5-2019

Influence of the Natural Setting on Environmental Education Outcomes

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INFLUENCE OF THE NATURAL SETTING ON ENVIRONMENTAL EDUCATION OUTCOMES

A Thesis
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
Parks, Recreation and Tourism Management

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by
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May 2019

Accepted by:
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ABSTRACT

Environmental education (EE) targets specific positive outcomes such as environmental literacy, positive youth development, and 21st century skill among others. However, there is no isolated research on the contribution of nature on EE outcomes, or how the specific characteristics of the nature experience during an EE field trip enhance these outcomes. Data collected from 334 specific EE field trip programs for 5-8th grade students, using both quantitative and qualitative research tools, were used to analyze the impact of the natural setting on positive learning outcomes. Certain attributes of the natural setting, including novelty, beauty, and naturalness, as well as means of utilizing the setting through place-based education, immersion, and time spent inside vs. outside, are suggested to positively impact people's experiences with nature. This purpose of this study is to isolate the attributes of the natural setting to observe how they influence outcomes and observe how the utilization of the natural setting influences outcomes.

ACKNOWLEDGMENTS

I would first like to acknowledge my committee chair and advisor, Dr. Bob Powell, for all of the guidance and support through the research process. I'd also like to acknowledge committee members Dr. Marc Stern and Dr. Barry Garst for helping to shape my thesis. I would like to thank fellow researchers, Anna O'Hare, and Tori Kleinbort for their friendship and comradery, as well as for all their hard work in helping to collect data. A special thanks is needed for my research and travel partner Eric Neff, for being an excellent teammate, writer, and superb friend. Finally, I'd like to acknowledge my wife Kaitlyn, my parents, my sister, and all my friends for encouraging and supporting me through every step in the process.

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March 2019

INTRODUCTION

Does exposure to nature during an environmental education (EE) program enhance outcomes? If it does, what are the specific qualities that enhance student learning outcomes? These are challenging questions to address. Researchers and advocates argue that exposure to a range of natural stimuli enhances cognitive functioning, increases self-discipline, promotes imagination and creativity, and enhances social relationships (Kellert, 2002; Maller, 2009; Wells, 2000; Wells & Evans, 2003). Researchers also argue that childhood, and in particular middle childhood, is the most important period in which exposure to nature improves cognitive and moral development (Dewey, 1899; Kellert, 2002; Kohlburg, 1979; Krathwohl, Bloom, & Masia, 1956; Piaget, 1953; Wells, 2000; Wells & Evans, 2003). One mechanism for exposing children to nature is through environmental education (EE). EE is immersive and experiential, and providers of EE seek to develop a range of outcomes including 21st century skills and environmental literacy (e.g., Powell, Stern, & Frensley, in press; Simmons, 1995).

Research has generally indicated that there are cognitive, social, and emotional benefits associated with environmental education (Ardoin, Biedenweg, & O'Connor, 2015; Stern, Powell, & Hill, 2014). One thing lacking in studies of EE programs to date is an exploration of the specific attributes and uses of the natural setting that influences the achievement/enhancement of specific positive learning outcomes for middle-school-aged students (grades 5-8). To isolate the influence of attributes and interactions with the natural environment, we investigated 334 EE programs for middle-school-aged students across the country. Specifically, we investigated how specific attributes of the natural

setting, including the novelty, beauty, and level of naturalness, influence outcomes? Additionally, how does the type of interaction, measured by the use of place-based educational techniques, the degree of immersion in the natural environment and proportion of time spent inside versus outside influence outcomes? These attributes and interactions were selected to represent the natural setting due to their hypothesized importance in prevailing research into how humans are influenced by the natural environment.

LITERATURE REVIEW

Environmental Education

The Tbilisi Declaration of 1977 states, "Environmental education is the result of the reorientation and dovetailing of different disciplines and educational experiences which facilitate an integrated perception of the problems of the environment, enabling more rational actions capable of meeting social needs to be taken" (UNESCO, 1977). The traditional desired positive outcomes associated with EE include environmental literacy and stem from the creation of a relationship with and understanding of nature (Ardoin et al., 2015; Emmons, 1997; Mcbeth, & Volk, 2010; Powell et al., 2016; Stern et al., 2014). EE programs are commonly identified based upon this outcome, but additional outcomes are also relevant and important for EE programs today. Other outcomes associated with EE include place connection (Ardoin, 2006; Gruenewald, 2003; Powell et al., 2016) and, in the case of EE field trips for youth, positive youth development (Bowers et al., 2010; Garst, Browne, & Bialeschki, 2011; Lerner et al., 2005; Powell et al., 2016) and contributing to meeting educational standards (Powell et al., 2016).

Youth EE programs, particularly those associated with school field trips, reside at a critical intersection between informal and formal education (Storksdieck, 2006). Informal education is often student-centered, immersive, experiential, and provided in an open environment, where the initiation of learning is shifted from the teacher to the students (Gerber, Cavallo, & Marek, 2001; Hofstein & Rosenfeld, 1996). In formal education, students are in the classroom and teachers initiate learning. Further, in traditional formal education settings, attendance is mandatory, motivation is often extrinsic, and some form of assessment after instruction is expected (Tamir, 1991). EE school-based field trips possess characteristics of both informal and formal education. Field trips are arranged by the school and undertaken for educational purposes that often reflect classroom learning, but are often more student-centered than formal education, allowing students to move around and create their own experience and provide a unique learning experience for participants (DeWitt & Storksdieck, 2008; Feher, 1990; Hofstein & Rosenfeld, 1996; Storksdieck, 2006). Furthermore, they provide opportunities for diverse audiences to participate in learning experiences they might otherwise not choose (or be able) to attend (Powell, Ramshaw, Jodice, & Stern, 2013). Although EE field trips can vary in their programmatic content and setting, they generally tend to facilitate direct contact with nature through hands-on interactions as well as some level of immersion in nature. Therefore, EE field trips provide an ideal opportunity to investigate the influence of the natural setting and the degree of contact with nature on positive learning outcomes.

Why in a Natural Setting?

Many argue that EE should occur in nature. However, education in western society is overwhelmingly experienced indoors. A range of informal education activities

occur indoors and have been shown to deliver positive learning outcomes (Zelezny, 1999; Zink & Burrows, 2008). Despite widely held assumptions regarding the value of directly experiencing nature, there is little empirical evidence supporting the relationship between setting characteristics and learning outcomes. Theories rooted in evolutionary and environmental psychology suggest that it would be beneficial to be doing anything, including education, in a natural setting (Kaplan & Kaplan, 1989; Wilson, 1984).

Biophilia and environmental psychology. Much of the research into the impact of nature on human health and well-being is rooted in theories laid out in seminal works of environmental psychology. Edward O. Wilson, in his book "Biophilia", discussed how evolution and natural selection developed a natural desire for humans to affiliate with nature and other forms of life (S. R. Kellert & Wilson, 1993; Wilson, 1984). This theory further suggests that human physical and psychological health is connected to a relationship to nature (S. R. Kellert & Wilson, 1993). In this theory, there is a specific focus on the qualities of interaction with nature and how nature can influence childhood development (S. R. Kellert, 2005). This hypothesis regarding level of contact with nature and the importance especially of direct contact with nature has influenced best practices in EE for enhancing desired outcomes. However, there is a lack of research regarding the optimal characteristics of setting or level of interaction between students and the environment for enhancing desired learning outcomes in EE.

Kaplan and Kaplan (1989) has hypothesized that certain landscape preferences and different landscape/nature attributes produce a wide range of human health benefits in their Attention Restoration Theory (ART).. Later Kaplan, Kaplan and Ryan refined ART and provided specific landscape attributes that enhance feelings of psychological

restoration and other outcomes (Kaplan, 1995; Ryan et al., 2010). According to this view, the degree to which each landscape attribute "preference" is present in a landscape predicts the level of desirability and the degree of positive outcomes associated with interacting in this space (Kaplan, Kaplan, & Ryan, 1998). These landscape preferences are designed around a framework based on complexity, mystery, legibility and coherence. In this framework, coherence (how orderly a site is) and legibility (how distinct a site is) are factors that provide information that can lead to understanding the setting, while complexity (how intricate a site is) and mystery (how compelling a site is to explore) factor into the desire to explore (Kaplan et al., 1998).

The seminal theories of Biophilia and Attention Restoration Theory in the study of human interactions with nature and their health benefits have been influential in the field of EE. The foundation that these theories and the studies associated with them have constructed is evident in almost all the research done to begin answering the research questions of this review, with the general assumption that positive health benefits correlates with higher levels of learning.

Child development: why children? It has been theorized for many years that education in a natural setting is beneficial for children (White & Stoecklin, 2008). It has been suggested that children learn best through sensory experiences provided by hands-on interaction and immersion in the environment (Bredekamp & Copple, 2006). It has been stated that children learn best when engaging all of their senses and involving their bodies and muscles in ways that are limited in the classroom setting (Kahn, 1997; Kahn & Kellert, 2002; Lewis Jr, 1975; Mand, 1967; White & Stoecklin, 2008). Through experiences in natural settings, children learn by exercising both their minds and their

bodies using the outdoors as a source of knowledge (Boss, 1998). John Dewey said, "The average American child seldom comes in direct contact with nature. In school, he learns a few dates from books, to press a button, to step on an accelerator; but he is in danger of losing contact with primitive realities – with the world, with the space about us, with fields, with rivers, with the problems of getting shelter and of obtaining food that have always conditioned life and that still do" (as cited in Sharp & Osborne, 1940, p. 236). The loss of the primitive realities discussed by Dewey, threatens to limit children's awareness of their place in the world as well as negatively impact their cognitive social and emotional connections to their environment at large (Louv, 2008; Montessori, 1967; Williams, 2017). Many years have passed since Dewey first wrote about the consequences of human-nature disconnection and how it affects children. Richard Louv's "Last Child in the Woods" (2008) highlighted that this disconnection trend continues today. In the United States, the average child is spending 90% of their time indoors (Kellert, 2015) and 11-13 year-olds are spending an average of 3.8 hours in front of screens (Twenge & Campbell, 2018).

Recent research suggests that experiencing nature produces positive outcomes for people of all ages. However, as reflected in Dewey's philosophy of education (Dewey, 1899), the theory of cognitive development (Piaget, 1953), the taxonomy of affective maturation (Krathwohl, Bloom, & Masia, 1956), and the theory of moral development (Kohlburg, 1979), during middle-childhood youth are developmentally primed to establish a positive relationship with nature (Maller, 2009; Wells & Evans, 2003). Studies suggest that exposure to nature enhances prosocial and other-focused value orientations (Weinstein, Przybylski, & Ryan, 2009), increased cognitive performance and

attention capacity (Hartig, Mang, & Evans, 1991; Wells, 2000), increased enthusiasm, a sense of aliveness that can positively affect feelings of vigor, activated positive affect, and calm energy (Ryan et al., 2010).

Additionally, since interactions with nature are less common for individuals in modern society, logic suggests that when interactions do happen, they are likely to be novel experiences in novel settings. Novelty has been suggested to be directly related to learning as it increases mindfulness and readiness to learn (e.g., Woods & Moscardo, 2003). Also, new experiences can create a disorienting dilemma, from which people must confront personal beliefs and values in the face of new information, ultimately lead to deeper learning (Mezirow, 1997). Though disorienting dilemmas are generally associated with transformative learning, which specifically relates to metacognition in adults, the theory helps to reflect the fundamental role of novelty in environmental education. Without a new idea, setting, or stimulus, learning by definition cannot occur. Thus, while there have been myriad studies researching the human relationship with nature, more attention is needed examining the relationship between natural settings and their attributes and positive learning outcomes in environmental education (2014; Maller, 2009; Wells & Evans, 2003).

Place-based Learning: A Framework

As a response to children's perceived disconnection from both their physical and communal environment, educators have developed place-based approaches to education that can be both multi-disciplinary and multi-functional (Gruenewald, 2003; Lerner et al., 2005; Smith & Sobel, 2010; Sobel, 1995; Woodhouse & Knapp, 2000). Place-based education strives to utilize the local heritage, culture and landscapes as a context for

education in a variety of subjects (Sobel, 1996) and when considering EE, the physical environment, by definition, is the primary context. Place-based education is an immersive experience that can include a range of pedagogical approaches. However, the underlying place-based approaches in EE are generally hands-on, issue-based, and experiential, though not limited to these approaches, which explicitly link the characteristics and elements of the local environment of the site to the lives of the students and is used to develop skills, understanding, and attitudes aimed towards helping to regenerate and sustain local communities (Gruenewald, 2008). The wide-ranging goals of place-base education align strongly with the environmental literacy and stewardship associated with EE (Vaske & Kobrin, 2001; Worster & Abrams, 2005). Place-based learning is grounded theoretically in Dewey and Piaget's perspectives on the importance of education being constructivist and experiential (Dewey, 1899; Piaget, 1953). Hallmark attributes of place-based EE are the use of "place" as pedagogy (Orr, 1993), which translates into a high level of use of the local/site's natural environment in all aspects of the curriculum and activities through varied techniques.

While place-based learning often utilizes social elements like culture and heritage (Gruenewald, 2003; Smith & Sobel, 2010; Sobel, 1995; Woodhouse & Knapp, 2000), in EE there is an explicit focus on the physical environment as the context for education (Ardoin, 2006; Stedman, 2003). However, Ardoin states, "Despite the seemingly obvious importance of the biophysical environment, both natural and built, its impact is often ignored. In many studies, the biophysical environment is either mentioned only in passing or not considered at all…" (Ardoin, 2006, p. 115). By focusing on the unique setting at hand, the place-based framework aligns with the goals of this study by focusing on how

various EE program settings and their attributes, as well as degree of interaction with natural setting, in diverse environments can influence EE outcomes.

What is it About Nature? Characteristics of the Nature Experience

Is there something about a specific environment or landscape characteristics that contributes to learning outcomes in EE? Natural settings have been shown to have impacts in terms of well-being and other indicators of positive functioning (Herzog, Black, Fountaine, & Knotts, 1997; Kaplan & Talbot, 1983; Plante, Cage, Clements, & Stover, 2006; Ryan et al., 2010; Tarrant, 1996). These studies have identified the attributes of nature that people prefer when it comes to natural settings. Research has shown that there are benefits to interacting with nature, but in order to understand how to best produce desirable outcomes, it is important to identify the attributes that enhance outcomes.

Attributes of the Natural Setting

Beauty. The link between beauty in nature and human experiences has been increasingly researched since the 1970's (Kaplan et al., 1998). The influence of aesthetics, which is concerned with the appreciation of beauty, has been tied to creativity and imagination (Holton, 1988), awareness of balance, symmetry, harmony and grace (S. R. Kellert, 2008) as well as motivation to participate in science (Chandrasekhar, 1987). Gruenewald (2008) claims beauty influences the connection to place, which is a fundamental goal of place-based education. This connection encourages individuals to become more receptive to others and our surroundings through appreciation of beauty and wonder.

However, historically there has been an ongoing debate of what characterizes beauty and how to define and quantify it. Beauty has been extensively discussed in research pertaining to landscape preference, a topic that is considered in environmental psychology for the purpose of understanding why and how people interact with the environment in specific ways. In this context, beauty can be broken down into two paradigms, one where the natural setting has some inherent quality, and another where beauty is in the eye of the beholder (Arthur, Daniel, & Boster, 1977; Lothian, 1999). Lothian (1999) has discussed the philosophical debate at length as well as efforts at the potential of quantifying beauty through the objective or the subjective paradigms. Additionally, there are those that describe beauty in nature as environmental intangibles (Coomber & Biswas, 1973), which suggests immeasurability. However, when discussing beauty from an environmental psychology and developmental perspective, there is an assumption that aesthetic beauty of a location can be objectively assessed irrespective of cultural and social learning influences (Di Dio, Macaluso, & Rizzolatti, 2007; Kaplan et al., 1998; Kellert, 2005). In empirical research, attempts have been made to quantify beauty using various scales (e.g., Daniel & Boster, 1976; Han, 2010; Ribe, 2009) and through observations and qualitative assessments (e.g., Powell, et. al. 2012; Powell, et al., 2016).

Naturalness. It has been stated that the best learning environments for children are outdoors and natural (White & Stoecklin, 2008). Research suggests that natural environments help to facilitate restoration of attentional fatigue (Han, 2010; Staats & Hartig, 2004; Staats, Kieviet, & Hartig, 2003) as well as provide developmentally appropriate settings for EE for middle childhood (S. R. Kellert, 2002; Sobel, 1995; White

& Stoecklin, 2008). The degree to which an environment is in its perceived natural state is generally what is meant by the term naturalness (Tveit, Ode, & Fry, 2006). At times, humans need to actively manipulate the environment to maintain or establish perceived naturalness (Landres, Brunson, & Morton, 2000; Sydoriak, Allen, & Jacobs, 2000). Landscape preferences research suggests that people prefer more natural environments over man-made settings (Han, 2010; Smardon, 1988; Ulrich, 1981, 1983). However, it has been suggested that at the extreme ends, preferences may go down with unfamiliar, powerful and potentially scary landscapes (Kaplan et al., 1998). Much of the research done to study how the environment can impact education has included some scale of "naturalness" (Born, Lenders, Groot, & Huijsman, 2001; Wells, 2000; Wells & Evans, 2003). Additionally, there have been distinctions made regarding the level of negative human impact on a setting (Clay & Smidt, 2004; Green, 1999; Mansvelt & Kuiper, 1999) as well as between ecological function and perceived naturalness, where perceived naturalness is context dependent for individuals (Clay & Smidt, 2004; Tveit et al., 2006).

Novelty. Novelty can be explained as a contrast between previous and current experience (Bevins, Klebaur, & Bardo, 1997; Jenkins, 1969; Judd, 1989; Pearson, 1970) or as something new, unique, or unfamiliar (Garst, Williams, & Roggenbuck, 2009). While Falk et al. postulated that novelty can detract from learning experiences (Falk, Martin, & Balling, 1978), research has shown that novel experiences can inspire people to be more prosocial, leading to awareness beyond the self and encouraging collaborative and collective action (de Waal, 2008; Keltner, Kogan, Piff, & Saturn, 2014; Nowak, 2006; Sober & Wilson, 1998; Powell et. al, 2012; Powell et. al, 2016). More recent research is showing that when appropriately planned for, novelty in natural environments

supports personal restoration, and can help manage stress and anxiety through the action of getting away from the familiar (Garst et al., 2011). Additionally, novelty of the setting can help youth perceive the world from new angles, while developing appreciation for the natural environment (Garst, Scheider, & Baker, 2001). In a study of impacts on outdoor adventure programs on youth, novelty was found to be a prominent component, both during and after the experience, and a major driver for change among the youth who participated (Garst, Scheider, & Baker, 2001).

Additionally, research on summer camps where new experiences generally occur in natural settings, has shown restorative effects for children (Garst, 2018). It also has been suggested that curiosity is piqued by environments perceived to be novel; and that there is an optimal level for individuals (Orion, 1989). Curiosity has been linked with exploratory behaviors (Berlyne, 1950, 1966) and shown to stimulate interest in environmental knowledge (Bixler, Floyd, & Hammitt, 2002; Chawla, 2006; Kals & Ittner, 2003). With curiosity, partial familiarity with a stimulus has been shown to result in more exploratory behavior than either full familiarity or full novelty (Lee & Crompton, 1992). A question that follows is, how do different types of landscapes factor in? For example, if one is from a desert, is a forest novel? There is no known EE research that provides information to answer this question, which is particularly important when considering how students might react to different settings. However, Balling and Falk (1982), through a study using photographs of five distinct biomes, have shown that elementary children, have a preference for savannah like environments over all others, while adolescents and adult participants showed preference for familiar settings, suggesting an evolutionary effect (Balling & Falk, 1982).

Uses of the Natural Setting

Immersion. Is more immersion in nature better for student outcomes? Research has shown that middle childhood learn best through immersive experiences that are hands-on sensory based experiences (Bredekamp & Copple, 2006; White & Stoecklin, 2008). Much of the research that has contributed to developing an understanding of the effects of nature on human health and development has been inconsistent in terms of how it defines nature and what level of contact, or immersion, with nature is necessary to reap potential benefits. Kellert (2002; 2005) describes three different types of contact with nature; direct, indirect, and vicarious. Direct and indirect contact both include physical contact. However, direct contact is a more intensive experience as indirect contact occurs in a highly controlled environment. Vicarious contact is not direct and instead utilizes representations of nature. All three types of contact with nature are widely assumed to have positive benefits in various contexts. However, in the context of EE direct contact has been suggested to be a common program characteristic associated with outcomes such as environmental literacy, positive youth development, place connection, and environmental stewardship(Rickinson, 2001; Stern et al., 2014).

Time Spent Inside vs. Outside. In addition to the attributes of the natural setting, the length of time that people are exposed to nature compared to being indoors is suggested to have an impact on EE outcomes (Stern et al., 2014). In studies of positive youth development, it has been claimed that sufficient nature exposure is necessary for the influences of nature to be fully realized (Garst, 2018). Additionally, duration of a nature experience has been shown to be a positive predictor of change in knowledge in nature-based tourism (Powell, Kellert, & Ham, 2009). While there has been a general

assumption that increased exposure leads to more positive outcomes (Stern, Powell, & Ardoin, 2008), due to the varying lengths and types of nature experiences associated with EE programs, we chose to study the relationship between nature exposure and outcomes by contrasting the time spent inside vs. outside. The influence of time spent inside vs. outside on positive learning outcomes in EE specifically, is not yet supported by empirical research.

METHODS

This study aimed to examine linkages between the natural setting and positive learning outcomes for middle school aged students (grades 5-8) attending EE single day field trips. This data collection was a part of a larger EE study designed to examine the linkages between a range of pedagogical approaches and positive student learning outcomes.

Selection of Sites

This study focused on EE day field trips for middle school aged students (grades 5-8). Field trip host organizations included national parks, state and local parks, nature centers, botanical gardens, wildlife reserves, farms, public forests, science museums, and other environmental organizations. Working with the North American Association of Environmental Education (NAAEE), the National Park Service (NPS), and the Association of Nature Center Administrators (ANCA), we attempted to identify as many providers as possible who offered single day EE focused field trip programs for students, grades 5-8, across the country. To select programs, we relied on Ruggiero's (2016) evaluation of Environmental Literacy Plans in the US, which ranked states in terms of the status and quality of their statewide Environmental Literacy Plans, as a proxy for the

general status of EE in each state. We divided the states into quartiles based on this evaluation and then systematically sought to sample at least 10 program providers from states in each quartile to ensure a diversity of programs (see Table 1).

We identified over 300 potential program providers across all four quartiles, using the following criteria: programs were field trips (no in-school programs were included); lasted a single day or less in duration; focused on EE; served grades 5-8; took place during the period of research (Jan-June 2018); and willingness to participate in the study. We also sought to maximize diversity in terms of program types and socioeconomic context. After contacting each potential provider, we identified clusters of program providers in different regions of the country. Ultimately, we observed 346 programs of 90 unique program providers: 18 providers from the first quartile, 39 providers from the second quartile, 19 providers from the third quartile, and 14 providers from the fourth quartile.

Table 1
State Rankings for Environmental Education/Literacy Plan Implementation (Ruggiero 2016)

State Ranking	# providers (by state)	State	Score (out of 1.0)	Groupings	# providers (by quartile)
1	4	Oregon	0.9875		
2	1	District of Columbia	0.825		
3	0	Kansas	0.8		
4	2	Illinois	0.75		
5	3	Colorado	0.7375	**Above 0.6**	
6	6	Washington	0.7125	Most up to date	18
6	0	Tennessee	0.7125	with formal EE	
7	1	Connecticut	0.7	requirements.	
7	0	Kentucky	0.7		
8	0	Hawaii	0.6625		
9	0	North Carolina	0.6375		
10	1	New Hampshire	0.625		
11	0	Rhode Island	0.6125		
12	2	Wisconsin	0.6		
13	0	Alaska	0.5625		
14	0	Alabama	0.525	**0.4125-0.6**	
15	3	Pennsylvania	0.5125	High levels of	
16	3	Ohio	0.5	progress on	
16	0	Nevada	0.5	ELPs, room to	39

16	0	New Mexico	0.5	develop.	
17	14	Florida	0.475		
17	0	Iowa	0.475		
18	3	Maine	0.4625		
19	14	California	0.4375		
20	0	Louisiana	0.4125		
21	7	Texas	0.4		
22	1	Nebraska	0.375		
23	2	New York	0.3375		
24	0	Missouri	0.3	**0.1-0.4**	
24	0	South Dakota	0.3	Low to minimal	
25	0	Idaho	0.2875	progress on	19
25	2	Michigan	0.2875	formal EE	
26	0	Vermont	0.25	requirements.	
27	0	New Jersey	0.2375		
28	3	Virginia	0.15		
29	0	Oklahoma	0.1375		
30	2	Indiana	0.1125		
31	2	Maryland	0.1		
32	0	Arkansas	0.05		
32	0	Delaware	0.05		
32	2	Georgia	0.05		
32	4	Massachusetts	0.05	**0-0.05**	
32	1	Minnesota	0.05	minimal to no	
32	0	Mississippi	0.05	ELPs or	14
32	0	South Carolina	0.05	formal EE plan	
32	0	Utah	0.05	progress.	
32	0	West Virginia	0.05		
32	0	Wyoming	0.05		
33	7	Arizona	0		
33	0	Montana	0		
33	0	North Dakota	0		

Data Collection

Upon arrival at a program site, researchers reviewed the purpose and required logistics of the study with educators. Basic information about the program was recorded by the observer, including time, location, type, topic focus, group size, and grade levels of the audience. During each program, researchers maintained as unobtrusive presence within the group as possible, watching and taking notes. The researchers systematically monitored the extent and quality to which program characteristics were displayed during the program, including attributes and uses of the natural setting. They recorded quantitative scores and qualitative notes immediately following each program. We also developed and refined observational methods through extensive pilot testing. These pilot studies included observing 13 live programs and two filmed programs during Fall 2017

and Jan. 2018. During these pilot studies, we scored each program as individuals and then compared and discussed at length any issues regarding the clarity of the operational definitions and/or measurement. We used this process to further develop consistent, reliable, and valid scoring of observed natural context elements across the eight field researchers.

For the first two weeks of program observation, pairs of researchers observed programs together and completed scoring independently. This enabled comparisons and conversations to come to consensus on the measure of each indicator. The pairs of researchers worked together to complete a final scoring for the program to ensure reliability and consistency in scoring of observational variables. After roughly two weeks for each pair, discrepancies in scoring were rare. Researchers then began to observe programs individually. Throughout the 22-week field season, researchers periodically attended programs together to ensure reliability and consistency in scoring each variable. Weekly check-ins were also completed between team members to ensure that observation techniques were consistent and to clarify questions about scoring certain variables. At three points over the course of the study, separate pairs were purposefully intermingled to observe programs together to further enhance the reliability of observation measures.

Immediately following each program, all attending students, grades 5-8, were invited to complete a survey regarding their opinions of the program and its influence on them. For all programs, we attempted a census of all eligible attendees. There was no time limit given for the students to complete the survey. The average completion time was around 8 minutes. Overall, 5,317 surveys were collected from participants from 346 programs. The collected surveys were used to assess the programmatic outcomes

represented by the scale Environmental Education Outcomes for the 21st Century (EE21) (Table 2).

Researchers also produced qualitative notes including descriptive, concrete examples of program characteristics and narrative descriptions of each program. Each observer individually recorded details addressing the following prompts:

> **Most influential program attribute(s):** Of all the characteristics you measured, which in your opinion were really driving the outcomes of the program? Share concrete examples of what this looked like in action.
>
> **Natural environment/site and context**: Take a photo of the primary educational site and load in folder with code of program. Describe the site/location of activities. What natural environmental characteristics were special, unique, or novel? To what extent did the program/instructor utilize the environmental characteristics and attributes of the site? How did the attributes of the location contribute to the learning environment? How did students interact with those characteristics?

Measurement

Outcomes: One of the biggest challenges facing EE research is developing meaningful outcomes that are valid, reliable, and sensitive (vary depending upon the quality of the program) that apply across a range of program types (NRC, 2009; Fenichel & Schweingruber, 2010). Such measures are necessary to conduct a large-scale comparative study to isolate what practices work and under what contexts. To develop these outcomes, we 1) reviewed the literature, 2) involved stakeholders and program

providers in a range of workshops to define and refine crosscutting outcomes applicable to a range of EE programs (Powell, Stern, & Frensley, In press); 3) operationalized the outcomes following recommended scale development procedures (e.g., DeVellis, 2003), which included iterative stakeholder review to ensure external validity 4) conducted 6 pilot studies in a range of EE settings across the US to refine scales using confirmatory factor analyses and multi-group invariance testing procedures so that the outcomes can be cross-tested for reliability and validity (Powell, Stern, Frensley, & Moore, 2019). This work identified 10 consistent crosscutting outcomes (Learning, Interest in Learning, 21st Century Skills, Self-efficacy, Self-Identity, Place Attachment, Environmental Attitudes, Environmental Behaviors, School Behaviors, and Communication Behaviors) (Table 2). We conducted additional confirmatory factor analyses on the final sample from this research, and the results indicate that the EE final model has excellent fit (SBCH2=2732.0996, 496DF; CFI=0.973, SRMR=0.027, RMSEA=0.036 (.034,.037)) (see Powell, Stern, Frensley, & Moore, 2019). All variables were scored on a scale of 0-10. Self-Efficacy and Environmental Attitudes were measured using a retrospective pre/post questions asking students to reflect on how they felt about given statements before the program, and after as a result of the experience. The means represent a difference between pre and post scores.

Table 2
Environmental Education Outcomes for the 21st Century (EE21)

Outcome	Definition	Items
Enjoyment	Positive emotions toward the experience	How would you rate the program on a scale from 0 to 10?
Connection/Place attachment	Appreciation and personal connection with the physical location of the program.	Knowing this place exists makes me feel good. I want to visit this place again. I care about this place.
Learn	Enhanced knowledge regarding the interconnectedness and	How different parts of the environment interact with each other.

	interdependence between human and environmental systems.	How people can change the environment. How changes in the environment can impact my life. How my actions affect the environment.
Interest in Learning	Enhanced curiosity, as well as increased interest, in learning about science, the environment, or civic engagement.	Science. How to research things I am curious about. Learning about new subjects in school. *Learning more about nature.
21st Century Skills	Enhanced skills in critical thinking and problem solving; communication; collaboration; and creativity and innovation.	Solving problems Using science to answer a question Listening to other people's points of view Knowing how to do research
Meaning/Self Identity	Impact of the program on components of participants' identities. . These may include a heightened sense of purpose, motivation, or identity.	Taught me something that will be useful to me in my future. Really made me think. Made me realize something I never imagined before. Made me think differently about the choices I make in my life. Made me curious about something.
Self-Efficacy	Changes in individuals' belief in their ability to achieve their goals and influence their environment.	I believe in myself I feel confident I can achieve my goals I can make a difference in my community.
Environmental Attitudes	Changes in sensitivity, concern, and dispositions towards the environment	I feel it is important to take good care of the environment Humans are a part of nature, not separate from it. I have the power to protect the environment
Action Orientation	*Intentions* to solve environmental and social problems in their communities or beyond	*As a result of the program, do you intend to do anything differently in your life?
Actions: Environmental Stewardship	Enhanced desire/intentions to address environmental and social problems in their communities or beyond	Help to protect the environment. Spend more time outside. Make a positive difference in my community. *Talk with others about ways to protect the environment.
Actions: Cooperation/Collaboration	Enhanced intention to cooperate and collaborate with others	Listen more to other people's points of view. Cooperate more with my classmates.
Actions: School	Enhance efforts in school.	Work harder in school. Pay more attention in class.

* Items not in final scale.

Program Characteristics: Based on past research (e.g., Stern & Powell, 2013) and literature reviews (see Stern, Powell, & Hill, 2014), we developed the list of variables pertaining to the natural environment associated with the delivery of EE programs.

We report the results of our investigation into attributes of the natural setting including, beauty of the non-built environment, naturalness, novelty of setting, as well as utilization of the natural setting through place-based education techniques, immersion, and portion of time spent inside vs. outside. Collectively these variables were defined and scaled to represent the quality of the natural setting (Table 3).

The measurement scale utilized for all independent variables was derived from the logic of Charles Ragin (2009) as described in "Redesigning Social Inquiry: Fuzzy Sets and Beyond." All variables are measured on a 1-4 scale in which 1 represented a total lack of presence or perceived influence, 2 was minor presence/perceived influence, 3 was moderate presence/perceived influence and 4 represented total presence or perceived influence. The difference between 2 and 3 can be viewed as the difference between more out that in versus. more in than out.

Table 3
Natural Setting Variables

Variable	Definition	Operationalization			
Attributes					
Beauty of the non-built environment N/A if entirely indoors	Degree to which the setting is aesthetically pleasing. At the extreme positive end these are amazing, of overwhelming attraction, or mesmerizing that create a "wow" effect in students.	1 Nothing at all desirable in the appearance of the settings or entirely indoors.	2 Somewhat pleasing setting	3 Clearly visually appealing setting	4 Setting is absolutely beautiful, awe-inspiring, breathtaking
Naturalness (as experienced/perceived by the students)	Degree to which the program takes place in a manmade vs.	1 Setting is completely	2 Setting is mostly	3 Setting is mostly	4 Setting is wilderness-

	wild setting	manmade/built	manmade with some components of a natural environment	natural with some manmade components	like, almost entirely.
Novelty of setting	Degree to which the setting is unique or special for the audience. In these situations, the students reflect the setting is unexpected/unfamiliar and they are more focused on environment.	1 Completely familiar or mundane setting to the students	2 Some minor uniqueness or quality that appears to be out of the ordinary to the students	3 A mostly novel setting that appears to be out of the ordinary for the students.	4 Students' reactions make it obvious that the setting stands out as special (excitement, selfies, exclamations, etc.)
Utilization of Setting					
Place-Based	Degree to which the program emphasized and utilized the unique attributes of the place/resource in the lesson.	1 Place-based was nearly irrelevant	2 Minor verbal connections were made to the activities	3 Moderate efforts to connect the lesson to place	4 The connection to place was well developed through repetition and engagement
Immersion	Degree to which students are immersed in the natural environment (muddy, wet, digging in the dirt, etc.)	1 Not at all	2 Mostly at arm's length. Maybe touching something here or there, but mostly on the trail.	3 Students are fully immersed for part of the program.	4 Fully immersed for most of the program.
Inside vs. Outside	Proportion of time spent inside vs. outside	1 Entirely inside	2 Mostly inside	3 Mostly outside	4 Entirely outside

Data Cleaning Procedures

Five thousand three hundred and seventeen students completed post-program surveys and 345 program observation sheets were entered into Microsoft Excel. Data were then transferred to SPSS for screening and analysis. First, we dropped three

programs (26 surveys) because response rates were below 50% of attendees. We then screened surveys for missing values and removed all surveys missing more than 25% of the items. We removed 210 surveys due to missing data. With these removals, one additional program dropped below a 50% response rate. It was removed entirely (8 additional surveys). We also screened for obvious patterns indicating invalid responses, such as no variability in answers, strings of consecutive numbers, or using one circle to indicate responses for multiple items. We identified and removed 94 surveys with these problems. One additional program dropped below 50% response rate following these removals. It was removed from the database (7 additional surveys). Data were then screened for multivariate outliers using Mahalanobis Distance (MAH). A total of 563 cases were removed for exceeding the criterion Mahalanobis Distance value. Six more programs dropped below 50% valid response rate and as a result and were removed from the database (dropping an additional 33 surveys). Our final resulting sample was 4,376 individual surveys from 334 programs and 90 program providers (Table 4)

Table 4.
Survey cleaning procedures

STEP	**Changed/ removed**	**Programs remaining**	**Respondents remaining**
Starting point	N/A	345	5,317
Removed all programs for which we did not achieve at least a 50% response rate	3 programs	342	5,291
Removed all individual surveys with more than 25% of data missing	218 surveys; 1 program	341	5,073
Removed all obvious patterns or invalid surveys – for example, no variability in more than half of the responses (e.g., all 10s), strings of consecutive numbers in responses, one circle around all numbers.	101 surveys; 1 program	340	4,972
Removed multivariate outliers using	596 surveys;	334	4,376

Mahalanobis Distance.	6 programs		

Structural Equation Modeling

As part of our analyses, used structural equation modeling (SEM) to examine the influence of the attributes and uses of the natural setting on EE21. We used SEM for this analysis because it is confirmatory (as opposed to exploratory) in nature and requires the researcher to have an explicit hypothesized model; it can model measurement error, which reduces inaccuracies; it allows for the analysis of a complete multivariate model including direct and indirect effects and in this case it can assess causal relationships between independent variables and a dependent variable (Byrne, 2006; Kline, 2005).

We used the EQS v6.1 software (Bentler, 2005) to perform the statistical analyses, which progressed in several stages. First, the data were screened for univariate and multivariate deviations from normality. Next, we used structural regression modeling to assess the causal relationships between independent variables and the dependent variable. We began with a model that contained all setting and use variables that met the criteria described above for the outcome. To develop the final structural regression model, we used an iterative process in which diagnostics (modification indices: Lagrange Multiplier Test (LM), Wald Test) indicated potential modifications, including removal of independent variables from the model, to improve fit and parsimony. Structural regression analysis provides multiple statistics that can be used to evaluate the "fit" of a specified model (Byrne, 2006). In this paper we report the Satorra-Bentler Scaled Chi Square (S-B χ^2), Robust Comparative Fit Index (CFI), Standardized Root Mean Square Residual (SRMR), the Robust Root Mean Square Error of Approximation (RMSEA) and its associated 90% confidence interval (Peter M Bentler & Yuan, 1999; Byrne, 2006).

The S-B χ^2, which should be interpreted like a χ^2 is reported because it corrects for the degree of kurtosis in the data (Satorra & Bentler, 1994). The Robust CFI accounts for non-normality in the data and is an "incremental or comparative fit index" that evaluates the change in fit between the hypothesized model and the "independence model" (Bentler, 1990; Byrne, 2006; Kline, 2005, p. 140). The independence model assumes that all the variables in the model are unrelated. The CFI represents the total covariation in the data and is measured on a scale of 0 to 1 with values greater than .9 indicating an acceptable fit and values greater than .95 indicating an excellent fit (Byrne, 2006; Hu & Bentler, 1999). The SRMR statistic provides the average difference between the sample and the predicted correlation matrices and thus is not susceptible to non-normality (Byrne, 2006). The SRMR uses standardized values with the range of scores between 0 and 1; values less than .1 are considered acceptable and less than .05 are considered a good fit (Hu & Bentler, 1995; Kline, 2005). The Robust RMSEA also accounts for non-normality in the data and is based on the average lack of fit per degree of freedom; therefore, as the fit improves, the RMSEA decreases. As such, this measure is sensitive to the degrees of freedom and the complexity of the model (Byrne, 2006). Like the SRMR, the scores range between 0 and 1, with values of .05 to .08 deemed acceptable and values less than .05 considered excellent (Browne & Cudeck, 1993; Hu & Bentler, 1999). Beta weights in structural regression models reflect the effect size of an independent variable on the dependent variable. R^2 values gauge the predictive validity of the structural model, explaining the proportion of the total observed variance in the dependent variable explained by the model. It is recommended to assess R^2 values independently of fit indices, as the latter do not pertain to predictive validity (Kline, 2005).

RESULTS

Program Description

All descriptive statistics reported are calculated only from the 334 programs validated by data cleaning procedures that met our sampling criteria. In total, four thousand four hundred and thirty-two student surveys were included in data analysis. Of these programs, individual surveys reflected that 45% were composed of a majority of students who identified as White and not of Hispanic descent (44.9%), 31% were composed of a majority of students who identified as Hispanic (30.8%), and only 26 programs were composed of a majority of students who identified as Black and not of Hispanic descent (7.8%). Roughly thirteen percent of programs were composed of a majority of students who identified themselves as "other" (13.2%). The mean program time was 190.8 minutes, with a standard deviation of 77.2 minutes. The mean group size was 15.8 with a standard deviation of 7.3. Of the respondents, 39% were in fifth grade (39.2%), 29% were in sixth grade (29.3%), 18% were in seventh grade (18.3%), and 5% were in eighth grade (5.1%).

Descriptive Statistics: Independent Variables

The descriptive statistics for the independent variables are reported in Tables 5 and 6. Place-based, beauty, naturalness, and novelty, have fairly normal distributions. A rating of 2 for Immersion accounted for over half of the data points showing that most providers used lightly immersive experiences at most. The ratings of 3 and 4 for time spent inside versus outside, show that they accounted for almost 85% of the data points reflecting how the large majority of the programs took place at least mostly outside.

Table 5
Natural Setting Variables Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Place	334	1	4	2.59	.868
Beauty	319	1	4	2.63	.676
Naturalness	334	1	4	2.64	.734
Novelty	334	1	4	2.50	.705
Immersion	334	1	4	2.23	.770
Outdoors	334	1	4	3.25	.800

Table 6
Frequencies

Variable	1		2		3		4	
	n	%	n	%	n	%	n	%
Place	31	9.3	129	38.6	120	35.9	54	16.2
Beauty	6	1.9	137	42.4	150	46.4	30	9.3
Naturalness	20	6.0	112	33.5	171	51.2	31	9.3
Novelty	12	3.6	172	51.5	121	36.2	29	8.7
Immersion	44	13.2	194	58.1	71	21.3	25	7.5
Outdoors	11	3.3	42	12.6	133	39.8	148	44.3

Descriptive Statistics: Outcomes (EE21)

Table 7 displays the means, standard deviations and factor loadings for each outcome that compose the EE21 as well as the grand mean and standard deviation for the scale. Using confirmatory factor analysis, we tested the hypothesized structure and measurement of the dependent variable scale EE21 and it was an excellent fit of the data and validated the hypothesized structure and measurement of EE21 (SBCH2=2732.0996, 496DF; CFI=0.973, SRMR=0.027, RMSEA=0.036 (.034,.037)) (see Powell, Stern, Frensley, & Moore, 2019). The factor loadings are provided in Table 7. For this analysis, we developed a composite score for the overall EE21 measure.

Table 7
EE21 Means, standard deviations, and CFA factor loadings of items.

Constructs and Items (n=4376)	**M**	**SD**	**CFA Factor Loadings**
Connection/Place attachment			
Knowing this place exists makes me feel good.	7.38	3.07	.799
I want to visit this place again.	7.41	2.88	.896
I care about this place.	7.81	2.77	.863
Learning			
How different parts of the environment interact with each other.	6.93	2.43	.766
How people can change the environment.	7.33	2.68	.813
How changes in the environment can impact my life.	7.41	2.67	.830
How my actions affect the environment.	7.73	2.65	.799
Interest in Learning			
Science.	6.33	3.20	.788
How to research things I am curious about.	6.36	3.07	.878
Learning about new subjects in school.	6.04	3.24	.844
21st Century Skills			
Solving problems.	5.56	3.18	.857
Using science to answer a question.	6.15	3.07	.852
Listening to other people's points of view.	6.56	3.10	.851
Knowing how to do research	6.26	3.29	.834
Meaning/Self Identity			
Taught me something **that will be useful to me** in my future.	6.63	3.07	.827
Really made me think.	6.67	3.12	.868
Made me realize something I never imagined before.	6.38	3.24	.840
Made me think differently about the choices I make in my life.	6.53	3.27	.817
Made me curious about something.	6.63	3.07	.840
***Self-Efficacy (Retrospective pre-post)**			
I believe in myself.	0.83	1.75	.578
I feel confident I can achieve my goals	0.78	1.59	.704
I can make a difference in my community.	1.12	1.77	.710
***Environmental Attitudes (Retrospective pre-post)**			
I feel it is important to take good care of the environment.	0.78	1.47	.577
Humans are a part of nature, not separate from it.	0.97	1.73	.622
I have the power to protect the environment.	1.17	1.85	.723
Actions: Environmental Stewardship			
Help to protect the environment.	7.34	2.81	.866
Spend more time outside.	7.12	3.03	.778
Make a positive difference in my community.	7.06	2.83	.920
Actions: Cooperation/Collaboration			
Listen more to other people's points of view.	6.80	2.99	.883
Cooperate more with my classmates.	6.79	3.08	.860
Actions: School			
Work harder in school.	7.08	3.26	.949
Pay more attention in class.	7.04	3.33	.913
EE21 Composite	5.01	1.77	Cronbach's Alpha=.964

Correlations

Do variables associated with the natural setting correlate with positive learning outcomes? Table 8 displays the correlation matrix between all of the variables.

Table 8
Correlation Matrix

	1	2	3	4	5	6	7
1. EE 21	-						
2. Place	.202**	-					
3. Beauty	.098	.205**	-				
4. Naturalness	.234**	.346**	.592**	-			
5. Novelty	.280**	.449**	.542**	.456**	-		
6. Immersion	.043	.236**	.347**	.537**	.324**	-	
7. Inside/Outside	.156*	.218**	.371**	.704**	.325**	.447**	-

** Correlation is significant at .01 level (2-tailed)
* Correlation is significant at the .05 level (2-tailed)

Examination of the distribution and relationship between each variable and EE21 revealed that the time spent inside vs. outside variable displayed a nonlinear relationship with EE21. A clear cut point was observed and confirmed through one-way ANOVA. The variable time spent inside vs. outside was recoded into a new 2-point variable that best reflected the data and the relationship with EE21. The new variable (Table 9) was scored 1= Mostly indoors (previously scored 1 and 2) and 2=mostly outdoors (previously scored 3 and 4). Descriptive statistics and t-tests are provided in Table 9.

Table 9
Time Spent Inside vs. Outside Transformed

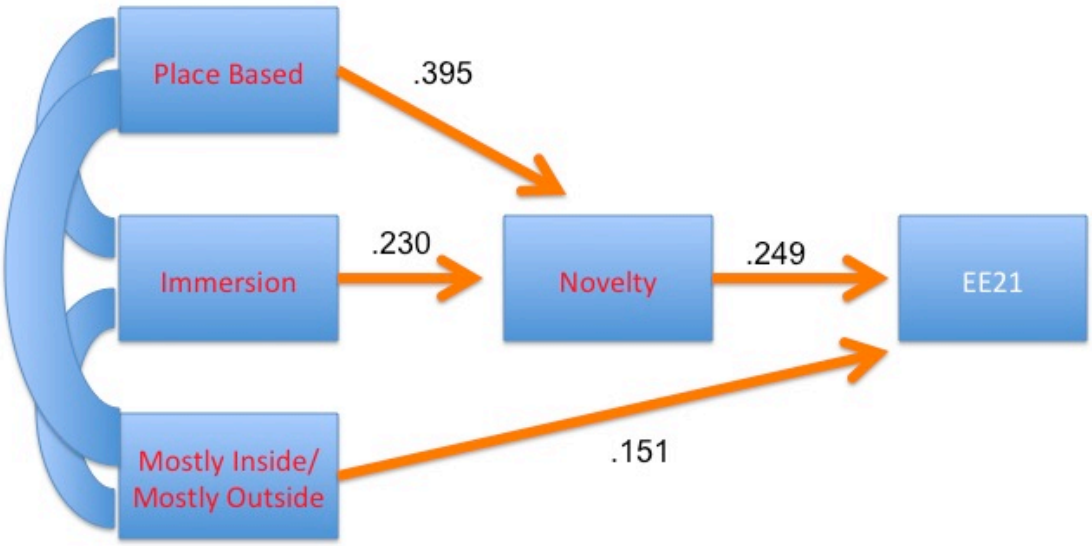
Variable	M (SD)	M-(SD) 1 (n=53)	M(SD) 2 (n=281)	t	df	p
Mostly Inside/ Mostly Outside	1.84 (.36)	5.29 (.99)	5.90 (.98)	-4.182	332	<.001

** Correlation is significant at .01 level (2-tailed)

Modeling Influence

A model was created using the variables in Table 9 to investigate the influence of the natural setting on positive learning outcomes. Initially, all of the independent variables were tested as direct predictors for the outcome EE21, but the fit of the model was deemed unacceptable. We also tested a model to examine if novelty mediated the relationship between all other independent variables and EE21 to test theories regarding the importance of novelty (e.g., Garst, 2018). While this model also has a fit that was deemed unacceptable diagnostics suggested that novelty did mediate the relationship. We adjusted the model through an iterative process using diagnostics that indicate potential model changes that would improve fit and parsimony. The final result, displayed in Figure 1, is a "best fit" model that represents the most parsimonious and predictive model for the outcome EE21 (SB-7.6110, 3-DF CFI .975; SRMR=.031; RMSEA =.068 (.000; .130)) and indicated that the model was acceptable representation of the relationships present in the data. The variables place-based (β=.395, p <.05) and immersion (β=.230, p <.05) were predictors of novelty (β=.395, p <.05) and accounted for approximately 25% of the variance in novelty, though they were not a direct predictor to the outcome EE21. Novelty in turn was a strong direct predictor of the outcome EE21 (β=.249, p <.05). The mostly inside/mostly outside variable was a direct predictor of the outcome EE21 (β=.151, p <.05). Novelty and mostly inside/mostly outside accounted for approximately 10% of the variance in EE21.

Figure 1
EE21 Model



Qualitative Results

What do the attributes and utilization of the natural setting look like? Table 10 provides definitions and examples from our field notes of extreme ends of the attributes of the setting and the methods of utilization.

Table 10
Qualitative Field Notes of Observed Variables of the Natural Setting

Variables	Examples
Place-Based: Degree to which the program emphasized and utilized the unique attributes of the place/resource in the lesson.	HIGH: Each instructor focused on the local environment and used the resources that the space provided to teach about the local ecosystem. Instead of trying to extrapolate the lesson to the greater world, they used the lesson to teach about an aspect of the city's water supply and did so using resources provided by the field trip site. HIGH: The program was focused on the specifics of the local river and also park where the program took place. The educator started the day with a discussion of history of the park and also a brief lesson on ecosystems and communities, which was taught using the local wildlife of as examples. When the students went on a nature walk, they saw a lot of wildlife and vegetation that was specific to the locality, and the instructor focused on relating what was observed to the specific site. LOW: Much of the program was directed towards performing experiments designed to meet curriculum standards. Water quality tests, dissolved oxygen tests, and wind speed tests were performed in a manner that could have taken place anywhere. The highly unique attributes of the locality were not discussed or made relevant to the experiments.
Beauty of the non-built environment: Degree to which the setting is aesthetically pleasing. At the extreme positive end these are amazing, of overwhelming attraction, or mesmerizing that create a "wow" effect in students.	HIGH: From the highest point on the hike, the glacier was visible off the top of Mt. Rainier. The students, teacher and chaperones were all heard discussing the beauty of the landscape throughout the day reacting to constant presence of expansive views of the snow-covered mountains. HIGH: The students walked down a wooded trail that opened up to a large limestone escarpment that dropped off shelf after shelf as it continued to the river. Along this escarpment, there were scattered pools of water from previous rains or floods. While walking along the river, the group passed a beautiful waterfall that had turtles perched on rocks at the bottom which drew comments from the students. LOW: The program site was right next to a major road. There was a large power line over most of it with a powerline clearing running through the park. The views were of suburban neighborhoods and bare foothills of the Rocky Mountains.
Naturalness (as experienced/perceived	HIGH: Once into the forest, the entire day was totally remote and natural. The majority of the trail went through a forest that

by the students): Degree to which the program takes place in a manmade vs. wild setting	was revealed to be about 70 years old, filled mostly with coniferous trees. The trail was almost entirely snow covered. At one point, the group crossed a small creek over a bridge made of downed trees, which was the only mand-made feature on the trail. Eventually the students reached the old growth forest, made up mostly of large pines and cedars. The students also spent time in an old creek bed, where they made observations about what had happened to cause the forest to be different on either side. HIGH: The program took a 2-mile paddle down the Colorado River. This paddle took a couple of hours. It was a virtual wilderness; there were no sounds or roads, and few signs of humanity. The students saw some waterfowl and also a cow on the banks of the river. The river was not blessed with any drastic formations or impressive sights, but it was a pleasant day and many of the students seemed to enjoy simply being out in nature. LOW: The program was set at a modern building complex. One activity was entirely indoors, while two others were set just outside the buildings under an awning. LOW: The park where the program was set had recently been drastically altered, with much of the wood and underbrush destroyed and transformed into mulch to help restore the habitat to the savannah that it once was. As a result, there were vast views that looked desolate save for the small number of trees that had been spared.
Novelty of setting: Degree to which the setting is unique or special for the audience. In these situations, the students reflect the setting is unexpected/unfamiliar and they are more focused on environment	HIGH: The students were at elevation and walking in snowshoes, which most of the students hadn't done before. The views were expansive and most of the snow cover was pristine, with no tracks of other humans or wildlife which seemed to contribute to the uniqueness of the environment and the experience. HIGH: The program was set in a densely forested swamp in which students were wading in for much of the day. The depth of the swamp varied but much of the students were wet beyond their wastes. It appeared to be a new and unique setting for many of the participants. The inexperience of moving through a densely forested and wet environment was displayed through the nervous laughter sound of excitement throughout the group. LOW: The program involved a hike in the park, but its setting was a fairly mundane unless one was very much into spotting

	birds and wildlife. Most of the students were not into it and were not allowed to interact with the environment apart from looking at it
Immersion: Degree to which students are immersed in the natural environment (muddy, wet, digging in the dirt, etc.)	HIGH: The dominant attribute of this program was the interaction with the natural environment, specifically the waters of the Atlantic Ocean at the shore. The students were geared with life jackets, dip nets and buckets and strode out into the shallow water, where they collected sea life for at least a half an hour. Some students were visibly nervous about entering the water. Many thought it was cold. Almost all of them were entirely engaged in hunting for sea life. They were excited and nervous that life was all around them. HIGH: The biggest programmatic element was the interaction with the natural setting. The majority of the program was on the move, snowshoeing in deep snow. The students were consistently tired and hot when arriving to the stops resulting from the demand of the high level of interaction with the environment. There were multiple stops where the students engaged in discussion about forces of change in the environment, but for the most part, students were too excited about being in the snow to focus much on the lessons.. LOW: The program was set at a modern building complex next to the Colorado River. One activity was entirely indoors, while two others were just outside under an awning. The students did not interact with the natural setting in any way.
Time Spent Inside vs. Outside: Proportion of time spent inside vs. outside	HIGH: The program took place entirely in nature. All day they were surrounded by a natural habitat. They were physically engaged with the natural environment for around 3 hours. They waded through knee-deep swamp water at the start, mucked through mud throughout, and had every opportunity to see, feel, and hear nature around them. LOW: The entire program took place in the classroom. There was no focus on the natural setting. The students were the recipients of a lecture and just sat and received information and looked at three animals.

DISCUSSION

This study sought to determine the influence of the natural setting and its use on positive learning outcomes for environmental education programs across the United States for middle-school aged children (grades 5-8). Our initial analysis looked at the bivariate relationships between the natural setting (i.e. beauty, naturalness, novelty, immersion, place-based, time spent inside vs. outside) and positive outcomes measured by the EE21 scale. The naturalness of the site, the novelty of the experience/site, the proportion of time inside vs. spent outside, as well as the use of place-based educational approaches were all positively and significantly related to EE21. These findings suggest that highlighting and using the unique attributes of the place, and spending most of the time outdoors, can influence positive learning outcomes. Similarly, the novelty and the naturalness of the setting both directly relate to positive learning outcomes. Additionally, the natural setting variables were all significantly correlated with each other suggesting that when one was present, the others were also typically present as well.

To further investigate the relationship between the characteristics and use of the setting, we used structural equation modeling. The resulting model revealed two lessons. First, the utilization of the natural setting through place-based techniques as well as through immersion, enhanced novelty, which had a strong relationship with positive learning outcomes. Place-based techniques that used the unique attributes of the environment, as well as engaged students in the setting through immersion, both contribute to the novelty of the setting, which in turn can help lead to positive learning outcomes. Second, programs that were spent mostly or completely outside versus completely or mostly inside also exhibited more positive outcomes.

Certain limitations in the data and analyses are important to consider when interpreting these findings. First, structural equation modeling explicitly aims to produce the most parsimonious model for selected outcomes. As such, the model does not display variables that might explain similar variance in EE21. For example, naturalness and beauty covaried with time spent inside vs. outside and were dropped from the model. Additionally, the small amount of variance explained by the aspects of the natural setting (10%) suggests that while it is a component of successful programs in achieving positive learning outcomes, other program characteristics and pedagogical approaches are also important. As such, our results help to illuminate the influence of only one part of environmental education programming.

Despite the limitations, the results suggest that outcomes are influenced by attributes of the setting and the utilization of the setting and that these variables influence and interact with each other. For example, highlighting the unique attributes of place in a program, and immersing students into the environment both enhance the novelty of the setting for the students, which relates to improved outcomes. This supports research that has suggested that novelty can be one of the most salient parts of an outdoor experience for youth and enhance positive outcomes (Garst, Scheider, & Baker, 2001), while also running contrary to the idea that high levels of novelty can inhibit field trip experiences (Berlyne, 1950; Falk, Martin, & Balling, 1978; Orion, 1989). This may be explained by the difference in outcomes measured, where previous research has focused on learning and mastery of concepts while the EE21 scale measured a broader range of outcomes beyond learning specifically. However, novelty of the setting has been shown in this study to have a relationship with learning and supports the idea that novelty contributes to

the formation of new ideas and new attitudes (Mezirow, 1997; Woods & Moscardo, 2003).

Spending a majority of the field trip experience outside was also correlated with positive learning outcomes. This supports findings from previous research that suggests that natural environments can enhance numerous outcomes associated with EE21 including interest, attitudes, emotions, and learning (Kahn & Kellert, 2002; Kaplan & Kaplan, 1989; Kaplan, Kaplan, & Ryan, 1998; Kellert, 2005; Stern et al., 2014). However, the results also highlight that simply sticking kids outside will not necessarily produce transformative outcomes. Instead, results reinforce the importance of complementing outdoor and novel experiences with good programming, implementation, and effective pedagogical approaches (Duerden & Witt, 2012; Durlak & DuPre, 2008; Morgan, Sibthorp, & Browne, 2016). With this knowledge, we urge practitioners to highlight the unique attributes of place and spend most of a field trip outside and immersed in the natural environment.

Future research could enhance and clarify the findings of this study in 3 ways. First, the influence of natural setting could be measured against each outcome associated with the scale EE21. This approach could identify how the setting relates to each outcome, in particular place attachment, environmental attitudes, and environmental stewardship. Secondly, the suggestion that the novelty of the setting influences positive learning outcomes warrants further and more in- depth study. In future research, novelty could be approached more holistically beyond the setting. Finally, beauty as a construct could expanded to include the built environment, our observations suggest that beauty

associated with nature can take many forms and does not exist solely in outdoor or fully natural settings.

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REFLECTION

The purpose of this study was to explore the influence of the natural setting on positive learning outcomes for environmental education (EE) for students grade 5-8. Ongoing human-nature disconnection threatens both the health of individuals and the health of the natural environment. The need for effective and lasting EE warrants a serious look at how the attributes of the setting and its uses can contribute to a host of positive learning outcomes that can connect children with nature. Limited research has been done to isolate specific attributes and the utilization of the setting across so many programs nationwide. I urge other researchers to continue to evaluate the relationship between the natural setting and positive learning outcomes as the natural setting can be representative of the environment at large and can hopefully inspire life-long connections for children to nature.

I believe that the findings of this study can contribute to and influence effective programming in EE. First, the biggest finding seemed to be the power and salience of novel settings through the utilization of place-based learning techniques and immersion into the environment. One of the challenges in observation was to try to keep separate the novelty of the setting and the apparent novelty of the experience, but in reflection, the utilization of novel settings seemed to consistently align with novel experiences. Through my own observations in the field, students were consistently more engaged and excited when they were having novel experiences. However, the relationship between novel experiences and effective learning that moved a program beyond just a fun field trip to a potentially lasting learning experience regularly seemed to rely on goo programming and the ability of educators to manage and channel the excitement of students.

Second, the added benefit of simply being outside, though not necessarily surprising in the context of EE, should help those designing and executing programs. Though much research discusses the disconnection between today's child and nature, my empirical observations showed me that children reacted positively to being outside and engaging with nature. Though some settings seemed to lead to better reaction from students, they all generally led to heightened energy levels, attitudes, and interest in the environment. Once again however, good programs also had good programmatic planning and capable educators who used the benefits that being outdoors generated for the students, channeling them beyond just having fun.

Finally, the most profound finding of the study for me personally, though it shouldn't have been surprising considering the background research of much of this study, was that simply being outside in nature generally seemed to be a novel experience for most students. The interactions of a few isolated classes with the setting demonstrated extensive previous outdoor experiences, but far and away, a majority of the students observed did not seem to be familiar with or previously connected with nature. In my opinion, this conclusion warrants continued research into the relationship of the natural setting and effectiveness of EE programming. It is important to clarify that this final conclusion stems solely from my own empirical observations, and is not, nor could it be supported through the data of this research.

In addition to the potential contributions of this study to the field is the definite contributions of this study to me professionally and personally. I was challenged academically beyond anything I had experienced to date in my schooling. The research process taught me the value of patience and trust. The team dynamic between my advisor

and fellow researchers motivated and inspired me to produce the best product possible. Further, the extensive field research experience challenged me personally beyond what I anticipated and led to much personal growth.

As I reflect on my experience at Clemson University, I feel proud of what I, and the team I have been a part of, have accomplished. I believe the findings of the research project at large can have a large positive impact on EE, which I believe is essential for the issues of modern society. The courses I took regularly challenged me academically, but more importantly, as a person. I found myself daily questioning the state of my knowledge and my perspectives, reflecting on why I believed what I believe.

As I think about my future, the growth I have experienced, and the knowledge I have gained, I feel increasingly confident in my ability to face new challenges. At the same time, the humility I have experienced will help me to approach challenges from a humble and more open-minded perspective.

APPENDIX

CLEMSON UNIVERSITY

VirginiaTech

STUDENT SURVEY

This survey asks questions about today's field trip. Your answers will help to us to improve future field trips. This is not a test. There are no right or wrong answers. Answer with your honest opinions. Your participation is voluntary. Thanks for your time!

1. **Your school's name**_____ **Your grade level** _____

2. **How would you rate this field trip on a scale from 0 to 10?** ***Circle a number.***

Terrible										Excellent
0	1	2	3	4	5	6	7	8	9	10

3. **As a result of this field trip, do you intend to do anything differently in your life?**

Circle one: **Yes** **No**

If yes, what will you do? ***Write your answer in the space below.***

4. **In the left-hand column, circle the number that matches how much you agreed with each statement before attending this field trip. In the right-hand column, circle the number that matches how much you agree with each statement now.**

	BEFORE this experience											AFTER this experience										
	Not at all				Somewhat agreed					Strongly agreed		Not at all				Somewhat agree					Strongly agree	
I believe in myself.	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
I feel it is important to take good care of the environment.	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
Humans are a part of nature, not separate from it.	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
I have the power to protect the environment.	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
I feel confident that I can achieve my goals.	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10
I can make a difference in my community.	0	1	2	3	4	5	6	7	8	9	10	0	1	2	3	4	5	6	7	8	9	10

Turn over to continue . . .

5. **How much do you feel you learned from this field trip, on a scale from 0 to 10?** ***Circle a number.***

Nothing at all										A huge amount
0	1	2	3	4	5	6	7	8	9	10

6. **How much did you learn about each of the following things as a result of this field trip?** ***Circle a number for each.***

How much did you learn about . . .	Nothing at all →					A fair amount →				A huge amount
How different parts of the environment interact with each other.	0	1	2	3	4	5	6	7	8	9	10
How people can change the environment.	0	1	2	3	4	5	6	7	8	9	10
How changes in the environment can impact my life.	0	1	2	3	4	5	6	7	8	9	10
How my actions affect the environment.	0	1	2	3	4	5	6	7	8	9	10

7. **Did this field trip make you feel any <u>more interested</u> in any of the following things?** ***Circle a number for each.***

	Not at all →					More interested →				Much more interested
Science.	0	1	2	3	4	5	6	7	8	9	10
How to research things I am curious about.	0	1	2	3	4	5	6	7	8	9	10
Learning about new subjects in school.	0	1	2	3	4	5	6	7	8	9	10
Learning more about nature.	0	1	2	3	4	5	6	7	8	9	10

8. **How much did this field trip help you <u>improve</u> any of these skills?** ***Circle a number for each statement.***

	Not at all →					A fair amount →				A huge amount
Solving problems	0	1	2	3	4	5	6	7	8	9	10
Using science to answer a question	0	1	2	3	4	5	6	7	8	9	10
Listening to other people's points of view	0	1	2	3	4	5	6	7	8	9	10
Knowing how to do research	0	1	2	3	4	5	6	7	8	9	10

9. **Did this field trip do any of the following things for you?** ***Circle a number for each row.***

The field trip . . .	Not at all →					A fair amount →				A huge amount
Taught me something <u>that will be useful to me</u> in my	0	1	2	3	4	5	6	7	8	9	10
Made me curious about something.	0	1	2	3	4	5	6	7	8	9	10
Really made me think.	0	1	2	3	4	5	6	7	8	9	10
Made me realize something I never imagined before.	0	1	2	3	4	5	6	7	8	9	10
Made me think differently about the choices I make in	0	1	2	3	4	5	6	7	8	9	10

Continue on the next page . . .

10. Did this field trip make you any more likely to do any of the following things within the next year?

	No more likely				Somewhat more likely						Way more likely
Help to protect the environment.	0	1	2	3	4	5	6	7	8	9	10
Spend more time outside.	0	1	2	3	4	5	6	7	8	9	10
Make a positive difference in my community.	0	1	2	3	4	5	6	7	8	9	10
Listen more to other people's points of view.	0	1	2	3	4	5	6	7	8	9	10
Talk with others about ways to protect the environment.	0	1	2	3	4	5	6	7	8	9	10
Cooperate more with my classmates.	0	1	2	3	4	5	6	7	8	9	10
Work harder in school.	0	1	2	3	4	5	6	7	8	9	10
Pay more attention in class.	0	1	2	3	4	5	6	7	8	9	10

11. How much do you agree with each of the following statements about this field trip? *Circle a number for each.*

During the program I felt . . .	Not at all				Some						Totally
Left out.	0	1	2	3	4	5	6	7	8	9	10
Free to follow my own interests.	0	1	2	3	4	5	6	7	8	9	10
Able to understand the lesson.	0	1	2	3	4	5	6	7	8	9	10

12. How much do you agree with the following statements about this field trip's location? *Circle a number for each statement.*

How much do you agree?	Not at all				Somewhat agree						Strongly agree
I want to visit this place again.	0	1	2	3	4	5	6	7	8	9	10
Knowing this place exists makes me feel good.	0	1	2	3	4	5	6	7	8	9	10
I care about this place.	0	1	2	3	4	5	6	7	8	9	10

13. What gender best describes you? *(Directions: circle one)* **Girl** **Boy**

14. Which of the following best describes your racial or ethnic background? *(Check all that apply)*

☐ White, not of Hispanic descent ☐ Hispanic ☐ Mixed (two or more races) ☐ American Indian or Alaskan Native

☐ Black, not of Hispanic descent ☐ Asian ☐ Native Hawaiian or other Pacific Islander ☐ Other_____

Thank you for your participation in this important study! If you have questions or comments contact Robert Powell by phone at 864-656-0787 or by email at rbp@clemson.edu. You may also contact the Clemson University Office of Research Compliance by email at irb@clemson.edu or toll-free at 866-297-3071 if you have questions regarding your rights as a research participant.