Fall 2014

Nature Center Preschools- A Teaching Tool for Early Childhood Environmental Education

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Nature Center Preschools- A Teaching Tool for Early Childhood Environmental Education

By

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AN UNDERGRADUATE THESIS

Presented to the Faculty of

The Environmental Studies Program at the University of Nebraska-Lincoln

In Partial Fulfillment of Requirements

For the Degree of Bachelor of Science

Major: Environmental Studies

With the Emphasis of: Natural Resources

Under the Supervision of Dr. Julia Torquati

Lincoln, Nebraska

December, 2014

December, 2014

Abstract

The data used in this study was obtained at the Schlitz Audubon Nature Center (SANC) preschool in Milwaukee, WI. The purpose of this study is to qualitatively and quantitatively examine how effective nature center preschools are as a teaching tool for early childhood environmental education. This study is significant for generating new knowledge of the ecological concepts young children do and don't understand, as well as to the future application of designing curriculum and implementing early childhood environmental education programs in the United States. Children are unhealthy, spending less time outside, and are environmentally illiterate (Louv, 2008; Roberts & Foehr, 2008; Driessnack, 2009; Louv, 2009; Coyle, 2005). Exposing children to nature, and implementing environmental education in early childhood programs can solve the growing concerns of today's youth and develop in an increase in understanding of ecological concepts. The research questions include: 1) Is there a change in knowledge of ecological concepts over a year period? 2) What improvements could nature center preschools make to increase learning of ecological concepts? The research questions were examined by coding interviews completed by children who attend the SANC preschool, summing the frequencies, and interpreting the frequencies using statistical analysis. The statistical analysis of the frequencies of indicators expressed during the fall and spring provides evidence that seven out of the thirteen indicators had a significant increase in expression therefore an increase in knowledge. An improvement that nature center preschools can make is to increase time spent on teaching concepts related to earth systems. Early childhood environmental education provides opportunities for children to develop skills to be environmentally literate, improve physical and mental health, and be exposed to nature.

Acknowledgements

Special thanks to the School of Natural Resources, the UNL Environmental Studies Program, Dr. Julia Torquati, and Shannon Moncure for providing continuous assistance throughout this entire undergraduate thesis study. The support received by all parties was critical in the success of this study.

Introduction

The purpose of this study is to examine how effective nature center preschools are as a teaching tool for early childhood environmental education. This study is significant for generating new knowledge of the ecological concepts young children do and don't understand, as well as to the future application of designing curriculum and implementing early childhood environmental education programs in the United States. Within the past two decades, ample research has been conducted supporting the correlation between the rise in children's health problems and the corresponding decrease of children's exposure to nature (Louv, 2009, Driessnack 2009). Children are unhealthy, spending less time outside, and are environmentally illiterate (Louv, 2008; Roberts & Foehr, 2008; Driessnack, 2009; Louv, 2009; Coyle, 2005). Exposing children to nature, and implementing environmental education in early childhood programs can solve the growing concerns of today's youth and develop in an increase in understanding of ecological concepts.

The research questions that will be addressed in this study include:

- Is there a change in knowledge of ecological concepts over a year period?
- What improvements could nature center preschools make to increase learning of ecological concepts?

Some terms that will be discussed in this study include:

- Nature center preschools: Curriculum is designed to include daily outdoor discovery to develop the child's ability to work independently and cooperatively, to act caring and responsible way toward their environment and others, and to foster a love of nature (Moore & Marcus, 2008).
- Biophilia: A child's innate need to explore and bond with the natural world (White & Stoeklin, 2008).

- Nature Deficit Disorder (NDD): Describes the growing gap between human beings and nature (Louv, 2009).
- Environmental Education (EE): Characterized as a way of teaching that makes connections between science, technology, policy, people, and the environment along with the goal to develop environmentally literate citizens (Disinger & Monroe, 1995; Simmons, 2010).
- Early Childhood Environmental Education (ECEE): Holistic concept that aims to develop a sense of respect and care for the natural world, and promote healthy development (Simmons, 2010).
- Environmental Literacy: Describes the capacity to perceive and interpret relationships between the health of environmental systems and action to improve the health of those systems (Disinger & Monroe, 1995).

This study is a part of a larger investigation of examining the influence of nature preschools on children's development and conservation beliefs and attitudes. Some potential assumptions in this study include that the children interviewed will have some knowledge on ecological concepts because of this enrollment in the nature center preschool. The interviews referenced in this study were formed based on measures that were framed for a different purpose so the interpretation of the data is limited.

Literature Review

Research regarding the correlation of the rise in children's health problems and the decrease of children's exposure to nature is gaining headway. Some of the most significant studies conducted focus on nature as a restorative property for multiple health problems. Kuo & Taylor (2004) found that young children show a reduction in symptoms of ADD/ADHD when engaging with nature. Huh & Gordon (2008), found a connection between the decrease in outdoor activities and increase in childhood vitamin D deficiency. Additionally, Science Daily

(2008), discovered associations between neighborhoods with higher available green space and slower increase in body mass index over a two-year period.

These studies are important because they display correlation of the data, but there is a lack in evidence of cause and effect relationships (Louv, 2010). Currently, there is a need for more research examining the relationship between exposure to nature, learning, and health. This study provides a qualitative and quantitative research approach of examining the effectiveness of nature center preschools as a teaching tool for early childhood education. By assessing young children's knowledge of ecological concepts, new knowledge can be gained to better implement early childhood environmental education programs in the future. Below provides supplemental background information regarding the problems in relation to the focus of this study along with feasible solutions.

Children are Unhealthy

Richard Louv (2008) discusses specific health problems of today's youth that are reaching epidemic levels. Childhood obesity is affecting more than one third of children and adolescents (Ogden, 2014), attention deficit disorder is affecting seven% of children ages seven through eleven (Kuo, 2004), and eight million children in the U.S. are suffering from mental disorders such as depression (Louv, 2008). Another daunting point is that the Duke Well-Being Index is showing that the health of children has sunk to its lowest point in the thirty-year history of the index (Louv 2009). In addition, pediatricians are estimating that today's children may be the first generation of Americans since World War II to die at an earlier age than their parents (Louv 2008). Many researchers point out that the loss of biophilia may be a cause of the current physical and emotional health implications among children (Louv, 2010, Driessnack, 2009).

Children are Spending Less Time Outside

Children are spending less time outside and more time inside or as Richard Louv (2008) calls it, "de-naturing". According to Driessnack (2009), "children between ages eight and eighteen years spend an average of six and a half hours a day with electronic media," (p. 73).

Most experiences with nature are not coming from direct experiences but are being replaced with artificial electronic versions from behind a glass (Driessnack, 2009). Reasons that children aren't going outside include the lack of green space, parental "stranger danger", competition with television and video games, structure of childhood, and the undervalue of unstructured play in nature. The lack of exposure to nature has caused a nature deficit disorder (Louv, 2009).

The Public is Environmentally Illiterate

According to Coyle (2005), regardless of age, income, or level of education, the average American adult fails to understand scientific concepts, which leads to signal that the United States will be unprepared for the increasing environmental responsibilities in the future. For example, only twelve% of Americans can pass a basic quiz on energy topics (Coyle, 2005). The common reasons for the gaps in knowledge are the lack of environmental terminology, and lack in understanding of complex relationships. Environmentally literate citizens are intellectually and psychological prepared to confront and resolve environmental issues (Disinger & Monroe, 1995). Developing basic environmental knowledge and awareness, encourages using that awareness to take action and cause change (Coyle, 2005).

Exposing Children to Nature

Nature has many physical and mental health benefits. Some of these benefits were briefly discussed earlier. According to Driessnack (2009), direct exposure to nature is critical for children's physical and emotional health, development of cognitive processes, and resilience to negative stresses and depression. Torquati (2010) discusses multiple studies that have been conducted supporting the claim of natural environments benefitting children's physical and psychological well-being. Some physical health benefits include lower body mass index, improved motor skills, and better regulation of behavior (Torquati, 2010). In addition, the mental health benefits include increasing children's attention spans, problem-solving skills, self-discipline, and self-regulation (Torquati, 2010).

Implementing Environmental Education

Environmental education provides a more complex way of learning. It encompasses many aspects such as science, technology, economics, policy, and the environment (Disinger & Monroe, 1995). It also encourages engagement that supports the investigation processes of observation, experimentation, data collection, prediction, and analysis (Torquati, 2010). According to Disinger & Monroe (1995), environmental education is designed to teach students how to think- not what to think. This is how learners develop critical thinking skills and become problem solvers. It also boosts children's academic achievements in social studies, science, language arts, and math in addition to out performing other children in traditional classroom settings (Louv, 2009).

Early Childhood Environmental Education

According to *Early Childhood Environmental Education Programs* (2010), introducing environmental education to young children is vital to building the foundation of inquisitive learning. Wilson (1996) discusses on how young children need healthy interactions with the environment. Not only because of the physical dependence but also because of the psychological and emotional interaction with nature. The main goals of early childhood environmental education are to encourage conservation of the natural world, and to aid in the healthy development of children (Wilson, 1996). Most attitudes are formed very early in life so if young children do not experience positive interactions with the natural environment the formation of those attitudes towards nature are difficult to develop later in life (Tilbury, 1995). Young children's minds and bodies are also growing at a phenomenal rate, creating new neural connections daily so exposing children to nature to critical for these neural connections (Simmons, 2010).

Methods & Materials

Research Methodology: The Influence of Nature Preschools on Children's Development and Conservation Beliefs and Attitudes

The data referenced in this study was collected for an independent research study that examined the influence of nature center preschools on children's development and conservation beliefs and attitudes. Data was collected over the course of two academic years (2010-2011 and 2011-2012) at the Schlitz Audubon Nature Center (SANC) preschool in Milwaukee, WI. Below provides a program description of the SANC preschool program, and the methods administered by the SANC researchers.

The SANC program differs substantially from traditional programs because the offerings are predominately oriented toward nature concepts and themes. The curriculum design ensures time spent outdoors, a focus on environmental/nature concepts, and infusion of nature into all areas of the curriculum, which makes it an ideal context for examining the benefits of nature and environmental education for young children.

The land is comprised of one hundred and eighty-five acres of restored prairies, forests, and shoreline adjacent to Lake Michigan. The preschool program serves approximately one hundred and thirty-five three-, four-, and five-year-old children in nine classes that meet two, three or four days per week. Each class period is approximately three hours long and the preschool program runs from the beginning of September to the end of May. Each class has two teachers and often a volunteer. A typical daily routine for the children begins with meeting their class in one of the three outdoor play areas: the woods, the gardens, or the cabin area, which they rotate every two weeks. Children spend approximately the first half hour of the session in the outdoor area assigned to their class, next each class goes on a forty-five minute nature hike, and then the teachers facilitate a discussion of the day's activities.

The researchers used a quantitative and qualitative approach to provide the most comprehensive answers to the research questions. In addition, a repeated-measures within-subject design was used to enable analysis of change in variables of interest over the course of the school year. The following research questions were addressed:

- Does a nature-focused preschool program promote holistic child development?
- Does a nature-focused preschool program enhance brain development in four critical areas: physical activity, observational skills, attention/awareness, and exploration?
- Does a nature-focused preschool enhance conservation attitudes?

Children were recruited for participation by sending letters home to parents with an informed consent form describing the purpose and procedures of the study. A total sample of one hundred and two children attending the SANC preschool during both years of the study were interviewed at the beginning and end of each year. Additionally, the parents completed surveys of children's nature experiences outside of school, and trained researchers conducted observations of the SANC classes as they engaged in their daily activities.

The children were interviewed in the fall and spring in a quiet room in the nature center. Each interview was recorded and took around ten minutes to complete. The interviews were later transcribed for further analysis. The measures completed by the children include 1) Biophilia Interview and 2) Conservation Attitudes Interview. The Biophilia Interview was designed for preschool aged children and is comprised of eleven items administered with the assistance of two puppets (Rice & Torquati, 2009). Children were given scenarios for each puppet and asked to choose "which puppet is more like you?" The second interview was designed to assess children's attitudes towards conservation of nature. Children were asked questions about the importance of animals, plants, parks, and gardens, and whether it is acceptable to litter (and why or why not).

After the interviews were conducted, the recordings of each conservation attitude interview were coded in the following ways. First, descriptive coding was used to categorize children's responses (i.e. categories of things they think about in regard to nature, things they do to help or protect the environment, percentages of children who have talked about the environment with their families and friends). Second, children's responses to the questions

regarding harm to nature were coded into the following categories: 1) harm to nature; harm to animals; harm to vegetation, harm to nonliving parts of nature; 2) biocentric reasoning; 3) anthropocentric reasoning 4) social convention; and 5) obligatory moral reasoning.

Research Methodology: Nature Center Preschools- A Teaching Tool for Environmental Education

The research methodology stated above is an introduction to how the interviews used in this study were collected. The data was interpreted differently due to the difference in research purpose and questions. A qualitative and quantitative design approach was used to interpret the data, because using numbers to support qualitative research helps extract the meaning from the results, and verify interpretations (Sandelowski, Voils, & Knafl, 2009). Counts and frequencies were also used to make sense of the data and code the interviews (Green, 2011; Maxwell, 2010).

As stated previously, after the interviews were conducted at the SANC preschool program, a trained researcher transcribed the recordings of each interview verbatim. The purpose of transcription is so the data can be reviewed at a later time for further analysis (Gorden, 1992). The primary investigator of the SANC research study approved the use of all of the transcribed interviews and secured them into four electronic zip-drives for unlimited access. Each zip drive comprised a series of Microsoft word documents containing interviews that were separated by the location, ID number of the children, and the time period the interviews were conducted (e.g. SANC 112 Y1T1). The interviews were then compiled based on when they were recorded and were separated into four master lists (i.e. Document 1-Year 1 Time 1, Document 2- Year 1 Time 2, Document 3-Year 2 Time 1, Document 4-Year 2 Time 2).

Once the interviews were separated into the corresponding time periods, a Microsoft excel file was created to document every interview in each of the four master lists. The purpose is so each interview could be located quickly and efficiently. Next, the documents sharing the same year were compared (e.g. Y1T1 vs. Y1T2, Y2T1 vs. Y2T2). This was done to determine

which children were interviewed twice in one year so that a future comparison of knowledge change could be examined. The total number of ID's found twice in Year 1 is eleven, and the total number of ID's found twice in Year 2 is nine making the sample population for this study forty interviews.

Once the sample population was determined, the interview responses were ready for coding by using a set of indicators to categorize the responses. The procedure of coding interview responses requires many steps, the first being finding a set of indicators to effectively code the data. The set of indicators used for this study are from the *North American Association of Environmental Education* (NAAEE), and describe the development of environmental understandings for young children. These indicators were chosen because they represent a broad foundation of ecological concepts and were designed specifically for early childhood environmental education programs. Each indicator (i.e. a1-a3) represents an expression of knowledge for two following categories: Earth Systems (ES) and the Living Environment (LE) (Simmons, 2010). (See Appendix A for complete list of indicators)

After the set of indicators were chosen, the transcripts were read through to search for sentences or phrases that represented expressions of the indicators. The expressions were highlighted and labeled by the code description, thereby displaying the indicator it belongs too. Once all forty interviews were read and coded using the NAAEE indicators, the frequency or number of times that each indicator was expressed during each individual interview was summed and entered into a Microsoft excel document.

Table 1
Example of frequency table for expressed indicators of SANC 101

Code Descriptions	a1	b1	c1	d1	e1	a2	b2	c2	d2	e2	f2	g2	a3	COUNT OF FREQ.
SANC 101 Y1T1				1		1					1		2	4
SANC 101 Y1T2				1		1				2	1		1	5

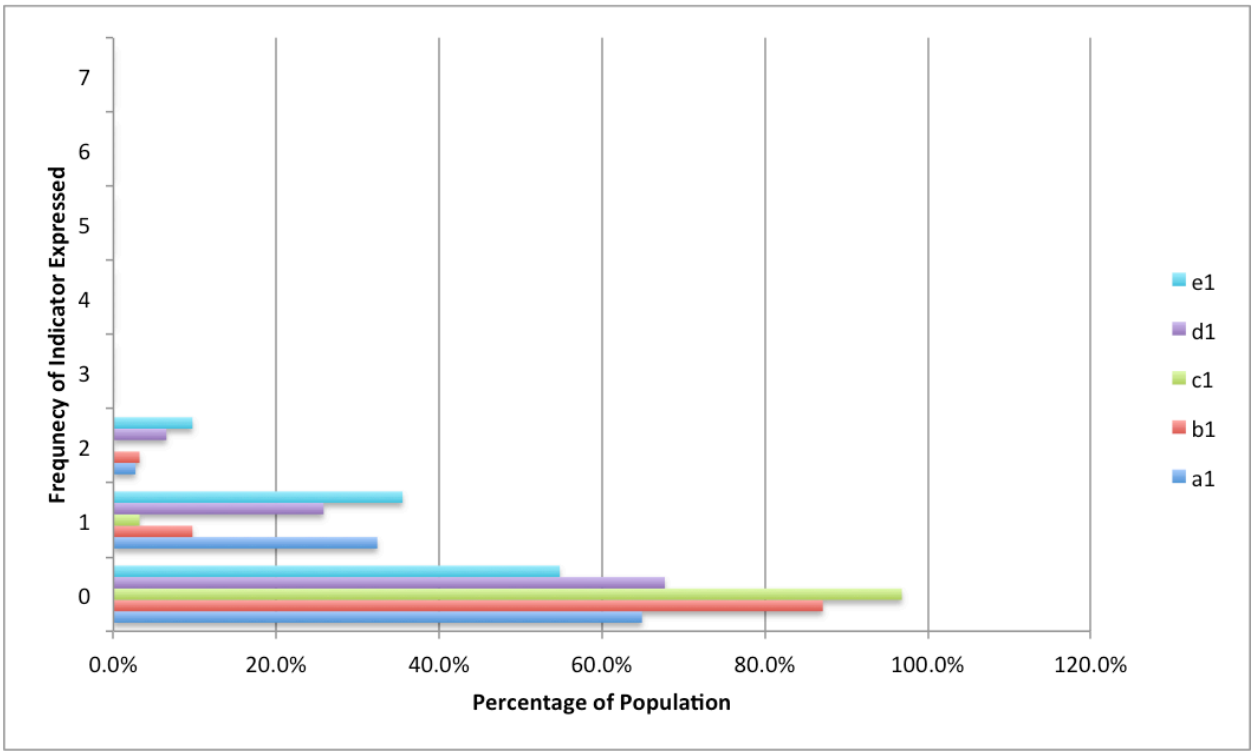
Results:

The research questions that are aiming to be addressed in this study are designed to produce evidence supporting the hypothesis that nature center preschools are an effective teaching tool for early childhood environmental education. Some hypotheses corresponding to the research questions include: more children will express indicators in the spring compared to fall, and children's expressions will increase from fall to spring on most indicators. Before comparing fall and spring data to determine if there was an increase in ecological concepts, and significance between the two, the raw data provides important information.

Figure 1 and Figure 2 represent the raw data of the frequencies expressed by the population regarding the Earth Systems (ES) indicators and Living Environment (LE) indicators. The data shown is the combined frequencies of both the spring and fall interviews. Comparing the frequency range of each category can determine which category was expressed the most. The ES indicators frequency range is from 0-2 meaning the maximum an ES indicator was expressed is twice an interview and less than 10% of the population expressed them twice. The LE indicators frequency range is 0-7 meaning the maximum a LE indicator was expressed is seven times an interview, and less than 10% of the population expressed them 7 times.

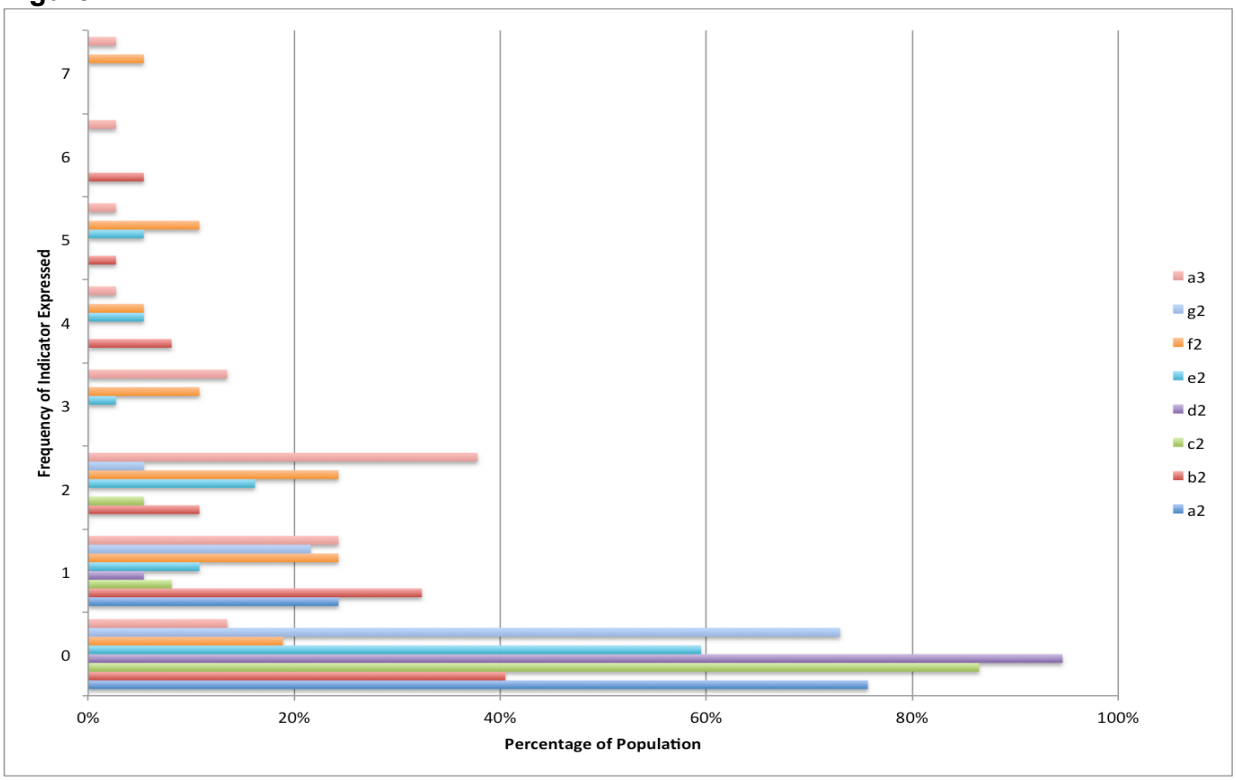
Out of the thirteen indicators, ten were not expressed by 50% of the population and eight indicators were expressed at least once per interview. This means that half the population didn't mention 77% of the indicators, and 61% of the indicators were mentioned once per interview. A similarity between the ES and LE indicators is that 20-30% of the population mentioned indicators at least once per interview.

Figure 1



Frequencies of Expressions for Earth System Indicators

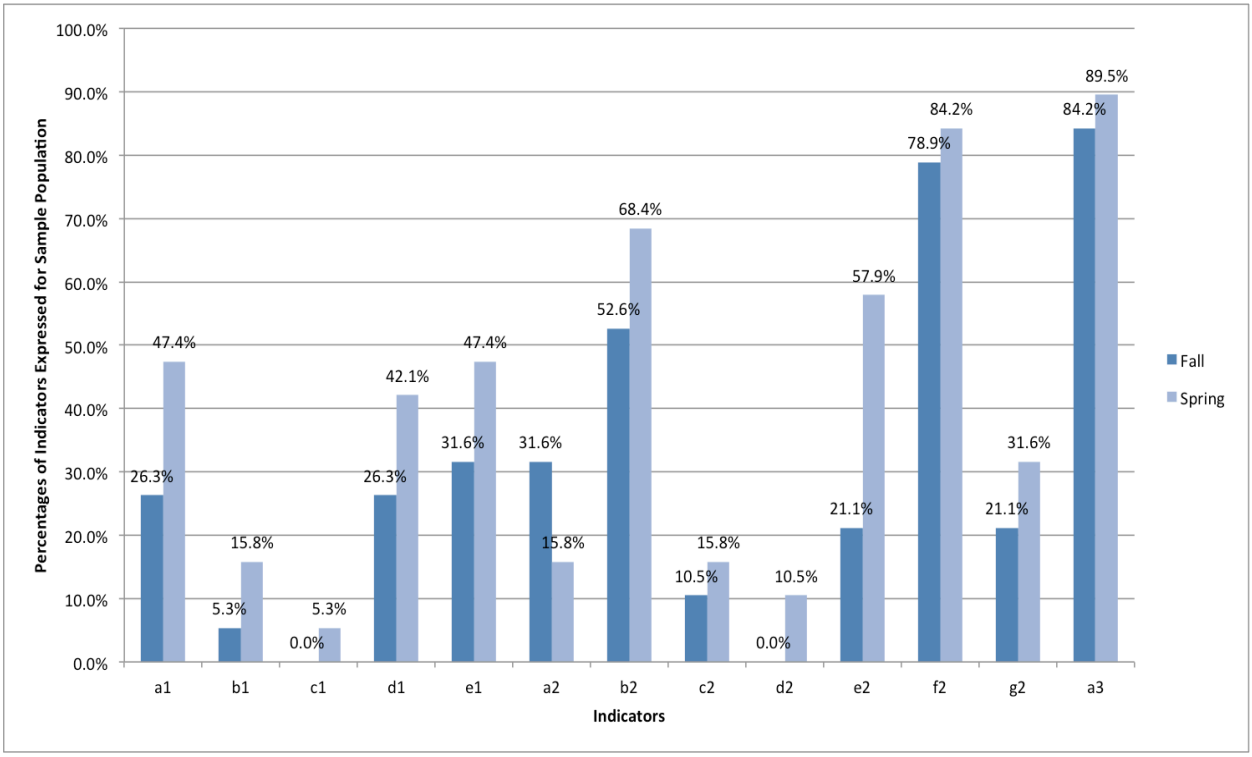
Figure 2



Frequencies of Expressions for Living Environment Indicators

Figure 3 represents the comparison of the fall and spring expressions of indicators of the total sample population. Twelve out of the thirteen or 92.3% of the indicators increased in expression between the fall and spring interview. Of those 12 indicators, b1, c1, d2, and e2 were expressed twice the amount in the spring compared to the fall. C1 and d2 were not expressed during the fall and increased 5-10% in the spring. The only indicator to not increase and actually decreased by half between the fall and spring is indicator a2. The indicators that were expressed by at least 50% of the population either in the fall or the spring are b2, e2, f2, and a3. F2 and a3 have the highest percentage of expression in both the fall (> 75%) and the spring (> 80%). That means over 75% of the population expressed both f2 and a3.

Figure 3



Fall versus Spring Sample Population's Expressions of Indicators

Table 2 represents the statistical analysis of the fall and spring frequencies of expressions. The table includes the chi-square values (i.e. p-value.) often referred to as the significance factor. The p-value is significant if it is less than .05. As the p-value decreases the significance increases. The p-values of the indicators are marked with asterisks to show significance, the more asterisks the higher the significance of the value. If p is less than .05 one asterisk is used (e.g. *), if p is less than .01 two asterisks are used (e.g. **), and if p is less than .001 three asterisks are used (e.g. ***).

To determine if the increase in ecological concepts is significant between the fall and spring, a chi-square analysis was computed using the population size for Time 1 and Time 2. Chi-square analysis indicated that seven out of the thirteen indicators had a significant increase from fall to spring. Indicators a1, b1, c1, a2, and g2 computed p-values less than .05, which means that the values had a significant increase between time 1 and time 2. The p-values of indicators d2 and e2 are less .01, which means they had the most significant change between time 1 and time 2.

Table 2
Statistical analysis of the Time 1 (i.e. Fall) and Time 2 (i.e. Spring) frequencies of expressions

	Time 1 n=22	**Time 2 n=18**		
Indicators	**SD**	**SD**	**F**	**P-value**
a1	.43	.61	7.53	.010 *
b1	.24	.53	5.73	.022 *
c1	.00	.23	4.24	.047 *
d1	.59	.84	1.95	.171
e1	.59	.69	1.56	.220
a2	.49	.37	6.33	.017 *
b2	1.45	1.91	3.59	.066
c2	.51	.54	.193	.663
d2	.00	.32	10.29	.003 **
e2	.92	1.78	8.3	.007 **
f2	1.82	2.01	.411	.526
g2	.43	.69	5.23	.028 *
a3	1.56	1.56	.306	.584

*= p< .05 **= p< .01 ***=p< .001

Discussion:

The results provide several examples that provide a substantial amount of evidence that supports nature center preschools as an effective teaching tool for early childhood environmental education, and also provides areas of improvement for the future application and implementation of nature center preschools.

The first research question requires evidence that displays an increase in expression of ecological concepts over time. The statistical analysis of the frequencies of the indicators expressed during the fall and spring provides evidence that seven out of the thirteen indicators had a significant increase in expression (Table 2). Although twelve out of the thirteen indicators did increase (Figure 3), the increase in five of the indicators was not significant so there is no statistical evidence to support the increase (e.g. $p > .05$). Indicators a1) observe changes in environment, b1) investigate properties of rocks, soil, and water, c1) importance of natural resources, a2) understand animal and human needs from the environment, g2) notice growth and changes in plants and animals, d2) notice changes in living things over time, and e2) understand that plants and animals have life cycles are the seven indicators that increased significantly. Three of the indicators are in the ES category and four are in the LE category.

The factors that may have contributed to the increase in ecological concepts include an increase in discussion and exploration of both categories during class time along with an increase in cognitive functioning and memory of the children during the time span between the first and second interview. Ruth Wilson (1996) discusses the importance of the development of neural connections in the first few years of a child's life. Early childhood environmental education provides the mental and physical stimulation needed by young children to support language development, social development, and emotional development.

Based strictly on looking at the indicators with the highest expressed percentage (Figure 3), the results display that the sample population of the children attending the SANC preschool had a sufficient understanding of indicators f2 and a3 in both the fall and the spring. The

increase in knowledge was not significant (e.g. p> .05) but it shows that these children understand the similarities and differences among plants and animals, as well as understanding that all animals need air, water, space, and food to live. Both of these indicators are in the LE category, which was overall expressed more than the ES category. A reason for the more frequent expression of the LE indicators may be due to the amount of time spent on discussing characteristics of plants and animals, and what they need live.

Another factor to consider is the difference in the weight of each category. There are more LE indicators than the ES indicators so there is a chance for a larger range of expression. The frequency graphs (Figure 1 & 2) show that generally as the frequencies increase, the indicators are expressed less by the population meaning that only a small percentage of the population mentioned more than two indicators.

The second research question assumes that there are areas of improvement for the future application and implementation of nature center preschools. There is a lack of expression when examining the range of the ES and LE indicators (Figure 1 and Figure 2). The ES indicators frequency range is from 0-2 meaning the maximum an ES indicator was expressed is twice an interview, which is small compared to the LE range of 0-7. In addition, there are several indicators that are expressed by less than 20% of the population. Those indicators include b1) investigate properties of rocks, soil, and water, c1) express observations of sun, moon, stars, and clouds, c2) recognize the differences between living and nonliving, and d2) notice changes in living things over time.

Based on this information the children are either not cognitively understanding the concepts or there is a lack of time spent on the indicators that are lacking expression. So an improvement for the SANC preschool is to increase discussion of earth system topics, living versus nonliving, and changes in living things over time.

Summary & Conclusions

Nature center preschools such as the Schlitz Audubon Nature Center are an effective teaching tool for early childhood environmental education because of the qualitative and quantitative evidence that supports the research questions. The data used in this study was obtained at the SANC preschool in Milwaukee, WI. This study is significant for generating new knowledge of the ecological concepts young children do and don't understand, as well as to the future application of designing curriculum and implementing early childhood environmental education programs in the United States.

The research questions were examined by coding interviews completed by children who attend the SANC preschool, summing the frequencies, and interpreting the frequencies using statistical analysis. The statistical analysis of the frequencies of indicators expressed during the fall and spring provides evidence that seven out of the thirteen indicators had a significant increase in expression therefore an increase in knowledge. An improvement that nature center preschools specifically the SANC preschool can make is to increase the time spent on teaching concepts related to earth systems along with the other indicators that are lacking expression of.

Although, the data provides evidence supporting that the children interviewed expressed an increase in ecological concepts, and that there is a lack of expression in some indicators, there are some limitations to the data. To achieve more significant results, a larger sample size would be beneficial because it would expand the sample population so there would be less error and more accurate values. There was also a design flaw because the interviews used were created to understand children's conservation beliefs and attitudes. While the interviews provided a sufficient amount of expressions of the indicators, questions related to the purpose of this study would be beneficial. In addition, only one person coded the interviews so in the future there should be a reliability test to verify that the expressions of the indicators were coded accurately.

The literature review discussed multiple problems and feasible solutions regarding children's health, learning, and nature were introduced. Early childhood environmental education is one of those feasible solutions. Children are unhealthy, spending less time outside, and are environmentally illiterate (Louv, 2008; Roberts & Foehr, 2008; Driessnack, 2009; Louv, 2009; Coyle, 2005). Exposing children to nature, and implementing environmental education in early childhood programs can provide assistance in decreasing the growing concerns of today's youth and develop in an increase in understanding of ecological concepts. Implementing early childhood environmental education programs will not only increase children's environmental literacy it will also benefit the mental and physical health of today's youth. Early childhood environmental education provides young children with an adequate amount of exposure to nature so that children will reap the benefits such as lower body mass index, a restored attention span, and based on the results of the study an effective teaching tool.

Appendix A – Coding Indicators for Qualitative Analysis

NAAEE Early Childhood Environmental Education Programs: Guidelines for Excellence

Guideline 4.3- Development of Environmental Understandings

Observe and understand earth systems:

a1 Observe changes in the environment

b1 Investigate properties of rocks, soil, and water

c1 Express observations of sun, moon, stars, and clouds

d1 Importance of natural resources

e1 Describe local environmental changes

Observe and understand the living environment:

a2 Understand animal and human needs from the environment

b2 Explore interactions between plants, animals, and fungi

c2 Recognize the differences between living and nonliving

d2 Notice changes in living things over time

e2 Understand that plants and animals have life cycles

f2 Notice similarities and differences and categories of plants and animals

2g Notice growth and change in plants and animals

a3 Understand that all animals, including humans, need air, water, space, and food

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