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“I Have a Hippopotamus!”: Preparing Effective Early Childhood Environmental Educators

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Abstract

This article describes an early childhood teacher-preparation program that infuses environmental education and nature experiences into courses, practicum, and student-teaching experiences. Program philosophy, pedagogy, materials, and methods are described and linked to the Early Childhood Environmental Education Programs: Guidelines for Excellence, the Guidelines for the Preparation and Professional Development of Environmental Educators, and state-level early learning guidelines that focus on connecting young children with nature. Preservice teachers build knowledge, skills, and dispositions for effective environmental education beginning from an awareness level and progressing to application and refinement. The value of nature is communicated explicitly and implicitly throughout the program. Preliminary analysis of student outcomes indicated that, over the course of the program, students’ ratings of the importance of nature and science experiences and outcomes increased, along with their confidence implementing environmental-education activities. There is growing interest in nature and environmental education (EE) in early childhood. Guidelines for Excellence have been published for early childhood education (North American Association for Environmental Education [NAAEE], 2010a), and the North American Association for Environmental Education has added a “Connecting Kids and Nature” track to the annual conference. Several books have been published on connecting young children with nature (e.g., Davis, 2010; Ward, 2008; Wilson, 2012) and early childhood EE curricula have been developed by Project Learning Tree and Project Wild (Council for Environmental Education, 2009; Project Learning Tree, 2010). A professional development program focusing on discovering nature with young children has been funded by the National Science Foundation (Chalufour & Worth, 2003) and the National Association for the Education of Young Children published a compilation of articles on nature and EE in early childhood (Shillady, 2011). A rating scale designed to assess EE in early childhood has also been published (Bhagwanji, 2011). You know things are getting serious when we start measuring!

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Color versions of one or more of the figures in the article can be found online at
<http://www.tandfonline.com/utne>.

Despite the increased focus on EE in early childhood and publication of curricula and materials supporting early childhood EE, teacher preparation for early childhood EE has received much less attention. This is a problem because knowledge about how to effectively prepare early childhood environmental educators is necessary for the field to mature. Early childhood educators must be effectively prepared to plan, to implement, and to evaluate EE programming in order to realize the potential of the foundational work described above, to further develop the field of EE in early childhood, and to provide meaningful EE experiences for young children. The purpose of this article is to begin addressing this gap by describing an innovative early childhood teacher-preparation program with an intentional focus on nature and EE and by presenting some preliminary data evaluating student development within the program. We begin by defining and describing EE in early childhood. We then review research on early childhood teachers' preparation to teach EE, and, because these data are somewhat limited, we include research on early childhood teachers' science preparation as well as relevant research on elementary teachers. Next, we describe our early childhood teacher-education program, including courses, objectives, pedagogy, materials, and experiences that are relevant to EE, and identify how these methods meet guidelines and standards for teacher preparation in EE, excellence in early childhood EE, and state-level early learning guidelines focusing on nature.

Environmental education in early childhood

Environmental education is a holistic process. According to the Belgrade Charter, the goal of environmental education is the following:

To develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones. (United Nations Educational, Scientific and Cultural Organization. [UNESCO], 1976, p. 3)

While the focus of this definition is on the relationships between people and natural environments, the Belgrade Charter also states that the goal of environmental action is "To improve all ecological relationships, including the relationship of humanity with nature and people with each other" (p. 2). Together these statements make clear that EE focuses on human communities, natural communities (ecosystems), and the relationships between them. EE is holistic in the sense that it includes knowledge, dispositions, skills, and behaviors (e.g., NAAEE, 2010b). EE is also a social endeavor, as collabora-

tive learning is a benchmark of EE quality and working “collectively toward solutions” requires collaborative relationships. Early childhood EE explicitly includes nurturing positive emotions such as “joy of closeness to nature,” social emotions such as “respect for other creatures,” and motivational emotions such as curiosity and fascination with nature (North American Association for Environmental Education, 2010a, p. 2).

Environmental education is also integrative, meaning that EE can and should be infused into all curricular domains (Essential Underpinnings of EE; North American Association for Environmental Education, 2010a, 2010b). Science is a component of EE, but, because all aspects of human living are interdependent with natural ecosystems, EE incorporates history, humanities, social sciences, and literature. Many states include standards specific to EE in their science-education standards as well as their early learning guidelines (e.g., relationships between animals, plants, and environment, preserving the environment, taking care of familiar plants and animals, neighborhood, population, and ecosystems, and recognizing what it means for a species to be extinct; see Table 1). These topics are to be learned during preschool and kindergarten years and beyond. Infusing math into EE and EE into math enhances learning in both domains, as children engage in authentic problem solving. Music, movement, and expressive arts can be inspired by nature and can also be used to communicate about natural environments. Integrated curriculum is a hallmark of quality in early childhood education, and this is one of the many points of complementarity between early childhood education and EE (Copple & Bredekamp, 2009; Hart, Burt, & Charlesworth, 1997).

Early childhood is typically defined as the period of life from birth to 8 years of age and emphasizes the multiple layers of systems that influence and are influenced by the child’s development (e.g., Bronfenbrenner & Morris, 2006). Early childhood educators understand that families, communities, and educational settings are all interacting systems, and, when these systems work together collaboratively children’s development is supported. Therefore, early childhood educators are prepared to collaborate with families and community organizations and resources for the benefit of children. This systems approach makes early childhood educators “natural” proponents of an EE approach; they already recognize the interdependence of systems within a child’s life and can translate this to include natural systems.

Early childhood educators often use the terms “environmental education” and “nature education” interchangeably (e.g., Meier & Sisk-Hilton, 2013; Wilson, 2012). This is in part due to the focus on nurturing children’s curiosity and enthusiasm for spending time in natural environments and learning about nature (e.g., NAAEE 2010a; Wilson, 2012). For example, *The Early Childhood Environmental Education Programs: Guidelines for Excellence* includes guidelines for the following: to focus on nature and the environment; to provide

Table 1. Scientific concepts included in science guidelines/standards for preschool to first grade (29 states).

Physical Science	Life Science	Earth Science	Technology
<p>A. Properties of Matter</p> <ul style="list-style-type: none"> - Explores characteristics of matter - Exploring different colors and white and black, shapes of objects, textures (rough/smooth) and feel (hard/soft) and size and weight - Identifying environmental sounds (e.g., cars, airplanes, wind, rain, birds) - Describing the difference between the wet sand and the dry sand - Describing how water flows through a tube - Experimenting with objects that sink or float in water Properties and Characteristics of Liquids, Solids, and Gas - Recognizing water in its three forms (liquid, solid, and gas); Describing the states of matter (e.g., observing ice melting) - Understanding changes when substances are mixed, shaken or cooked - Involving in transformation of materials (e.g., cooking, painting) - Acting out a melting snowman, popping popcorn, and object rolling down a hill 	<p>A. Living and Nonliving</p> <ul style="list-style-type: none"> - Identifying things as living and nonliving based on their characteristics - Breathes, moves, grows - Animals, plants, rocks, buttons - Describing characteristics, patterns, basic needs, and simple life cycles of living things (i.e., plants, animals, and people) - Various patterns and products: e.g., parents and offspring, describing how puppies are like dogs, ducklings are like duck. (e.g., That tree grew really tall; food, water, sunlight, soil, air, space, temperature) - Illustrating complete metamorphosis (e.g., butterfly, frog) - Illustrating incomplete metamorphosis (e.g., grasshopper; herbivores and carnivores; compare and contrast complete metamorphosis and incomplete metamorphosis - Exploring and describing similarities, differences, and categories of plants and animals (e.g., compares size and shape) - Understanding changes in the appearance, behavior, and habitats of living things (e.g., plants, spider webs) - Asking questions about growth, change, function, and adaptation in plants and animals (i.e., evolution) - Structure and function of living things - Five senses - Oral hygiene: how clean teeth - Human body parts: heart, lungs, brain, stomach, muscles, bones - Plant parts: leaves, stems, flowers, roots 	<p>A. Properties of Earth and Space</p> <ul style="list-style-type: none"> - Classification of natural objects (e.g., seeds, cones, leaves) according to shapes, forms, and textures - Atmosphere (air), mixture of gases, including water vapor, and minute particles; Water and its uses; Sun – heat and light; Supporting life on earth; Sound (thunder, wind); Shadows - Weather - Temperature - Seasons - Day and night - Sunlight and shade - Identifying patterns and routines in daily life - Weather predictions - Identify types of precipitation - Measuring devices (e.g., thermometer, rain gauge, ruler, cup, bowl; experiments with windsocks, pinwheels, telescopes, binoculars, kites, magnifying glasses - Order or stages of animal and plant growth Describe how things change naturally, age, weight Maintain a balanced ecosystem (Solves problems involving earth and space; Pollution; Recycle, reused and conserved) - Natural and man-made things - Composition and structure of the universe and the Earth's place in it - Rotation - History of the earth - Concept of rotation, - Sequence of planets in the solar system 	<p>A. Tools</p> <ul style="list-style-type: none"> - Use age appropriate tools to investigate. - Exploring simple tools (e.g., ramps, magnets, magnifying glasses, scales, eyedroppers, unbreakable mirrors, cups, funnels, tape measures, balls, prisms, etc.) - Correctly use thermometers, balance scales, magnifying glasses, etc. for investigation - Use tools to collect data and record information. - Uses computer to solve problems. - Natural objects vs. manmade objects (Continued)

Table 1. (Continued).

B. Force, Motion, & Energy	B. Environment	B. Uses
<p>Force and Motion:</p> <ul style="list-style-type: none"> - Describing the ways that objects can move (e.g., in a straight line, zigzag, up and down, back and forth, round and round, and fast and slow) - Position vocabulary (e.g., over/under, in/out, above/below) - Forces in nature - Understand Gravity - Magnets: predicting which objects magnets attract (pull) or repel (push); categorizing properties of materials using magnets <p>Energy:</p> <ul style="list-style-type: none"> - Different forms of energy (e.g., light, heat and sound energy) - Transfer of energy - Importance of light and heat <p>Investigating sound</p> <p>Represents observations of the physical world in a variety of ways</p>	<p>Relationships between animals, plants, and the environment (i.e., habitats)</p> <ul style="list-style-type: none"> - Fish live in water. <p>Taking care of familiar plants and animals</p> <ul style="list-style-type: none"> - Waters houseplants, feeds pet fish, growing plants and caring for pets <p>Preserving environment</p> <ul style="list-style-type: none"> - Recycling, planting a tree <p>Neighborhoods</p> <p>Population and ecosystems</p> <p>Recognizing what it means for a species to be extinct</p>	<p>How we use technology and the affect it has on our lives.</p> <p>Promotes safety – begin to understand basic safety practices</p> <p>How technology affects our lives.</p> <p>Relationships among science, technology, environment and society</p> <p>Apply the concepts, principles and processes to technological design</p>

Note. Underlined concepts were included only in first-grade science standards.

authentic experiences in nature; to use the natural world as both a context and focus of learning, as well as natural materials; and to provide ample opportunities for play in natural environments (North American Association for Environmental Education, 2010a). Environmental education is of course much broader than this, but, in large part, natural environments are both the medium and the message in early childhood EE. For the purpose of this article, we will use the term environmental education (EE).

Early childhood teachers, science education, and environmental education

Contemporary preservice teachers belong to the generations described by Richard Louv's *Last Child in the Woods* (Louv, 2008). While there are certainly exceptions, on the whole, contemporary young adults have spent much less time outdoors in natural environments than did previous generations. Direct experience with natural environments in childhood is a key predictor of adult time spent in natural environments as well as proenvironmental attitudes (Chawla, 2007, 2009; Chawla & Derr, 2012; Sobel, 2008). Although EE is a multidisciplinary concept, environmental literacy is an important core competency for environmental educators (North American Association for Environmental Education, 2010b). Less than 30% of teachers feel adequately prepared to teach life science (National Science Board, 1999), and early childhood teachers report anxiety about teaching science (Copley & Padron, 1999). This is not surprising because early childhood teachers take few science courses, on average (President's Council of Advisors on Science and Technology [PCAST], 2010) and few states require EE coursework for teacher certification (Archie, 2001). Early childhood educators rank science and nature experiences and learning outcomes as significantly less important than experiences and outcomes in other curricular domains and also rate their confidence implementing such activities as significantly lower than implementing activities in other curricular domains (Torquati, Cutler, Gilkerson, & Sarver, 2013).

Providing direct experiences in natural environments is a cornerstone of EE (e.g., North American Association for Environmental Education, 2010a, 2010b; State Department of Education, 2008; Wilson, 2012). However, one study found that elementary teachers reported low levels of confidence teaching in natural contexts (Simmons, 1998), and another reported that teachers preferred built settings more often than natural settings for EE (Simmons, 1994). Similarly, a study of early childhood preservice teachers found that human-maintained outdoor settings such as parks were preferred for EE activities over natural outdoor settings such as fields and forests (Ernst & Tornabene, 2012), sug-

gesting that preservice teachers need specific guidance on how to use natural environments for teaching. A few examples appear in the early childhood literature, such as Gerdes and Leeper-Miller (2011), that demonstrated how early learning standards for cognitive, social-emotional, physical-motor, and language development can be met with an inquiry-based, nature-focused approach in natural settings, and Meier and Sisk-Hilton's (2013) volume focuses especially on inquiry, nature, and science. These types of articles with specific guidance are rare, however, leaving a gap for pedagogy for preparing current and preservice teachers.

Throughout the description of the program, elements that address the Early Childhood Environmental Education Programs Guidelines for Excellence are denoted in parentheses with a letter "E" and the number of the guideline (see Table 2); elements that address the Guidelines for the Preparation and Professional Development of Environmental Educators are denoted with a letter "P" and the number of the guideline (see Table 3); and elements that address the State Early Learning Guidelines Nature Supplement are denoted with a letter "N" and the number of the guideline (see Table 4). Additional guidelines from each of these publications are also met by the program, but the most salient are presented in the tables.

Table 2. Early childhood environmental-education programs guidelines for excellence selected key characteristics.

Guideline	Description
Key Characteristic 6: Educator Preparation	
6.1	Foundations of early childhood environmental education
6.2	Professional responsibilities of the educator
6.3	Environmental literacy and teaching
6.4	Educators provide interdisciplinary, investigative learning opportunities
6.5	Educators create a climate in which children are motivated to learn about and explore the environment
6.6	Assessment and evaluation
Key Characteristic 2: Developmentally Appropriate Practices	
2.2	Authentic experiences
2.3	Child directed and inquiry based
2.4	The whole child
Key Characteristic 3: Play and Exploration	
3.1	Use of the natural world and natural materials
3.2	Play and the role of adults
Key Characteristic 4: Curriculum Framework for Environmental Learning	
4.2	Curiosity and questioning
4.3	Development of environmental understandings
4.4	Skills for the environment
Key Characteristic 5: Places and Spaces	
5.1	Spaces and places to enhance development
5.2	Natural components
5.3	Health, safety, and risk
Key Characteristic 1: Program Philosophy, Purpose, and Development	
1.7	Partnerships

Table 3. Selected themes from guidelines for the preparation and professional development of environmental educators.

Theme	Description
3.1 Exemplary EE Practice	<ul style="list-style-type: none"> * Environmental education used as a tool for meeting curriculum standards * Partner with community members and organizations in providing EE * Model responsible, respectful, and reasoned behavior during instruction * Model the process of inquiry and environmental investigations
4.1 Knowledge of Learners	<ul style="list-style-type: none"> * Identify methods for EE in appropriate and engaging ways for learners of different ages, backgrounds, levels of knowledge, and abilities * Select EE materials that are developmentally appropriate * Recognize the validity of varying cultural perspectives of learners
4.2 Knowledge of instructional methodologies	<ul style="list-style-type: none"> * Select EE topics for study based on learners' interests and their ability to construct knowledge and conceptual understanding * Use a variety of teaching methods and strategies appropriate for EE content and context (hands-on observation and discovery in the environment; inquiry; cooperative learning; project-based learning)
4.3 Planning for instruction	<ul style="list-style-type: none"> * Select instructional methods based on learning objectives, learner characteristics, and available resources * Design a plan for EE that integrates across disciplines * Develop a plan for a coherent, focused EE program consistent with the Guidelines for Excellence * Demonstrate how plans for EE will help learners meet national, state, and local standards in specific disciplines * Use resources and training offered by national, state, and local EE programs and organizations * Use the internet to access information about the environment and educational resources. Critically evaluate the usefulness of internet resources
4.5 Technologies that assist learning	<ul style="list-style-type: none"> * Use a variety of tools for environmental observation, measurement, and monitoring and instruct learners in their safe and proper use * Demonstrate proficiency with technologies used to display, analyze, and communicate environmental information
4.6 Settings for instruction	<ul style="list-style-type: none"> * Demonstrate concern for learner safety in designing, planning, and implementing instruction, especially experiences that take place outside the classroom

(Continued)

Table 3. (Continued)

Theme	Description
	<ul style="list-style-type: none"> * Identify, create and use diverse settings for EE, including the school yard, field settings, community settings, museums, and other places * Plan and implement instruction that first links content to learners' immediate surroundings and experience, then expand to larger environmental contexts * Create a developmentally appropriate scope and sequence for EE curricula * Develop a plan for integrating EE into curriculum, either as a separate focus or within one or more areas of study * Demonstrate links between EE curricula and national, state, or local standards * Infuse instruction with a sense of the importance and excitement of the content * Provide opportunities that increase learners' awareness of – and enthusiasm for – the natural and human-designed environment * Incorporate opportunities for learners to have firsthand experiences exploring the world around them * Implement performance-based assessments such as portfolios, group or independent research, or other projects
4.7 Curriculum planning	
5.1 A climate for learning about and exploring the environment	
6.2 Assessment that is part of instruction	

Table 4. Selected indicators from the Nebraska early learning guidelines nature supplement¹.

The Adult:	
1	Responds to child-initiated inquiry
2	Models curiosity, respect, and wonder about the environment
3	Shows a positive attitude to the outdoors and nature including insects, animals, plant life, and weather
4	Extends and enhances children's learning based upon their individual interests
5	Provides opportunities and time for children to explore the environment in depth
6	Encourages creativity by utilizing natural and man-made materials
7	Promotes active investigation by encouraging children to develop theories and test their ideas about the natural world
8	Engages and supports parental involvement in outdoor exploration, and communicates the benefits of outdoor play
9	Provides adequate time to explore and create in the outdoor setting
The Outdoor Environment Includes:	
10	Open-ended natural or manmade materials that can be counted, sorted, or grouped
11	Field guides and books with basic information on local trees, birds, insects, flowers, etc.
12	Natural and man-made materials for creating two- and three-dimensional representations
13	Tools for exploring such as magnifying glasses, binoculars, nets, thermometer, etc.
14	Safe, open space to explore the environment, be loud, and move expressively
15	A variety of experiences that connect the beauty of nature to the feelings, expressions, and social interactions of children

¹ The indicators are not numbered within the publication but are used here to indicate the referents in text.
This is not a complete list of the indicators.

University child, youth, & family studies early childhood educator preparation

Program overview

The early childhood education program at the University of Nebraska-Lincoln prepares students to work with children with a range of abilities in a variety of settings (P4.1). Students in the program can follow one of three certification tracks: Inclusive early childhood education, in which graduates can apply for certification by the state department of education to work with children from birth through age 8 and including children with disabilities; early care and education: birth through kindergarten; and elementary education with an early childhood education endorsement. Some students choose a program that does not lead to teacher certification. All students take a common set of courses, and EE is infused into a subset of those courses that are described in greater detail below.

Courses integrating early childhood EE

Four courses explicitly incorporate content related to early childhood EE: (a) development of the preschool child; (b) curriculum planning: early childhood education; (c) math-, science-, and nature-integrated methods for early childhood education; and (d) student teaching in early childhood education. Other

courses may implicitly or incidentally include content related to early childhood EE. Preservice early childhood educators must all participate in at least one practicum and a student-teaching experience at the Ruth Staples Child Development Laboratory (CDL) (in addition to other practicum experiences). Program faculty have made deliberate curriculum decisions to maximize student learning about environmental education. The integrated nature of the CDL and the other early childhood classes ensures that students are exposed to environmental education beginning from an awareness level and progressing to application and refinement levels.

Regardless of course content, it is particularly noteworthy that all early childhood education courses and practicum experiences taught by faculty in the Department of Child, Youth and Family Studies are characterized by a culture that values nature and experiences in and about nature for young children (P5.1). Culture involves shared values that are expressed through daily activities, relationships, and design of environments (e.g., Harkness, 2002). Values are thus transmitted to members of a cultural group both explicitly through activities such as direct teaching and implicitly through modeling attitudes and behaviors, selection of curricular foci, and design of environments and experiences. Early childhood education faculty members identified a set of core values in 2001 and used these values to inform program design and implementation (see Figure 1). The culture of the program provides cohesiveness among the courses and experiences, and, because acculturation is a key process in professional development, we provide a detailed description of the program culture and how it is conveyed to students.

The Ruth Staples CDL is the hub for many of the learning experiences for early childhood education students. The CDL serves approximately 40 children ages 18 months to 5 years of age and their families. The culture of the program is reflected in the physical environment and in the programming for children and families served by the CDL, and early childhood education students are immersed in this culture through participation in a practicum experience and student teaching. The indoor environment communicates value of nature through the use of natural materials such as tree logs to hold writing tools, cedar and pine wood pieces in the block area, and puppets reflecting realistic animals that are of species with which the children would come in contact in their own environment (P4.6; E5.2). Representations of nature are displayed such as child-created field guides of the immediate surroundings in their daily lives, illustrations of trees, flowers, insects, birds, and clay models created from children's observations in nature (P4.2). Activities and materials often focus on nature. For example, children may create texture collages with items from nature, paint with natural items such as leaves, pine cones, or rocks, take a nature walk looking for animal tracks in the snow or go "birding" around the campus (P4.6). The classrooms are well provisioned with magnifying glasses, field guides that have been published, and field guides authored by children and teachers (P4.5; N11).

Core Values of the ECE Program: Who we are and what we strive to do

We are a community of learners.

We strive to promote learning and development by creating a community of learners based on supportive, respectful, and trusting relationships. Regardless of age, ability, or background, people learn best in the context of caring relationships. Our community includes students, children and their families, faculty and staff, the university and college communities, the city of Lincoln, the total culture, and links to the wider world. Partnership with parents is the foundation for the education of young children. We strive to create, sustain, and participate in a community in which learning can be shared and negotiated, and celebrated among diverse people.

Teaching and learning is a partnership shared by teachers, students, children, and families.

Trust is the foundation of our partnership. As teachers, we trust that children will show us their competence and their interests if we are good listeners and observers. Children and families trust us as teachers to listen and support their learning, interests, and development with respect. Students trust us to carefully prepare learning experiences that will support their development as people and professionals.

We are reflective practitioners.

Reflective practitioners engage in a cycle of inquiry about children's development, about teaching, about themselves and others, and about the world around them. We observe, question, discuss, negotiate, document, share, observe, and ask new questions. We celebrate and make visible the learning and the cycle of inquiry, by sharing our discoveries with a wide range of people. We model reflective practice as a primary process of teaching and learning.

We are artists and scientists.

Providing experiences for learners that provoke inquiry requires us to question, observe, and create. We believe that art and science share a core set of processes: observation, appreciation, abstraction, investigation, and communication. We strive to provoke learners to observe, appreciate, wonder, develop hypotheses and test them. We strive to provoke learners to experience and create beauty. We believe that learners develop deep understandings through rich and meaningful learning experiences in which they explore the interconnectedness between things.

We are connected to the natural world.

The natural world is our ecosystem, and we live in relationship to the living plants and animals as well as the earth, water, skies, and cosmos. We create opportunities for children to observe, wonder, and marvel in their relationship with nature. We provide learning experiences that help children understand interdependence between people, plants, animals, the earth, and the skies. We promote stewardship and respect for all living things.

Figure 1. Core values of the Early Childhood Education (ECE) Program: Who we are and what we strive to do.

We believe that development is holistic.

Development and learning are best supported by considering each individual as a whole person. Physical, cognitive, social, emotional, spiritual, and personality development are interconnected. Teachers promote children's learning by supporting all domains of development. Learning is most powerful when it is imbued with passion and incorporates multiple modes of learning and representing. Teachers are good listeners and observers of the many ways children communicate their knowledge.

We believe that all children, families, and students are competent.

All children, families, and students are competent, and we are entrusted to create environments and opportunities to support them in reaching for their potential. We explicitly include learners with a range of abilities in our community, and prepare students to work competently with diverse learners.

We believe that children are precious.

Children need and deserve to be in beautiful and respectful environments. We create a beautiful and respectful environment that communicates how much we value them. We strive to be truly present with our students and children, and in so doing, we are transformed.

Figure 1. (Continued)

Children in both classrooms are organized into "family groups" that are identified by tree species native to Nebraska. Being a member of the ash, oak, maple, or cottonwood groups familiarizes children with the tree species in their own ecosystem and also becomes part of their individual and group identities (i.e., "I am an Ash tree"). Children are able to identify the leaf for each group, which is used on name tags, parent-teacher-communication journals, and portfolios, and the older group of children (3-5 years) can also identify the species of trees in the outdoor classroom and the surrounding campus (P4). Associating a name with a species gives it uniqueness and importance and helps children to have an intimate relationship and connection with the natural world around them. This is one of the myriad of ways that nature is made visible and celebrated within the program.

The CDL has a large outdoor classroom where children spend 2.5-3 hours or more per day (N9). Both classes spend an hour outdoors in the morning and 1-1.5 hours outdoors in the afternoon, and the older class also goes outdoors for about 45 minutes between lunch and naptime (P4.2). Sometimes children spend additional time outdoors during the family group time, and, in the warmer seasons, some classroom activities such as lunch, snack, literacy, music and movement, and sometimes naptime take place outdoors. The outdoor classroom includes built structures as well as naturalized spaces, including a prairie area, pine forest, vegetable garden, sand and water, and

many mature trees. A weeping mulberry tree is a favorite refuge for children (E3.1). Parents understand that children will be outdoors every day if the wind chill is above 0°F, and they provide appropriate clothing. Children engage in both planned and spontaneous activities focusing on nature. The presence of natural elements and processes affords a multitude of opportunities for spontaneous activities involving insects, water, plants, birds, and elements such as snow and soil (P4.6; E4.3).

Each of the courses that explicitly focus on EE in early childhood is described below, including the relevant objectives, materials, and learning experiences designed for students. Two of the courses (Curriculum Planning: Early Childhood Education and Student Teaching) include experiences in the CDL. One of the courses (Math, Science, and Nature Methods) includes observations in the CDL. All of the courses emphasize holistic development, the importance of relationships for children's development, and for effective teaching, and integration of curriculum (N15). Nurturing children's curiosity, joy, and enthusiasm for learning about and spending time in nature is emphasized (E4.2; N2).

Environmental education: Awareness level of development

Students are introduced to environmental education in the Development of the Preschool Child course. The content examines children's development from a holistic and systems perspective, focusing especially on guided observations of different domains of development, relationships in early childhood classrooms, and ways to interact appropriately with young children (E6.1). Topics covered include the following: the importance of play for development (E3.2), with special emphasis on outdoor play (E5.1); designing, using, and supervising outdoor play (E5.3); benefits of gardening and nature play; how to meet learning standards through activities in natural outdoor environments (E6.1); and the restorative properties of nature and research on reduction of attention deficit/hyperactivity disorder (ADHD) symptoms. This content addresses needs identified in previous research, specifically how to use outdoor environments for EE, how to supervise children in natural settings, and how to meet learning standards in natural settings (P4.6; Ernst & Tornabene, 2012; Simmons, 1994). The *Nebraska Early Learning Guidelines* for 3- to 5-year-olds as well as the *Early Learning Guidelines – Nature Supplement* are introduced to students in this course to guide their observations of preschool children's development and learning, and in future classes to inform their lesson planning.

Environmental education: Application level of development

Students begin applying their knowledge of EE in the Curriculum Planning for Early Childhood Education and the Math, Science, and Nature Integrated

Methods courses. Because the young adults preparing to be teachers tend to have limited direct experiences with nature (Louv, 2008), students complete a “nature immersion” assignment in which they are required to spend 45 minutes alone in a natural space without any electronic devices and to look at nature “through the eyes, ears, nose, and touch” of a child and to write a reflection on the experience. This helps students to become more comfortable in natural environments, to enhance their sensory awareness in nature, and to become aware of the opportunities for young children to experience nature. Students use the guidelines and nature supplement to conduct observations of the CDL program and to identify recommended materials, activities, and interactions (P4.3). All of these activities introduce the central concepts of EE to preservice teachers.

Students learn how to plan, to implement, and to evaluate learning experiences for young children in each developmental domain (physical, aesthetics, mathematics, science, social-emotional, literacy, and language) but holistic development and integration across curricular domains is emphasized (E2.4). Students are given examples of how curriculum can be integrated and focus on nature (E6.4; P4.3). For example, in the science domain, children may learn about birds by birdwatching (observation), examining feathers, and consulting experts. This can be expanded by observing and counting the number of each type of bird seen in a chosen area, then creating a graph representing the data in the math domain. Children can experiment to see which kind of seed would attract each type of bird and compare results in the scientific domain (E6.4; P4.3). Listening to bird songs, creating two- and three-dimensional representations of birds (drawings, paintings, or sculptures), examining bird artwork, and creating and performing bird dances and puppet shows are examples of the aesthetic domain. Reading books about birds and writing and illustrating stories about birds are examples of the language and literacy domain. As a culminating experience students design an integrative collection of lessons addressing each curricular domain (P4.3) connected by a common natural theme (e.g., insects, trees, flowers).

The value of nature and outdoors is communicated to students in several ways (P5.1). Students are expected to be prepared to implement any activity focused on any developmental domain outdoors. Students are encouraged to use natural materials, for example, sorting leaves rather than plastic counting bears when planning a math activity (N10). The ethic of respect for living things is introduced in the Curriculum Planning class, reinforced in the Math, Science, and Nature Integrated Methods class, and intentionally modeled by the faculty at the CDL where students implement their lessons (P3.1; N2).

Integration of curriculum is emphasized and interdependence of human and natural communities is explored (P4.3; E6.4). Course objectives related to EE are presented in Table 5. Students gain additional knowledge about EE as well as practice applying what they are learning.

Table 5. Worlds of wonder: math-, science-, and nature-integrated methods for early care and education objectives.

Learners will do the following:
Develop an understanding of cognitive development and learning for young children in the domains of math, science, and nature
Understand the importance of relationships for learning
Identify key experiences for learning in the domains of math, science, and nature
Develop skills in assessing children's conceptual development in the domains of math, science, and nature
Plan, implement, and evaluate developmentally appropriate activities for young children in the domains of math, science, and nature
Become familiar with research and theory on young children's learning in the domains of math, science, and nature
Gain a holistic, developmental, and relational perspective on development and learning of young children

Environmental education: Refinement

Student teaching for early childhood educators is a semester-long experience in the CDL. The student-teaching experience is designed to nurture student teachers' positive disposition toward nature and EE, to provide opportunities to practice planning and implementing activities in and about nature, and to provide excellent models for how to implement such activities. Students plan, implement and evaluate developmentally appropriate activities for young children in a younger (18 months–3 years of age) or older (3–5 years of age) classroom. A course objective related to EE is the following: "Student teachers will be open to using indoor and outdoor environments and use what is available to teach any objective" (E3.1; E5.1). This objective emphasizes the holistic nature of early childhood curriculum in that indoor and outdoor environments can be used to teach standards across literacy, math, science, and social-emotional domains (P3.1; P4.3). In action, this means that literacy can be taught under a tree or through an experience with a spider about which children then discuss, journal and represent through drawings. Students continue to gain knowledge about early childhood EE but move well into the application and refinement levels of learning during the student-teaching experience.

The pedagogical approach to EE in student teaching involves four elements. The first element is immersion in a culture that values nature and nature experience. Second, students participate in specific professional development focusing on environmental education in early childhood (Growing Up Wild) early in the semester (E1.7; E6.2; P4.2). Third, master teachers model using natural environments effectively to learn about nature specifically and to integrate learning across all curricular domains (E3.1; E2.2) and model enthusiasm and curiosity about nature (E6.5; P3.1; N2). Fourth, students engage in early childhood education practice and reflection on their practice with guidance from master teachers. Together these elements of culture, knowledge, modeling, and guided practice and reflection form a coherent experience for learning about early childhood EE.

During the first three weeks of the semester, master teachers develop the lesson plans and take the lead teaching role and engage in modeling while student teachers participate in the implementation of the lesson plans. Stu-

dent teachers spend 25 hours per week in the classroom with children and 1.5 hours per week in a reflection meeting with their “family group” teachers and a master teacher. Reflection meetings provide an opportunity for the preservice teachers to reflect on their observations of children’s interests and development and to brainstorm possible provocations to support these interests. A “provocation” is an experience that provokes further inquiry and interest; it creates a challenge or a “cognitive knot” for children to build theories and understandings around a specific interest (Edwards, 1998). A dialogue takes place as the preservice teachers read their observations of children to the group. Questions are asked to encourage reflective thinking such as the following: What do you think this means? What are the children trying to figure out? In what materials are the children interested?

Documentation is also a focus of this reflection meeting. Preservice teachers bring artifacts (i.e., children’s work), photographs of children engaged in activities, and panel documentation to help co-construct meaning from their experiences with children. During the planning session, the master teachers guide preservice teachers to think about intentional teaching strategies and encourage teachers to be reflective about how their interactions and teaching through play can meet a variety of standards (E3.2; P4.3). The end product is a lesson plan for the following week and a plan for documentation to make children’s learning visible (P4.3; E2.3). Students engage in pedagogical documentation, which is a cycle of inquiry comprised of observation and documentation of children’s activities, development, and learning, and reflection about children’s learning that then informs subsequent lesson planning (Edwards et al., 2007; Jones-Branch, 2012). This in-depth observation of children gives students the opportunity to get to know the interests, needs, and developmental status of the children in the class (P4.1; P6.2). Assessment is multifaceted, so in addition to the authentic assessment through pedagogical documentation, student teachers connect activities to the domains and objectives of the on-line assessment tool Teaching Strategies GOLD™ (P6.2; E6.6). Student teachers use documentation of children’s activities, development, and learning to construct portfolios that are shared with families (P6.2; E6.6).

Intentional focus on nature and outdoor environments

Beginning in the fourth week of the semester, student teachers become responsible for lesson plans. Students are expected to take children’s interests, needs, and development into consideration when designing lesson plans (P4.2; P4.3). Master teachers continue modeling best practices and also provide guidance and feedback on the lesson plans, which may include asking a student the following: “How can you use nature to accomplish this objective?”

Student teachers are required to plan outdoor activities each week, and master teachers provide guidance toward using the natural environment (E3.1; E5.1; E5.2). For example, student teachers may plan to offer sidewalk chalk,

and the master teacher may suggest that, in addition, they plan to use anticipated changes in the environment (snow) to have children look for tracks and to identify what animals have been visiting the outdoor classroom or to incorporate gardening activities according to the season.

Modeling effective use of outdoor environments for learning

"Teacher Jenny! I have a hippopotamus." – Ruby (Age 4)

"You do, let me see!" Teacher Jenny

"No silly, you don't see a hippopotamus you listen to it." R

"Ok, now I am really curious, tell me more." J

"I think that if I dig really deep I will find worms." R

"Ohh, you think that if you dig deep you will find worms. . .tell me more." J

"I need to find worms, so I will dig deep and then their home will be deep." R

"Okay would you like to hear my hypothesis?" J

"Sure, is it the same as mine?" R

"Kind of, I think that if I find a muddy spot there will be worms. Should we go test our hypothesis?" (hippopotamus)

Family group time is often used for in-depth investigation of questions or topics of interest to the children (P3.1; P4.2; E2.3), so they become very familiar with science vocabulary related to inquiry such as "hypothesis," "prediction," and "investigation" (E6.3). Because children spend a good deal of time outdoors in natural environments, they have many opportunities to engage in spontaneous investigations as the presence of natural materials and phenomena provoke their interest (E2.3; E3.1; N1). When student teachers observe and interact with children who are actively engaged in exploring and investigating natural phenomena, they become more aware of the affordances for learning in natural environments and can practice facilitating both structured and unstructured learning experiences in natural environments (E3.1; E6.5).

Implementing EE activities for children

Student teachers implement EE activities for children, often planned in collaboration with master teachers. For example, the younger classroom incubated chicken eggs, observed them hatching and cared for them for five days before finding a home for them. During the summer session, the children, families, student teachers, and staff participated in International Mud Day

(N15), an event begun in Nepal to bring children closer to nature and promoted by the World Forum Foundation and Nature Action Collaborative for Children (for more information, see Bhatta, 2010). The University Landscape Services Department provided a truckload of fresh soil that was soaked with water from a hose (E1.7). Children, parents, and teachers changed into clothes that could get dirty (very dirty!) and played in the mud. Children experimented with creating shades of colored mud. Children who preferred to explore with a more familiar material were provided water and soap to clean rocks, watching their clean water quickly turn a soupy brown. Children and teachers used a colander to create a shower of mud under which to run. Children tested combinations of water and dirt to create various consistencies of mud pie (N5). These activities gave student teachers the opportunity to practice EE with young children, to become more comfortable in natural environments, and to reflect on how children learn and develop through play in natural environments and with natural materials (E5.1, E5.2, E5.3; E3.1, E3.2; E2.2).

Implementing EE activities for parents

Parents are children's first and most important teachers. Partnerships with parents are important for children's development and success in school, so student teachers are given many opportunities to practice building relationships with children's parents (E1.7). An example of this is family activity nights where once each semester the activity focuses on nature. One Parent and Children Together (PACT) night focused on birding. The staff used resources from State Games and Parks Commission (E1.7) to create a sensory and hands-on exploration of birds (E2.2). Exploration stations included buckets of seed to touch and feel, bird feathers, bird feet, and bones to explore and observe under a microscope and magnifying glass, and materials for children to make binoculars out of paper towel and toilet paper rolls (N12, N15). Nebraska Game and Parks provided each family with a *Birds of Nebraska Resource Guide* to support families' continuing investigations of birds in their own backyards (Tekiela, 2003). A second PACT night focused on gardening and our natural world around us. Parents and children helped prepare the lab school garden and plant vegetables (N8). The parents and children also explored in our butterfly garden that has native state plants. Art materials were provided for parents and children to illustrate their favorite plant or to create nature collage frames (N12). Teachers photographed the families and placed the photos in the nature frame to display around the school. At the end of the growing season, a harvesting PACT night took place and families harvested and ate vegetables at a potluck dinner.

Using technology for EE

Using technology to display, to analyze, and to communicate environmental education is one of the competences identified by NAAEE for the preparation and professional development of environmental educators (North American Association for Environmental Education, 2010b). Three examples of this practice are described here. An iPad is used in the both classrooms to support children's inquiry (P4.3). For example, a child asked, "What is pink eye?" and a teacher helped the child to look for the information using the iPad. Another child wondered what sound a grasshopper makes, and a teacher helped the child to find the information using the iPad (E2.3). The child and his or her friends then imitated the sound and incorporated it into their dramatic play. Developmentally appropriate applications are also introduced to the student teachers, such as a birding app with which users can identify birds, listen to recordings of their songs to aid with identification and mark a location on a map where they were observed (P4.2; P4.3; E2.2; E6.5). This app has been used with children on birding walks around the campus. Children also used the iPad to view the Eagle "Nest Cam" in Decorah, Iowa, and teachers projected the video feed onto the classroom wall each morning and throughout lunch time (P4.5). Student teachers were introduced to this way of integrating technology and the natural world; prior to this experience, they did not know about the wildlife "cams" that can be used for educational purposes. They became devoted to watching the eagle raise her chicks both in and outside of school. Children made observations such as "The wind will make them cold!" One child was concerned that "The birds will get sick!" Another child wondered "Why aren't the mommy birds laying on top of them?" Student teachers learned that this kind of technology can provide rich experiences for preschool-aged children who would not otherwise be able to observe an eagle nest or a bear den, and children's interest and curiosity can be supported through further inquiry (P5.1; E6.3; E6.5). This was also an opportunity to nurture children's compassion and respect for living things.

Using technology for environmental observation, measurement, and monitoring is also a competency identified by NAAEE (2010b). Children set out fruits and vegetables that were left over from lunch and snack near a trail camera to find out what kinds of animals use the outdoor space at night. The photographs revealed a possum, a cat, rabbit, and squirrel (P4.5). Children and student teachers were mutually excited when checking the cameras to see what animals had been there.

Community resources and collaboration

Exemplary EE practice includes partnering with community members and organizations in providing EE (North American Association for Environmental Education, 2010b). Master teachers model partnerships with community members and provide students with experiences to practice engaging in partnerships to provide EE for young children (P3.1). Teachers have borrowed

EE “curriculum trunks” from State Game and Parks to use with children and families. An example of curriculum-trunk content is “skins and skulls,” which includes several different labeled specimens that children can explore, touch and identify, along with related stamps and stencils and developmentally appropriate reference materials. A set of child binoculars can be checked out for children to use in their exploration and observations of nature (P4.5). Student teachers make use of local EE resources such as the greenhouses at the university plant sciences department, visits to the animal science department, caring for insects on loan from the entomology department, and use of campus green spaces, including a prairie, an arboretum, and several gardens and open spaces. These field trips also give student teachers opportunities to practice supervising young children in natural settings (E5.3).

Preliminary data: Evidence of student growth in EE competencies

In this section, we present two analyses of data to examine whether students enrolled in our teacher-preparation program demonstrate increases in their EE competencies over the course of their studies. The first analysis is a cross-sectional comparison of student ratings of the importance of EE and their confidence implementing EE at three points in the program: in an introductory course taken in the freshman or sophomore year; in the methods course taken in the junior year; and in the student-teaching course taken in the senior year. The second analysis compares students’ ratings of their comfort and confidence before and after participating in *Growing up Wild* at the beginning of their student-teaching semester.

Student ratings of importance and confidence in EE

Students completed a survey designed to assess the following: (a) perceived importance of nature and science experiences for young children (12 items, $\alpha = .93$); (b) importance of learning outcomes for young children in the domain of nature and science (four items, $\alpha = .88$); and (c) confidence implementing nature and science activities (15 items, $\alpha = .72$). The rating scale ranged from 1 (not at all important) to 5 (very important) for the first two subscales, and from 1 (not at all confident) to 4 (very confident) for the third subscale. The survey was voluntary, and, after signing informed consent, the students completed the survey in class. Results of the analysis of variance (ANOVA) are presented in Table 6 and suggest that juniors and seniors rated nature and science experiences and outcomes as more important than did freshmen and sophomores, and that juniors and seniors perceived themselves as more confident implementing activities in these domains than did freshmen and sophomores. Results of this cross-sectional analysis should be interpreted with caution, because there were few freshman or sophomores who completed the survey and because significant differences could be a function of unmeasured variation in student cohorts.

Student teachers' ratings before and after participating in Growing Up Wild. Students rated three items before and after participating in *Growing Up Wild*: "How comfortable/confident do you feel about implementing EE topics?"; "How confident are you in planning for all learning domains in the outdoor classroom?" and "How important is it to provide opportunities for children to learn in the natural environment?" Students circled a sad face, neutral face, or happy face to indicate their ratings, and results are presented in Figures 2–4. Student ratings of confidence implementing EE topics and confidence planning for all learning domains in the outdoor classroom increased substantially after *Growing Up Wild*. It is interesting that no students gave a negative rating before or after

Table 6. Student ratings of importance of nature/science, compared by year of study (Freshman/Sophomore, Junior, Senior).

Domain	Range	Freshman/Sophomore (<i>n</i> = 7)	Junior (<i>n</i> = 32)	Senior (<i>n</i> = 27)	<i>F</i>
Nature/Science Experiences	1–5	3.5 (0.4)	4.5 (0.5)	4.3 (0.5)	9.99***
Nature/Science Learning Outcomes	1–5	3.5 (0.5)	4.2 (0.6)	3.9 (0.6)	3.7*
Confidence Implementing Nature/Science	1–4	2.5 (0.7)	3.1 (0.7)	3.2 (0.6)	3.47*

* $p < .05$. ** $p < .01$. *** $p < .001$

Note: parentheses indicate standard deviation

Figure 2. Student teachers' confidence implementing EE topics before and after participating in *Growing Up Wild*.

Figure 3. Student teachers' confidence in planning and implementing in all learning domains in the outdoor classroom before and after participating in *Growing Up Wild*.

Figure 4. Student teachers' ratings of the importance of providing opportunities for children to learn in the natural environment before and after participating in *Growing Up Wild*.

Growing Up Wild, and this is possibly a consequence of the expectation and experience of planning for all learning domains in the outdoor classroom in their Curriculum planning class. Similarly, all students gave a positive rating to the importance of providing opportunities for children to learn in the natural environment before and after *Growing Up Wild*. Apparently, by the time students begin their student-teaching experience, they understand that it is important to provide children with outdoor learning opportunities but they need ad-

ditional practice with application and refinement to increase their confidence implementing EE topics as well as all learning domains outdoors.

Limitations and future directions

This article describes an approach to preparing early childhood educators to become competent and confident environmental educators, and this approach is grounded in the philosophy and pedagogy of Reggio Emilia, in ecological systems theory (Bronfenbrenner & Morris, 2006), and guided by the interdependence of human and natural systems encompassed by the Belgrade Charter (UNESCO, 1976) and the complementary guidelines of the National Association for the Education of Young Children (NAEYC) and NAAEE. However, this cohesive, philosophically and theoretically grounded approach has limited systematic evaluation data. The analyses presented here are suggestive but not conclusive, so it will be necessary to assess students longitudinally across their program of study and, optimally, beyond graduation. Observational assessments of teachers' implementation of environmental-education activities and ratings of materials and lesson plans could also be used to triangulate measures of competencies.

Summary and conclusions

Early childhood education and EE have many points of complementarity such as the importance of relationships and collaborative learning, integrative curriculum, and authentic experiences that are all addressed in the University of Nebraska-Lincoln early childhood education teacher-preparation program (North American Association for Environmental Education, 2010a, 2010b; State Department of Education, 2008; Wilson, 2012). Many of the professional guidelines for EE emphasizing the relational, holistic, and integrative nature of development and learning are also met by the program. Students learn about human development from an ecological systems perspective so forming partnerships with families and community resources to support EE is a natural extension of this perspective. This systems and relational perspective advances the Belgrade Charter goal of improving relationships between humanity and nature as well as people with each other (UNESCO, 1976).

We are aware that, when we plan EE experiences for young children and their families, we are also planning those experiences for our students who often express their lack of specific nature/EE experiences such as never gardening, peeling an apple, observing spiders (instead of stepping on them), jumping in puddles, or going sledding. Considering the potentially limited time that young adults have spent in nature, student teachers need experiences in natural environments both to become more comfortable for themselves, as well as to learn how to use natural environments for teaching and learning (Ernst & Tornabene, 2012; Simmons, 1994, 1998). We address this need as stu-

dent teachers progress from awareness and observation early in the program to application and refinement in their methods classes and student-teaching experience. Students are taught to recognize the myriad opportunities inherent in natural learning environments, and faculty members provide support as they increase their comfort interacting with elements of nature such as insects and snakes. Faculty members model respect for living things and curiosity and enthusiasm for learning about and being in natural environments, and, in turn, student teachers model this respect in their interactions with young children.

Spending abundant time in natural environments, supporting play and inquiry, using natural materials, and focusing on local nature makes EE an everyday activity for student teachers and young children. Students use EE as a tool for meeting state early learning guidelines and also use the guidelines nature supplement to plan, to observe, and to assess children's learning. Student teachers support children as they engage in inquiry on topics of interest, individualize for diverse learners and use authentic assessment integrated with planning. Student teachers use technology and other tools for EE as they engage in cycles of inquiry with young children eager to test their hippopotami. Students experience a culture that values nature and supports inquiry, with the goal that students will re-create such a culture in their own classrooms upon graduation.

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