the risk of obesity in the early years of a child’s life *by improving the quality of our nation’s childcare settings*” [authors’ emphasis]. Laughlin (2013), using 2011 Survey of Income and Program Participation (SIPP) data, reports 61 percent of the nation’s total of 20.4 million children under 5 years old were cared for in “some type of regular arrangement” including relations (parents, grandparents, other relatives, and siblings) and nonrelatives. Almost one in five children were cared for in an “organized care facility” (day care center—here, childcare center is the term used—13 percent, and nursery school/preschool, 6 percent). Hours per week varied between 33 and 25 (day care center) and 25 and 16 (nursery school/preschool), according to whether the mother was employed or not (Laughlin 2013). An earlier study (Cappizano and Main 2005) report higher values of between 42.0 and 50.6 hours per week for children of employed mothers.

The significance of time investment in early childhood environments can be underscored by comparison to the mandated time children spend in U.S. primary and secondary schools. Combined, the total is approximately 980 hours (DeSilver 2014). Equivalent annual hours for a child attending childcare full time (30 hours per day, 50 weeks per year) would be 1500 or 50 percent more than school attendance. Moreover, this is time spent in a highly controlled institutional

environment during the most critical stage of development. It is not uncommon to observe children attending childcare centers for nine or ten hours per day (e.g., parent drops the child off at 7:30 am to start work at 8:00 am, and picks up the child at 5:30 pm). If such a child started full-time childcare at six weeks old, she or he would spend approximately the same amount of time (12,000 hours) in childcare as in their primary/secondary school career.

The U.S. government online resource, *Healthy People 2020* (U.S. Department of Health and Human Services 2010), includes a new objective related to early and middle childhood with a focus on physical activity in childcare settings. The *Physical Activity Guidelines for Americans Midcourse Report* (President's Council on Fitness, Sports & Nutrition 2012) expanded the childcare focus by recognizing that "interventions to modify the physical environment can increase physical activity among young children during the school day" (15).

An emphasis on intervention through naturalization is supported by the growing empirical literature demonstrating multiple, positive health effects of green environments (Kuo 2010). In relation to children's health, these effects include attention functioning (Faber Taylor and Kuo 2009), motor development (Boldemann et al. 2006; Fjørtoft 2001), stress reduction (Chawla et al. 2014), and reduction of the prevalence of myopia (Rose et al. 2008). Ensuring that the youngest of our species are exposed to the richness of local ecosystems beginning in the first year of life may be a viable, long-term strategy for implementing a "one health" policy.

The Power of Policy: Preventing Obesity by Design

With an obesity rate greater than 15 percent, North Carolina's 2- 4-year-olds rank seventh in the U.S. for childhood obesity (Trust for America's Health and Robert Wood Johnson Foundation, 2014). In response to this worrisome metric, the NC Institute of Medicine (NCIOM 2014) led a statewide taskforce of stakeholders (including the Natural Learning Initiative—NLI)¹ to develop a comprehensive strategy to improve the healthy weight status of young children. In part it is focused on the childcare center, as it is a strong predictor of physical activity (Finn, Johannsen and Specker 2002). The potential for change is substantial. Approximately 37 percent (234,000) of North Carolina children under 5 years old are enrolled in 4,766 regulated childcare centers (North Carolina Division of Child Development and Early Education 2013). Participating children receive most of their meals during the week at these centers.

Prior to the NCIOM taskforce, the North Carolina Outdoor Learning Environments Alliance (2006), self-organized as an informal statewide network of early childhood practitioners, researchers, and policy leaders to develop a strategy to influence state policy in relation to the outdoor environment of childcare centers. In 2007, an expert panel presentation to the state regulatory board, Division of Child

¹ The Natural Learning Initiative (NLI) was founded in 2000 at NC State University as a design assistance, research, and professional development unit with the mission: "Creating environments for healthy human development and a healthy biosphere for generations to come." To learn more, visit <http://www.naturalelearning.org>.

Development (now Division of Child Development and Early Learning, DCDEE), changed the term “playground” to “Outdoor Learning Environment” (OLE) in the licensing rules for childcare centers (North Carolina Division of Child Development 2009). This breakthrough expanded the function of childcare center outdoors beyond informal recreation to all areas of learning and child development, including health promotion.

In 2006, imminent re-framing of the childcare center outdoors as a learning environment aligned well with the mission and methods of NLI and helped launch Preventing Obesity by Design (POD), with support from the Blue Cross and Blue Shield of North Carolina Foundation (BCBSNC). POD is an action-research health promotion strategy, activated through built environment/naturalization interventions in North Carolina childcare centers. The goal is to create diverse OLE settings, with sufficient level of microclimatic comfort irresistibly “pull” children and teachers outside to enjoy higher levels of physical play activity and hands-on engagement with gardening. POD can be considered a “one health” model focused simultaneously on human health promotion and ecological restoration. The approach contributes to strategic system change through improvement of OLE quality as a professional training vehicle, with primary intended outcomes of change in teacher and child behavior and land restoration.

Action Research

The POD action-research orientation addresses the need for applied research conducted on the installed environment to observe the behavioral response. The aim is to create an evidence base related to the local context so that future developments can be informed, as elegantly illustrated by Zeisel (2006, 25-32, 95-97). Action research also recognizes the difficulty of matching timelines of project implementation and research support, which ideally would include an expanded sample and control sites, with research conducted by a third party. Bricks-and-mortar (or landscape) funding rarely supports research at this level and vice-versa: research funding usually does not support implementation. However, carefully managed project evaluation can yield sufficient data to compare the impact of pre-post site renovations (Cosco, Moore and Smith 2014). Results provide evidence-based/informed tools for decision makers to use to embark in built environment interventions to improve OLE quality to support child health.

Naturalization Strategy

“Naturalize” means “to cause a plant or animal from another place to begin to grow and live in a new area” (Merriam-Webster 2014). It is an important key word because the vast majority of childcare centers can be considered land restoration sites, where natural ecosystems must be restored, designed, and managed in such a way that both allows use by dozens of children and ensures that short-term recovery is possible. Naturalization offers children opportunities to engage with the natural world of plants and animals through self-motivated free play and learning experiences (both informal and teacher-directed) (Moore 2014).

The restoration/naturalization task is enormous. There are approximately 114,000 childcare centers in the U.S., where 4 million children are enrolled (Child Care in

America 2012, State Fact Sheets, 8). Considered as ecological restoration sites, a conservative estimate of the amount of land comprising these centers is around 30,000 acres (equivalent to 35 New York Central Parks), where every day young children are exposed to ecologically deprived land and receive a seriously flawed message about how we treat our natural resources. However, as childcare is highly regulated in most states, the potential for change is substantial. Even though some centers in urban areas may have little or no open space to naturalize, installing planters or greening common areas may suffice to stimulate children's contact with nature.

The POD approach offers naturalization as a cost-effective means of improving OLE environmental quality. The preschool outdoors is already a determinant of children's physical activity (Cardon et al. 2008). Naturalization adds value by supporting play with nature, improving microclimatic comfort for children and teachers, and motivating extended time outdoors to achieve higher levels of physical activity. "Edible landscape" is a complementary health promotion component consisting of permanent, fruiting species integrated into the OLE, along with designated vegetable gardens. Children can be engaged in hands-on gardening most of the year in North Carolina's benign climate.

Establishing an OLE Quality Baseline

How can the quality of an OLE be empirically measured? The traditional answer refers to the number and size of pieces of play equipment, the safety of which has been the main focus of state regulators. But a childcare center is not a city park—where periodic visits and "rediscovery" of the playground may be a meaningful, re-occurring experience in a child's life—rather, it is a place of daily, outdoor experience that must provide year-round physical activity and support healthy eating. To stimulate all developmental domains, children attending childcare need hands-on, interactive, fluid, affordance-rich spaces that can be manipulated in multiple ways to serve developmental outcomes—including physical health. Research demonstrates that a compact mix of diverse natural and manufactured settings (Cosco 2006), containing a multitude of loose parts offered by nature (Fjørtoft and Sageie 2000) offers such a play and learning experience.

Children's play, as recognized by Article 31 of the Convention on the Rights of the Child (United Nations 1990), is the means through which ecosystem affordances are actualized (as described by Kyttä 2004). Play is considered to be a learning process for the child, through which the world (childcare ecosystem) is discovered and assimilated via the senses, laying the groundwork for cognitive understanding in later stages of development (Moore 1986, 6-16).

To begin to answer the quality question, a baseline survey was conducted by the authors (Cosco and Moore 2002), which showed a lack of natural settings and diverse play materials in North Carolina childcare centers. Even the top-ranked centers, which were further assessed via site visits, exhibited substantial limitations as early learning environments. These findings became part of the impetus to develop a valid, reliable tool for measuring the quality of outdoor learning environments. The result was POEMS (*Preschool Outdoor Assessment Measurement*

Scale; DeBord et al. 2005), developed with research and practice colleagues.

Building an Evidence Base

In parallel with these advances in thinking and in response to the growing obesity health crisis, the authors devised an interdisciplinary research framework to understand the link between design variables and health promotion outcomes in early childhood outdoor environments. Grants from Active Living Research (Cosco 2006) and the National Institute of Environmental Health Sciences (Smith et al. in press) supported the effort, which from the beginning involved collaboration with colleagues in public health, nutrition, and social science.

Behavior mapping (based on theories of affordance (Gibson 1979; Heft 2001), behavior setting (Barker 1976), and territoriality (Hart 1979; Moore 1986), developed by Moore since the 1970s) become our primary research method enabling physical environment and behavioral variables to be coded simultaneously (Cosco, Moore and Islam 2010; Moore and Cosco 2010). Our aim was to identify variables that could directly inform design guidelines and policy at a level of detail that would be difficult to capture using separate tools to measure environment and behavior and require complex statistical modeling to analyze. Early data were gathered using small handheld PDAs (PDA Dell Axim Pocket PC, Austin, Texas), simultaneously plotting data point locations on a paper site plan. We are now using high-end tablets (www.tabletkiosk.com) to code data directly on a screen with a viewable, responsive site plan, without need for paper.

A behavior mapping study conducted by Cosco (2006) is believed to be the first that used GIS to study preschool outdoor environments in childcare centers. Three comparable sites with varied outdoor environmental qualities (natural, manufactured, and mixed) were investigated to understand associations between environmental variables and level of physical activity. The findings strongly suggest that the amount of physical activity afforded by preschool play areas can be intentionally improved by design. Diverse play areas containing pathways and natural elements and combining a range of setting sizes appear to be the most effective. The level of activity in a play area is due to the additive effect of the layout of the site and its attributes. The most active setting at the most active center was a wide, curvy, looped wheeled toy pathway (Figure 1). Such a setting also supported greater numbers of children playing together—a factor that might explain the increased number of child-child interactions and therefore their higher levels of physical activity.

Figure 1. Wide, curvy, looped wheeled toy pathway provides form to the OLE and easy circulation within it, and is one of the most important settings to support higher levels of physical activity



However, findings also showed that a high-quality outdoor environment is not necessarily sufficient to encourage prolonged preschool physical activity (Cosco 2006). A key conclusion was that the educational approach is critical in guaranteeing children's use of the outdoors for extended periods beyond mandated "outdoor time," so that teachers engage children in meaningful, curriculum-driven learning activities. The creation of compact settings that support rich, social interactions together with educational programs that foster these interactions are more likely to result in longer time outdoors for children and secure sustained moderate and vigorous outdoor physical activity day to day.

The results of the Cosco (2006) study provided sufficient evidence to launch POD that same year as a community-grounded, action-research, evidence-based, health promotion program to address outdoor quality in childcare centers through built-environment design. The first iteration was a pilot project with three childcare centers. Based on a successful outcome, BCBSNC supported POD Phase 2 (POD2) to take on 30 additional centers and to refine the POD process. With additional support from other funders, POD programs have developed in populous Wake County (benefiting from NLI's location on the North Carolina State University campus), and extended to "Down East North Carolina" (the sparsely populated, rural, low-income region of the state). Over eight years, POD has grown into a comprehensive built environment intervention for increasing early childhood physical activity, engagement in gardening, and fresh food awareness through research-based/ evidence-informed design assistance, teacher training, and dissemination of information. On-going, pre-post evaluation is a critical component, providing continuous feedback to improve practice, as well as research data to continue building the evidence base. Findings from a separate behavior mapping study of 30 childcare centers demonstrate a significant effect of setting adjacency or more broadly the importance of form/layout in OLE design (Smith, Moore and Cosco in press).

POD Process Components

The POD process combines NLI design expertise on children and family outdoor environments with the infrastructure of state/county-wide early childhood technical assistance agencies, including Partnerships for Children and Child Care Resource and Referral Agencies. Childcare centers are chosen by competitive process, through which they are required to demonstrate their willingness to produce changes in the outdoors and to develop the leadership and community engagement necessary to sustain the intervention.

A complete POD Team comprises the NLI design team, center director, lead teachers, and representatives from the organization providing local technical assistance. A train-the-trainers approach is used to transfer knowledge about designing and managing outdoor environments to support the specific health outcomes of physical activity and healthy nutrition, while also helping participants to be aware of other research-based health outcomes referred to above. Implementation of POD projects includes a seven-step participatory design process (Table 1).

Table 1. Seven-step process of a typical Preventing Obesity by Design (POD) project

POD Seven-Step Process
<ol style="list-style-type: none"> 1. Pre-renovation baseline data gathering using behavior mapping, the <i>Preschool Outdoor Environment Measurement Scale</i> (POEMS, DeBord et al. 2005), center director survey, and interviews. 2. Participatory design assistance facilitates incremental site development including the following activities: <ol style="list-style-type: none"> a. Community workshop to bring stakeholders together and introduce them to the POD process (Figure 2). b. Design workshop to create a design program and preliminary conceptual design through a hands-on process with the center staff facilitated by NLI staff (Figure 3). c. Schematic design developed by NLI trained landscape designers based on the design program and preliminary conceptual design (Figure 4). d. Design reviews of schematic design conducted by NLI with center staff. e. Development of a phasing (incremental development) plan tailored to the funding and implementation capabilities of the center. f. Compilation of construction cost opinion to guide fundraising efforts. g. Review of health and safety regulations. h. Delivery of affordable renovation solutions and planting suggestions. 3. "Seed grants" (\$2000-\$3000) awarded to support the cost of design implementation, construction materials, plants, and gardening tools. 4. Teacher training workshops and webinars focused on use of renovated outdoor settings to promote physical activity and gardening (food awareness and healthy eating). 5. On-call, on-site, and web-based technical assistance. 6. Dedicated website section for each participating center (http://www.naturalearning.org/content/projects) 7. Post-renovation evaluation data gathering using behavior mapping, the <i>Preschool Outdoor Environment Measurement Scale</i> (POEMS, DeBord et al. 2005), center director survey, and interviews.

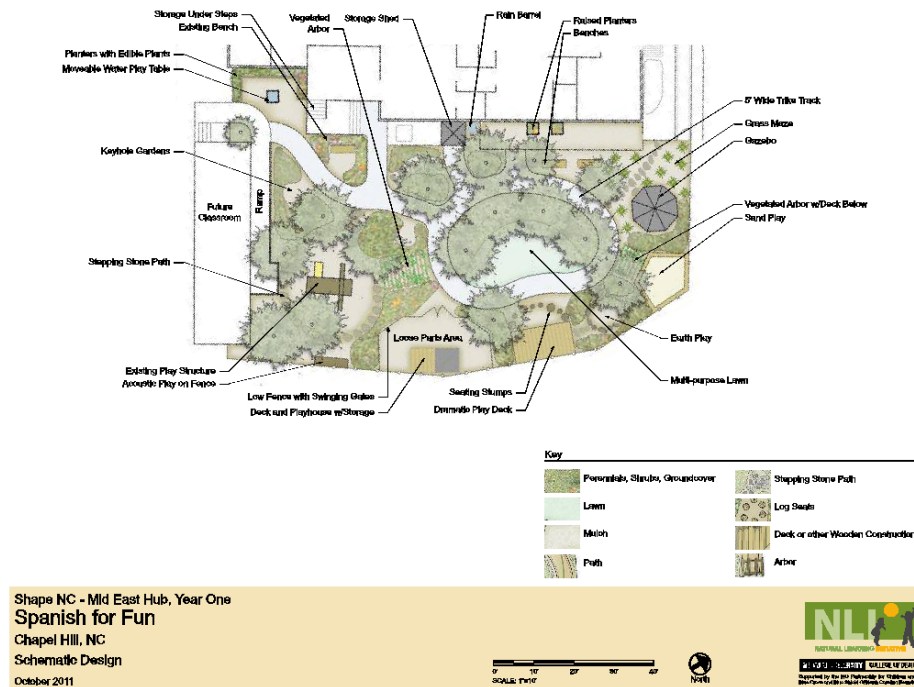
Figure 2. Stakeholder community meeting. The design team, parents, and community partners discuss the project and the journey being embarked on together



Figure 3. Design Workshop. Teams from ten centers prepare information about their center ahead of time and spend a day working with the NLI design team developing a design program (left) and a preliminary schematic design (right), which is then refined back-and-forth over several weeks by the NLI design team.



Figure 4. Final schematic design. The result after refinement by the NLI design team in sufficient detail that the center can move forward with incremental construction using local contractors.



Adding UV Protection

In 2007, Swedish colleagues at the Karolinska Institute and Linnæus University, approached NLI to partner on KIDSCAPE, a project to investigate relationships between sun exposure, physical activity, and environmental variables in childcare centers in Sweden and the USA (Boldemann et al. 2006; Raustorp et al. 2011). This international collaboration with experts in skin cancer prevention resulted in NLI acquiring new knowledge and expertise in this key health promotion area, highly relevant to the southern latitude of North Carolina. Sky View Factor analysis became one of the POD research and evaluation protocols (Boldemann et al. in press).

Working with Regulators

In 2010-2011, the NC Division of Child Development and Early Learning (DCDEE), contracted with NLI to launch "Creating a Supportive Network," a training program for the full complement of North Carolina Licensing Consultants and Environmental Rating Assessors (hereafter called consultants and assessors)—206 in total.

Project goals included: 1) to implement naturalized outdoor learning environments in North Carolina childcare centers in compliance with current regulations by creating a specialized professional network including all consultants and assessors;

2) to identify and remove barriers to the creation of OLEs; 3) to create a specialized professional network to support the emergence of OLEs; 4) to increase access and understanding of the knowledge base related to naturalized OLEs to ensure consistent professional judgments of regulatory consultants and assessors appropriate with implementing and managing high-quality naturalized outdoor environments for young children.

A special advisory committee of DCDEE consultants and assessors was created to guide the development of training materials and events, to advise NLI on policies and regulations affecting the implementation of OLEs containing natural elements, and to shape recommendations for improving policies related to naturalized OLEs—an effort now almost complete.

NLI created a multi-pronged strategy to deliver information and stimulate discourse. Included was a two-hour training session covering the benefits of outdoor play for young children, background research, and design considerations for naturalized OLEs delivered to DCDEE staff and broadcast live statewide by NLI from DCDEE headquarters. NLI delivered quarterly webinars (Naturalizing Outdoor Play Spaces, Design Guidelines, Costs and Affordable Solutions, Plants and Wildlife) to transmit OLE naturalization knowledge to consultants and assessors. A series of information sheets was created by NLI addressing key topics related to the design, development, implementation, and use of outdoor learning environments by young children. A Resource Directory was produced for the NLI website, containing an annotated list of research findings, major publications and websites on outdoor learning environments. Regional workshops were organized for consultants and assessors including visits to model naturalized OLEs in existing childcare centers. A comprehensive training module on outdoor learning environment naturalization was produced for delivery by trainers as part of the DCDEE Basic Job Skills Training Plan. A one-day intensive symposium was held at the North Carolina Zoo with speakers from the fields of early childhood education, child health, physical fitness, and landscape design—covering best practices, research, design considerations and use of naturalized outdoor learning environments. Program participants also attended the 2011 NLI Design Institute at the North Carolina Botanical Garden.

The program of face-to-face meetings created an important two-way street of mutual learning and awareness. We discussed many myths and realities. When exposed to “before and after” documentation and data to support related positive behavioral change, consultants and assessors realized that OLE naturalization could have a positive impact on child health as well as improve the sense of ownership and pride on the part of childcare providers (Figures 5a and b). NLI learned about the challenging “professional judgment” issues faced by consultants and assessors, which suggested topics for research and publication of topical guidelines for providers.

Figure 5a. Before renovation: play equipment, sand play area, moveable play houses, and underutilized wooden structure. Spanish for Fun, Chapel Hill, NC



Figure 5b. Eight months after renovation: boardwalk looped path, play equipment, shade trees, stage, play house, and vegetable gardens. Spanish for Fun, Chapel Hill, NC.



Positive Impacts

Survey results (N=202) after the year-long project indicated that perception of the importance of OLE quality and awareness of opportunities for outdoor play and learning increased. Ninety percent of participants believed that existing North Carolina childcare center OLEs were either poor or of average quality and that improvement could be achieved by installing natural elements. Voted as important by the majority were the following natural components: trees and shrubs, natural ground surfaces, mounds and slopes, perennial plants, flowers, vegetable gardens, stepping stones, logs, and smooth rocks. Based on this positive outcome, DCDEE created an internal staff committee to continue the work on policy change and training, which is still underway.

POD and Shape NC

Each iteration added value to the overall POD effort, which in 2011 was adopted as the built environment component of Shape NC, a multipronged system-level effort to ensure healthy weight in North Carolina's preschool children, administered by the

North Carolina Partnership for Children (NCPC).² As an “expert partner,” together with others representing nutrition and physical activity, NLI was tasked with implementing OLE best practice standards in the design and environmental management of 18 Model Early Learning Centers (2011-2013). NLI’s assigned role was to assist centers with OLE renovation and naturalization to transform their existing traditional playgrounds into stimulating, nature play and learning environments offering diverse opportunities for increased physical activity and healthy nutrition. “Edible landscapes” installed and managed by centers include designated vegetable gardens and permanent fruit trees, shrubs, and vines integrated into the landscape. As one center reported, “The kids run out every day to check to see what’s growing.” Continuing involvement by NLI in Shape NC is focused on a train-the-trainer program to extend reach of the POD model.

Children Gardening in Wake County

The hands-on gardening emphasis of POD is supported by literature pointing to the importance of overcoming “neophobia” and picky eating by exposing children to fresh vegetable and fruit early in life. Gardening increases the frequency of consumption and acceptance of varied vegetable and fruit tastes (Cabalda et al. 2011; Castro, Samuels and Harman 2013). As a food awareness activity, gardening is regarded as a positive strategy to support healthy eating (Castro, Samuels and Harman 2013; Mienen et al. 2012; Story et al. 2008; Benjamin-Neelon and Evans 2011). Strangely, what we understand to be basic to the sensory learning of young children around fresh vegetables and fruit does not show up strongly in the nutrition literature or in the practice of nutrition professionals. Direct exposure to gardening can impact parents as well. As a teacher reported in a post-renovation interview in 2013, “My ‘ah-ha moment’ was when a parent saw a zucchini for the first time ever in the garden when she came to pick up her kids.”

Opportunities for POD action research on gardening have expanded to POD centers in Wake County, within easy driving distance of the NC State Campus. A “gardening crew” based at NLI makes weekly visits to POD-Wake centers to train, encourage, and engage staff and community volunteers in gardening activities (Figure 6). Staff response has been dramatic. Once teachers realize that gardening is not only fun and that beyond the basic principles of good soil, water and sunlight it is difficult to fail, there is no holding back. “At the planting day every family was represented. Donors stopped by to help. We had over 70 volunteers” (center director, post-renovation interview, 2013).

² <http://www.smartstart.org/shape-nc/shape-nc-background>

Figure 6. Kids gardening with community volunteer at POD-Wake OLE

Gardening technical assistance is provided via the Green Desk and NLI *InfoSheet* library hosted on NLI's website.³ Interactive design training for ten centers twice a year will result in an additional 60 participating centers (out of the 250 centers in the county) by the end of the project. Evaluation measures include environmental and behavioral changes and changed attitudes towards gardening activities.

From a young child's perspective, a focus on *food* and on-site gardening is key to developing healthy tastes. Gardening is the critical, hands-on, direct experience that helps children understand that food comes from the Earth. Children jump right into every aspect, including a fascination with earthworms and composting. Gardening is a process that appears highly functional, yet is full of surprises. "All the kids went outside, picked herbs and put them in their pockets. When they came inside to make spaghetti, they all smelled just like herbs" (teacher, post-renovation interview, 2013).

As an example of garden productivity, before becoming a "POD Lab," the OLE at First Environments Early Learning Center (designed by MIG⁴ and NLI), in Research Triangle Park, was already producing several hundred pounds of food annually from a raised-bed garden built by parent volunteers in a single weekend (Figure 7). In addition, permanent fruiting trees, shrubs, and vines located throughout the OLE add variety. Apart from tasty snacks, the food goes into the center kitchen. At mealtimes, the children experience the cooked result of what they have helped grow as fresh ingredients.

³ <http://www.naturalearning.org>

⁴ <http://www.migcom.com>

Figure 7. Raised-bed vegetable garden at First Environments Early Learning Center, Research Triangle Park, NC. The carefully monitored garden produces approximately 600 pounds of food a year. Permanent fruiting tree, shrub, and vine species in other locations throughout the OLE add variety of tasting and culinary options



Developing Best Practice Indicators

NLI membership in the Shape NC team has enabled development of best practice indicators by building on and expanding the dichotomous items contained in the validated POEMS tool. Indicators were derived from the contents of almost 60 POD designs generated by NLI's landscape design team, all of whom received professional landscape architecture education. Best practice indicators are scored using a four-point scale, ranging from "none" to "fully achieved." Measures include settings such as primary pathways; shade; amount of trees, shrubs, and vines, including edible species; natural and manufactured loose parts; vegetable gardens and edible landscapes; outdoor classrooms and storage.

Measuring Success

An evaluation survey of POD2 centers (N=26) tracked positive increases in settings and tree planting. Particularly encouraging were post-renovation outcomes of key proxies for physical activity and food awareness: time outdoors, and vegetable gardening (Cosco, Moore and Smith 2014).

- **Time outdoors.** Even though many of the renovations were modest, increased time outside was reported for all seasons.
- **Gardening.** Installation of designated vegetable gardens increased by 62 percent across centers (from 19 percent to 81 percent). Teachers mentioned

the creation of vegetable gardens as great achievements. The gardens supported children's tasting of vegetables and fruits grown in the centers. "We are proud of the garden, with kids planting and picking green beans, red onion, sunflowers, lettuce, carrots, mustard greens, turnip greens, spinach, squash, green peppers, tomatoes, and blueberries" (center director, post-renovation interview, 2013).

- **Peaceful behavior.** Almost 70 percent of center directors reported positive changes in children's behavior, such as less altercation (Figure 8). "Our proudest achievement is the discipline improvement. The kids are not all doing the same things, instead they are using their imaginations" (center director, post-renovation interview, 2013).

Figure 8. Floating on a sea of pine needles. Three boys play with a real, donated, unanchored dingy in a remnant grove of pine trees that serves as a shared, flexible OLE setting for the all children.



- **Integration of children with different abilities.** In 2013 post-renovation interviews, teachers mentioned how the renovated OLE supported better integration of children with different abilities:

There are more ways for disabled children to play and interact with other children, not just watching.

The garden is a kind of therapy to the children from difficult situations with special needs.

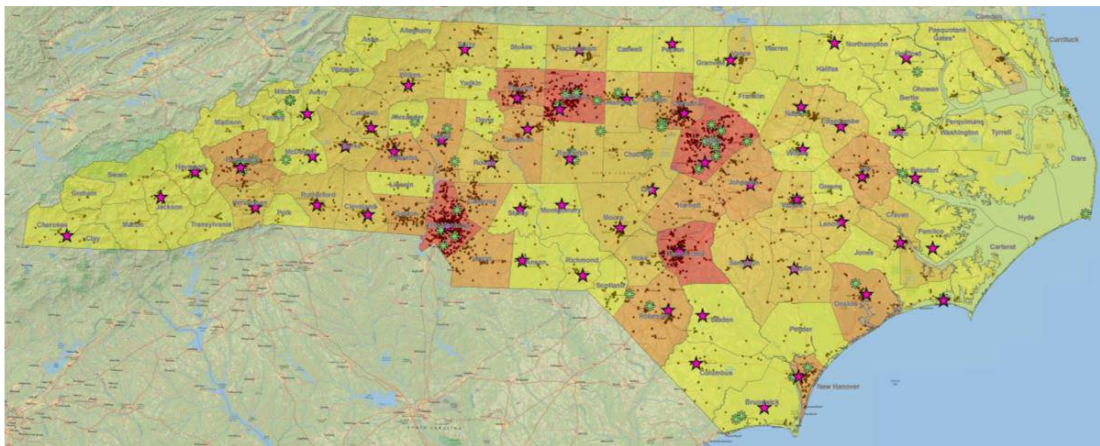
Now, our special needs children are on a level field on the playground—you can't tell the difference.

- **Community engagement** as an invigorating social process was praised by center directors and emerged as the all-important vehicle of success. Center directors recognize how OLE renovation can be a vehicle for community engagement. "For a community with little to be proud of, this playground is a proud achievement, a blessing, and a gift for everyone" (center director, post-renovation interview, 2013).

POD³ (cubed)

How can the many years of POD findings, the Shape NC experience, and the outcome of the DCDEE initiative, "Creating a Supportive Network," be scaled up to eventually influence the quality of most childcare centers in North Carolina? Through transferring knowledge, building capacity, and extending reach, the goal of POD³ is to convert outdoor design and programming "best practices" into "common practices" for adoption by early childhood educators, providers, regulators, and landscape designers and managers. Working closely with the NC community college system and existing statewide and regional partners, a strategy is emerging for diffusing OLE innovation, system-wide. A significant factor is that many of the remaining 4,766 childcare sites are located near one of the state's 58 community colleges or 60 POD demonstration and lab sites. The map in Figure 9 shows that almost three-quarters (72 percent) of center sites are within 20 miles of a POD site; 95 percent are within 20 miles of a community college.

Figure 9. POD³ geography: map shows location of community colleges (red stars), POD demonstration and lab sites (green circles) and balance of 4766 childcare centers (purple dots).



Implementation Challenge

Getting physical change to happen on the ground remains a challenge because it requires professional skills that are in short supply or, more accurately, cannot be affordably delivered to centers in the neediest communities. Development of effective, locally available basic landscape design services is one of the more pressing issues. One path towards solution is to continue working with the landscape industry to increase understanding of the design/build market in

childcare center OLE improvement, and to include appropriate training through the community college system. Collaboration with the Cooperative Extension Service County Offices is another fruitful strategy.

Landscape design is a professional skill that requires years of professional education and practice to acquire. Obtaining a license to practice landscape architecture takes several additional years. Skill in designing landscapes for young children (or children in general) is rarely available and is difficult to deliver through the traditional landscape architecture "fee-for-service" model for several reasons: childcare providers do not understand the need for landscape professional expertise, and/or they feel they cannot afford the design fees, and/or they are in a rural location far from a landscape professional design office. The challenge is to find design professionals with early childhood knowledge and understanding of how to create environments to support child health outcomes. If skills are inadequate, standards can slip so that results on the ground no longer meet best practice and standards revert to the status quo. However, center directors reported in post-renovation interviews that they are beginning to understand the role of design and the difference it can make to outdoor quality:

Our biggest success was the design—having a direction to go and a vision to implement.

The plan was exactly what the teachers had envisioned.

The best thing was the plan.

Demand for design/build services may well increase from this newly educated client base. "We are proud of the whole thing—seeing all the components come together. We take parents out on the playground at orientation and show off the new space" (post-renovation interview, 2013). As providers experience successful implementation they may invite not only parents but educators and community activists to see results on the ground and "spread the word" across the state.

Conclusion

Almost eight years of POD growth and development—from three pilot childcare centers to more than 60 sites across the state, has involved working in collaboration with networks of childcare providers, licensing authorities, and now community college instructors who deliver pre-professional education in early childhood and landscape construction. To address the scale of change required, POD was launched with the premise that much could be accomplished by working with early childhood systems to influence state policy. Only time will tell the full extent of success of the community-based, bottom-up strategy for upgrading OLEs that demonstrate best practice quality on the ground.

The importance of top-down leadership in adding synergy to drive action has also been demonstrated by the North Carolina Institute of Medicine (NCIOM 2013) recognition, that physical quality of the childcare center OLE is a significant component of community-based strategies to promote healthy weight for young

children. Once policy is translated into accreditation regulations that become viable vehicles for environmental change, POD evidence suggests that outdoor renovation may influence behavior modifications that positively affect the daily lives and healthy development of thousands of children.

Childcare centers and equivalent early learning institutions can be considered “supportive environments” where “one health” policies promoting human health and improved ecosystem health can be combined and delivered through community action.

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