Assessing the influence of preparation and follow-up on student outcomes associated with environmental education field trips

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ACADEMIC ABSTRACT

Experiential learning theory stresses the importance of adequate preparation and reflection surrounding concrete experiences. This study explores the relationship between preparation and follow-up, classroom experiences and the outcomes of environmental education (EE) field trips, including environmental literacy, 21st century skills, positive youth development, satisfaction, and self-reported behavior change. Surveys with both students and their school teachers who attended over 300 EE programs reveal that both pre-trip preparation, especially concerning logistics, and post-trip follow up, related to the subject matter of the field trip, were significantly related to more positive student outcomes. The authors recommend both schools and organizations take into consideration how they can work together to create more holistic learning experiences.

GENERAL AUDIENCE ABSTRACT

Environmental and science education in the form of school field trips have the capability of to enhance student learning, increase motivation to do well in school, and develop skills such as thinking critically and collaborating with peers. Learning theory illuminates the importance of in-school preparation and reflection surrounding field trips. We wanted to discover what happens in the classroom before and after these field trips that contribute to creating truly valuable educational experiences. Student and teacher surveys from over 300 field trip programs highlight the importance of preparing students both logistically and with the educational content, as well as following-up after the field trip by reviewing and utilizing newly gained knowledge and skills. We recommend schools and field trip providers, such as parks, zoos and nature centers, collaborate to create more holistic science learning experiences.

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CHAPTER 1 – Introduction

Humans' understanding of natural resources and the environment is central to how we interact with the natural world and perceive its issues. Education about the environment can enhance this understanding. The environmental movement of the 1960's reformed the way we educated about nature and the environment. As concern for human impacts on the environment grew, as did calls for educational institutions to address these issues (Disinger, 2001). In 1977, the Tbilisi Conference, organized by the United Nations Educational, Scientific, and Cultural Organization, was the first intergovernmental conference on environmental education (EE). Governments from around the world collaborated to define the goals and characteristics of environmental education, as well as strategies implement EE. From this, modern environmental education was shaped. The Tbilisi Declaration defined environmental education as a process by which people gain awareness and knowledge of environmental issues, acquire skills to address these issues, and cultivate attitudes and motivations to take action (UNESCO, 1978).

In the years since the Tbilisi Conference, the United States, like many other countries, has taken steps to develop more environmentally literate citizens. Derived from the definition of EE, environmental literacy involves having the awareness, knowledge, attitudes and skills to analyze, reason and communicate interpretations and solutions of environmental problems (Hollweg et al. 2011). As we crossed over into the 21st century, the call for environmental education and environmentally literate citizens intensified. In a 2008 report, the National Council for Science and the Environment stated that for humans to continue thriving on earth and preventing environmental catastrophes, it "requires an educated populace and a diverse and competent workforce prepared for the rapidly changing world of the 21st century" (NCSE, 2008).

Education systems are adapting to prepare students to address 21st century issues regarding society and the environment. Across the country, EE objectives are being incorporated into goals of formal education (NAAEE, 2014). To achieve todays' goals of science and environmental education, collaboration between informal science education institutions—e.g. parks, museums, zoos, aquaria, and nature centers—and formal education institutions has become increasingly important (Hart, 1981). Often schools do not possess the onsite resources to adequately demonstrate science concepts. They thus turn to outside sources, such as informal science education institutions, for resources and guidance (Kisiel, 2013). In 2007, the National Science Board stressed the importance of schools and informal organizations working together to improve science curriculum and teacher development. They stated that along with on-site visits, such as field trips, organizations can provide teacher professional development opportunities, online learning resources and other invaluable supplementary resources (NSB, 2007).

The school field trip is the most common form of direct interaction between schools and informal science education institutions (Kisiel 2013). Investments in these types of programs lead both schools and field trip providers to ask, are we achieving the outcomes we hoped for? Research on the effectiveness of informal science and EE field trips spans decades, and recent reviews of the literature have found that informal EE programs can achieve a range of student outcomes associated with environmental literacy, science literacy, interest in learning, pro-environmental attitudes and behaviors and overall enjoyment (Ardoin et al., 2015; Stern et al., 2014). Therefore, we know science and environmental learning benefit from experiences outside of the classroom with informal learning centers, and we know educational programs at these places can advance the objectives of environmental education set forth almost 40 years ago, but what makes a successful program?

When discerning what makes an EE program successful, it essential to think about how students learn. A constructivist learning paradigm tells us that students, based on their prior understanding, construct knowledge by transforming their experiences (Klein & Merritt, 1994; Fosnot, 2005; Olusegun, 2015). EE field trips are often thought of as opportunities for experiential learning (Behrendt & Franklin, 2014), where on the field trip students are actively engaged in a concrete experience. Experiential learning theory asserts that learning happens when these experiences are transformed, by additional stages of reflection, conceptualization, and experimentation (Kolb, 2015), which often occur in the time surrounding a field trip experience. In other words, student learning associated with EE field trips is influenced by what happens before and after the trip, in addition to the trip itself.

Past studies have examined pre and post field trip experiences, typically labeled as pre-visit preparation and post-visit follow-up, and their relationship with student outcomes. Preparation and follow-up on EE field trips has been shown to enhance the achievement of student outcomes, such as environmental responsibility, interest in learning, character development and leadership (Anderson et al., 2000; Farmer & Wott, 1995; Finson & Enochs, 1987; Gennaro, 1981; Lucas, 2000; Smith-Sebasto & Cavern, 2006; Stern et al., 2008; Storksdieck, 2001). One study in particular found that only when preparation and follow-up were both done properly did students have significantly more positive outcomes (Smith-Sebasto & Cavern, 2006).

Preparation and follow-up on EE field trips are one of many potential program components that affect student outcomes. Overall, assumptions about the program components that lead to better outcomes in EE are often based on circumstantial evidence, and most of the body of research looks at singular programs, making it difficult to generalize any findings to the broader field of EE in the United States (Stern et al., 2014). We have evidence that certain characteristics of EE programs lead to better outcomes for single case studies, but do they hold true across multiple programs and providers? Researchers Dr. Marc Stern and Dr. Robert Powell set out to answer this question and obtained funding from the National Science Foundation to conduct the first national environmental education study of its kind. Teams of researchers traveled the country from January to June 2017, observing single-day EE field trip programs for students 10-14 years old. We collected data in efforts to address the overarching question: what program characteristics lead to better student outcomes? My focus as a member of this team was to illuminate the relationship between pre-visit preparation, post-visit follow-up, and student outcomes.

The following thesis addresses questions regarding informal environmental education programming through original research and reflects on the research process of a novice academic. The remainder of this thesis is organized in the following two chapters: Chapter two is an empirical study of the relationship between pre-visit preparation, post-visit follow-up, and student outcomes on environmental education field trips. It is in the format of a manuscript and will be submitted to the Journal of Environmental Education for publication. The third and final chapter is a reflection of what I learned about environmental education in my master's experience, from theory, observation, and research. It includes suggestions of what I would do differently if we were to repeat the national EE study, and how I plan to apply what I have learned in the future as a EE professional.

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CHAPTER 2 – Manuscript to be submitted to The Journal of Environmental Education for publication

Title: Assessing the influence of preparation and follow-up on student outcomes associated with environmental education field trips

Introduction

Out-of-school field trips with informal environmental education (EE) providers, such as nature centers and parks, can enhance student learning outcomes desired by schools and EE organizations, including the advancement of knowledge, attitudes, skills, and behaviors regarding science and the environment, positive youth development, and academic achievement and motivation (Ardoin et al., 2015; Powell et al., in review; Stern et al., 2014). Field trips provide opportunities for experiential learning (Behrendt & Franklin, 2014), and their success is influenced not only by the experience itself, but also by events in the classroom before and after (Storksdieck, 2006).

The inclusion of pre-visit preparation and post-visit follow-up activities have been associated with higher achievement and longevity of student outcomes (Farmer & Wott, 1995; Smith-Sebasto & Cavern, 2006; Stern et al., 2008; Storksdieck, 2001). However, many teachers report doing little to no preparation or follow-up to field trips (Anderson et al., 2006; Stern et al., 2008; Stern & Frensley, 2017; Storksdieck, 2001), and many organizations report that supplementary materials they provide for these purposes are rarely used (Phillips et al., 2007). Previous studies have looked at the relationship between preparation and/or follow-up for individual programs, but not across multiple programs and providers. This study specifically examines the interactions between pre-visit preparation, post-visit follow-up, and student outcomes across a large sample of informal EE programs for adolescent youth, ages 10-14, in the United States.

The study examines elements of environmental literacy, positive youth development, 21st century skills, and student learning, as self-reported by student participants and their teachers. Environmental literacy refers to students' awareness, knowledge, attitudes, and skills to address environmental issues (Hollweg et al., 2011; Stern et al. 2014). Positive youth development includes students' physical, intellectual, social, and psychological well-being (Eccles & Gootman, 2002). Recent research illuminates the importance of these outcomes in the promotion of student success (Bowers et al., 2010; Lerner et al. 2005; Seligman et al. 2009). Twenty-first century skills include critical thinking, problem solving, collaboration, and communication abilities to solve real-world problems (IMLS 2009). While prior research has demonstrated that EE field trip can achieve these goals, we know of no study yet to examine the role of pre-trip preparation and post-trip follow-up across a large sample of programs.

Literature Review

Theoretical Framework

Storksdieck's (2006) Integrated Experience Model, describes field trips as having three distinct phases: pre-trip (preparation), trip, and post-trip (follow-up). The model illustrates when factors that influence student learning surrounding these experiences can occur. Therefore, when we think of student learning on field trips, we must consider all three phases, and we can conceptualize learning on field trips through Kolb's (2015) Experiential Learning Cycle. Kolb (2015) illustrates the learning process as a process as a cycle with four stages. Learning can begin at any stage, but the hypothesized sequence remains constant: (a) concrete experience, (b) reflective observation, (c) abstract conceptualization, and (d) active experimentation (Figure 1). The experiential learning cycle may occur over long periods of time or in short bursts; therefore, there are several ways experiential learning can occur relevant to a field trip experience.

One way to conceptualize student learning on a field trip, as explained by Healey and Jenkins (2000) and Krakowka (2012), is to think of the trip as the concrete experience. Concrete experiences occur when students are actively engaged in learning activities, such as laboratory or field work. A recent review on field trips asserts that the trips themselves “serve best as opportunities for exploration, discovery, first and original experiences” (Dewitt & Storksdieck, 2008, p. 181). Reflective observation typically occurs after the field trip, when students reflect on their experience and consider inconsistencies within their understanding. In the abstract conceptualization stage, students modify prior concepts, incorporating new knowledge and formulating a new way of understanding. This readies the student to plan to test this knowledge, leading into the active experimentation phase. During active experimentation, students apply constructed knowledge to a new situation. This phase involves organizing knowledge transformed from prior experiences, such as classroom lessons, and planning to use it in an upcoming experience— in some case, on a field trip (Healey & Jenkins, 2000; Krakowka, 2012).

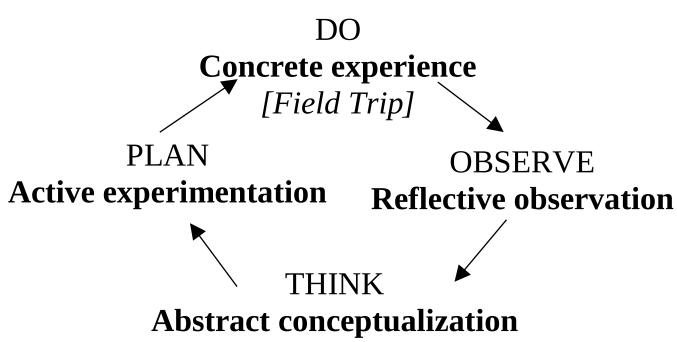

Figure 1. Student learning surrounding a field trip experience, conceptualized through Kolb’s Experiential Learning Cycle (Kolb, 2015), adapted from Healey and Jenkins (2000) and Krakowka (2012).

While the on-site components of a field trip could potentially encompass the entire learning cycle (for example, in the case of making observations, developing a research question and hypotheses, collecting data, drawing conclusions, and then testing them in a new location), planning, reflection, and conceptualization may often happen before or after the concrete experience on-site. The planning phase enables students to formulate reasonable expectations, potential questions and hypotheses. This may include a form of active experimentation, in which students begin to build hypotheses based on their prior knowledge to examine during an upcoming field trip (Healey & Jenkins, 2000; Krakowa, 2012). Prior research suggests that logistical preparation may be similarly important in managing student expectations prior to a field trip (e.g. Orion, 1994; Wong & Wong, 2018). Oftentimes, field trips may involve only a portion of the learning cycle, such as data collection in a stream. Post-trip reflection may involve analysis and interpretation of the meaning of the data in relationship to watershed activities, drawing out abstract conceptualizations of the system-wide relationships between people and their environment. They might then to test this new knowledge by designing their own stream-related research or taking another field trip (active experimentation).

Pre and Post-visit Activities

Prior literature demonstrates the relevance of pre-visit preparation and post-visit follow-up for enhancing student outcomes on EE and other science-based field trips (Anderson et al., 2000; Farmer & Wott, 1995; Finson & Enochs, 1987; Gennaro, 1981; Lucas, 2000; Smith-Sebasto & Cavern, 2006; Stern et al., 2008; Stern & Frensley, 2017; Storksdieck, 2001). For example, Stern and colleagues (2008) found that greater pre-visit preparation was associated with higher environmental awareness measures in students and increased interest in learning and discovery following a residential EE program. A multi-year evaluation of another residential EE program also found a relationship between more pre-visit preparation and better student outcomes, including measures of character development and leadership, environmental responsibility, and attitudes towards school (Stern & Frensley, 2017). In the same study, students who extensively used an organization’s online resources in preparation for a multi-day field trip experience achieved more positive outcomes than students who did not prepare in this way (Stern & Frensley, 2017).

Students completing follow-up activities facilitated by field trip educators, including content review and interactive lessons, after a field trip at a public garden demonstrated more positive outcomes than those who did not (Farmer & Wott, 1995). Storksdieck (2001) also found a significant difference between post-experience environmental attitudes between students who reported follow-up activities and those who did not after a museum field trip, and concluded that informal education institutions should supply and promote resources for teachers to be used in the classroom. Another study, however, found that only when both pre-experience preparation and post-experience follow-up were included did students exhibit significant increases in positive attitudes toward the environment (Smith-Sebasto & Cavern, 2006). Other studies also suggest that on-line or paper materials can facilitate curriculum integration by providing relevant preparation and follow-up activities (Anderson et al., 2006; Anderson & Zhang, 2003; Dewitt & Storksdieck, 2008).

Taken together, the results from these and other studies (see Stern et al., 2014) highlight pre-visit preparation and post-visit follow-up activities as potentially important drivers of program success in terms of overall achievement of student outcomes and lasting influences. Existing literature, however, has only investigated preparation and follow-up among single organizations. This study analyzes the effect of preparation and follow-up on student outcomes across diverse organizations and program types.

Methods

Sampling/Site Selection

We sought a diverse sample of single-day EE-focused school field trips for grades 5-8 across the United States for the study. To ensure a basic diversity in the types of programs included, we relied on Ruggiero's (2016) evaluation of Environmental Literacy Plans (ELPs) in the US, which ranked states in terms of the status and quality of their statewide ELPs to serve as a proxy for the general status of environmental education in each state. ELPs are "state-specific comprehensive frameworks that support school systems in expanding and improving environmental education programs" (NAAEE, 2014, p. 4) and thus represent a measure of the formal degree of support for EE in each state. We divided this ranking into four quartiles and systematically sought to sample at least 10 program providers from states in each quartile to ensure diverse contexts of the programs we observed (Table 1). We worked with partners in the North American Association of Environmental Education (NAAEE), the National Park Service (NPS), and the Association of Nature Center Administrators (ANCA) to reach out to member organizations and sites to identify qualifying programs – those that offered single-day EE-focused school field trips for grades 5-8 during our field season (January – June 2017).

Table 1. *States ranked based of Ruggiero's (2016) criteria for Environmental Literacy Plan (ELPs) development and implementation status. State list was divided into quartiles, and we sought providers from each quartile to achieve a diverse sample.*

		1st teacher survey (s1)		**2nd teacher survey (s2)**	
Groupings	State	# providers (by state)	# providers (by quartile)	# providers (by state)	# providers (by quartile)
Above 0.6, most up to date with formal EE requirements	Oregon	4	17	2	10
	District of Columbia	1		0	
	Kansas	0		0	
	Illinois	2		2	
	Colorado	2		1	
	Washington	6		4	
	Tennessee	0		0	
	Connecticut	1		1	
	Kentucky	0		0	
	Hawaii	0		0	
	North Carolina	0		0	
	New Hampshire	1		0	
	Rhode Island	0		0	
0.4125-0.6, high levels of progress on	Wisconsin	2	36	2	18
	Alaska	0		0	
	Alabama	0		0	

ELPs, room to develop.	Pennsylvania	1		1	
	Ohio	3		1	
	Nevada	0		0	
	New Mexico	0		0	
	Florida	13		7	
	Iowa	0		0	
	Maine	3		1	
	California	14		6	
	Louisiana	0		0	
0.1-0.4, low to minimal progress on formal EE requirements.	Texas	7	20	2	11
	Nebraska	1		1	
	New York	2		2	
	Missouri	0		0	
	South Dakota	0		0	
	Idaho	0		0	
	Michigan	2		2	
	Vermont	0		0	
	New Jersey	1		0	
	Virginia	3		2	
	Oklahoma	0		0	
	Indiana	2		1	
	Maryland	2		1	
0-0.05, minimal to no ELPs or formal EE plan progress.	Arkansas	0	14	0	9
	Delaware	0		0	
	Georgia	2		2	
	Massachusetts	4		3	
	Minnesota	1		0	
	Mississippi	0		0	
	South Carolina	0		0	
	Utah	0		0	
	West Virginia	0		0	
	Wyoming	0		0	
	Arizona	7		4	
	Montana	0		0	
	North Dakota	0		0	

Within this population, we aimed 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 by conducting internet searches for additional potential program providers not identified in our collaborations with partner organizations. We identified over 300 potential program providers across all four quartiles. Data were collected at 346 field trips provided by 88 different organizations.

Data Collection

Two surveys were administered to teachers who attended the field trips. The first survey was administered to teachers on site. The short paper survey asked questions about the nature of teachers' preparation with their students prior to the field trip (Table 2). It also asked for permission and contact information to send a follow-up survey.

In a few cases, more than one teacher filled out on-site surveys for the same group. Only the teacher who reported the highest level of preparation was selected, because it was the most indicative of what the students' experienced. This resulted in 207 teachers reporting data for 287 programs from 87 unique program providers in 24 states and Washington D.C.: 17 providers from the first quartile, 36 from the second quartile, 20 providers from the third quartile, and 14 from the fourth quartile (Table 1).

The online follow-up survey, designed to take 8-10 minutes, was delivered via email two weeks after the teachers' field trip date and collected data on follow-up activities (Table 2). It also included open ended questions to see what teachers thought about the overall field trip. Follow-up survey data were used to address the influence of both preparation and follow-up activities. Seventy-five teachers completed follow-up surveys for 66 programs from 48 unique program providers in 21 states: 10 providers from the first quartile, 18 from the second quartile, 11 from the third quartile, and 9 from the fourth quartile (Table 1). Qualitative data was collected from 40 teachers, who provided open-ended comments at the end of the survey. Because multiple teachers could opine on outcomes for different groups of students attending the same field trip, multiple responses were accepted for single field trips.

Table 2. Teacher survey items. *[s1] denotes items on the first survey and [s2] denotes items on the second survey.*

Pre-visit Preparation [s1]	**To what extent did you do any of the following with your students prior to this field trip?** *(5-point scale, not at all to a great deal).* We discussed logistics (scheduling, what to bring, rules, etc.) We talked about the subject matter the students would be learning about. We did specific lessons/activities related to the lessons on site.
Post-visit Follow-up [s2]	**To what extent did you do any of the following with your students after the field trip?** *(5-point scale, not at all to a great deal).* We reviewed what happened on the field trip, but we didn't review the subject matter in detail. We reviewed the subject matter of the field trip as a class. We did specific lessons/activities related to the field trip content to follow up.
Pre-trip Visit/Outreach [s1]	**Did anyone from the host organization visit your school to interact with your students prior to the field trip?** Yes/no.
Materials Use [s1]	**Did you use any education materials provided by the host organization prior to the field trip?** Yes/no.
Materials Use, and When [s2]	***[Did you receive any educational materials from the organization that provided the field trip? If yes…]*** **Did you use the materials? Please check all that apply.** Yes, before the field trip. Yes, after the field trip. No, not at all.
Teacher Perceptions of Student Outcomes [s2]	**To what extent did you feel the overall experience, including the field trip and any pre-trip preparation and post-trip reflections, positively influence the following for your students?** 5-point scale, not at all to a great deal. 13 items relevant to student learning outcomes (see Table 3).

All participating students were given a survey on-site at the conclusion of their field trip, which was designed to measure the achievement of student learning outcomes. Collectively, 3,807 students completed these surveys, with an average completion time for the student survey was approximately 8 minutes. Student outcome measures were developed over a two-year participatory process, which included a literature review, iterative stakeholder input, pilot studies, and confirmatory factor analyses (Powell, Stern, Frensley, & Moore, 2019). This process resulted in 10 crosscutting outcomes (Table 3), as well as single items to measure satisfaction and behavior change. A single index, called "EE21," short for "environmental education outcomes for the 21st Century," represents the mean of the ten subscales defined in Table 3, equally weighted.

Satisfaction was measured with a single question, "How would you rate this field trip, on a scale of 0 to 10?" with the anchors "terrible" and "excellent" at 0 and 10, respectively. Mean scores were scaled to the group level for analyses. ICC (1) and ICC (2) values ranged from 0.21-0.24 and 0.78-0.80, respectively, justifying the aggregation of individual outcomes variables to the group level (Woehr et al. 2015).

Behavioral change was measured using an open-ended question, "As a result of this field trip, do you intend to do anything differently in your life? (yes/no). If yes, what will you do? (write in response)." Answers were screened for intentions relevant to the programming, and nonsensical or unrelated outcomes (e.g., I will play Fortnite) were removed. Individual responses were scaled to the group level, such that each program was scored as the proportion of students reporting a relevant positive behavioral change (e.g., "I will recycle more;" "I want to become a scientist."). Additional cleaning of individual survey data removed surveys with no variability, clear nonsensical patterns, and those missing more than 25% of the data.

Table 3. *Environmental education outcomes for the 21st century (EE21)—Mean scores for student-reported outcomes included in the EE21 index. All items were measured on a scale of 0-10. Self-efficacy and environmental attitudes were measured as a change score, and the means reflect the difference between how students viewed these outcomes before and after the program.*

Outcome	Definition	Items	Mean	SD
Place connection	Appreciation and the development of personal relationships with the physical location and its story.	*How much do you agree with the following statements? (anchors: not at all, some, totally)*		
		· Knowing this place exists makes me feel good.	7.53	1.30
		· I want to visit this place again.	7.59	1.58
		· I care about this place.	7.94	1.34
Learning	Knowledge regarding the interconnectedness and interdependence between human and	*How much did you learn about each of the following things as a result of . . .? (anchors: nothing at all, a fair amount, a huge amount)*		
		· How different parts of the environment interact with each other.	7.09	1.13
		· How people can change the environment.	7.46	1.19

	environmental systems.	· How changes in the environment can impact my life.	7.50	1.17
		· How my actions affect the environment.	7.87	1.16
Interest in Learning	Enhanced curiosity, increased interest in learning about science, the environment.	*Did this . . . make you feel any more interested in any of the following things? (anchors: not at all, more interested much more interested)*		
		· Science.	6.41	1.49
		· How to research things I am curious about.	6.49	1.47
		· Learning about new subjects in school.	6.22	1.54
21st Century Skills	Critical thinking and problem solving; communication; and collaboration.	*How much did this . . . help you improve any of these skills? (anchors: not at all, a fair amount, a huge amount)*		
		· Solving problems.	5.62	1.61
		· Using science to answer a question.	6.45	1.45
		· Listening to other people's points of view.	6.65	1.51
		· Knowing how to do research.	6.39	1.62
Meaning/Identity	A heightened sense of self-awareness, critical reflection, and purpose.	*Did this . . . do any of the following things for you? (anchors: not at all, a fair amount, a huge amount)*		
		· Taught me something **that will be useful to me** in my future.	6.75	1.41
		· Really made me think.	6.89	1.40
		· Made me realize something I never imagined before.	6.50	1.56
		· Made me think differently about the choices I make in my life.	6.64	1.57
		· Made me curious about something.	6.84	1.34
Self-Efficacy	Belief in one's own ability to achieve one's goals and influence their environment.	*Retrospective pre/post items (anchors: not at all, somewhat agree(d), strongly agree(d):*		
		· I believe in myself	0.84	0.71
		· I feel confident I can achieve my goals	0.79	0.60
		· I can make a difference in my community.	1.13	0.67
Environmental Attitudes	Sensitivity, concern, and positive dispositions towards the environment.	*Difference between retrospective post-experience and pre-experience scores (anchors: not at all, somewhat agree(d), strongly agree(d):*		
		· I feel it is important to take good care of the environment	0.79	0.47
		· Humans are a part of nature, not separate from it.	1.03	0.65
		· I have the power to protect the environment.	1.15	0.70
Environmental Stewardship	Motivations to perform stewardship-related behaviors.	*Did this . . . make you any more likely to do any of the following things within the next year? (anchors: no more likely, somewhat more likely, way more likely)*		
		· Help to protect the environment.	7.60	1.28
		· Spend more time outside.	7.33	1.24
		· Make a positive difference in my community.	7.22	1.26
Collaboration	Motivation to collaborate more with others.	*Did this . . . make you any more likely to do any of the following things within the next year? (anchors: no more likely, somewhat more likely, way more likely)*		
		· Listen more to other people's points of view.	6.89	1.39
		· Cooperate more with my classmates.	6.93	1.31

School motivations	Motivation to work harder in school.	*Did this . . . make you any <u>more likely</u> to do any of the following things within the next year? (anchors: no more likely, somewhat more likely, way more likely)*		
		· Work harder in school.	7.19	1.45
		· Pay more attention in class.	7.11	1.51

Analysis

All data was input and analyzed in the IBM SPSS Statistics software, version 25. Visiting school groups were divided into those whose lead teachers responded that they prepared (or followed-up) "a moderate amount" to "a great deal" and those who reported doing so "not at all" to "somewhat." This cut point was chosen based on qualitative conversations with teachers throughout the research and examining effect sizes of different cut points in teacher-reported preparation and follow-up. Both indicated the most meaningful differences between scores of 3 (somewhat) and 4 (moderate) on the surveys. Independent samples t-tests were performed to compare outcomes scores for each group.

Preparation and Student Outcomes

Five types of preparation were measured: logistical, subject matter-related, program-provided materials use, a visit by field trip staff to the school, and specific lessons/activities. Student outcome scores included satisfaction, behavior change, and EE21. Satisfaction and EE21 scores reflect the mean scores for each group; behavior change reflects the proportion of each group reported a positive behavioral change resulting from the program.

Independent samples t-tests compared mean student outcome scores for groups who received different levels of preparation. Independent samples t-tests were also used to compare mean student outcomes scores between groups who used materials shared by the program providers and groups who did not, as well as groups who received a pre-trip visit from the host organization and groups who did not.

Preparation, Follow-up and Teacher Perceptions of Student Outcomes

The second set of analyses examined the relationship between teachers' perceptions of student outcomes and pre-visit preparation and post-visit follow-up. Survey measures were developed to roughly mirror EE21 measures. Principal component analysis with varimax rotation was conducted on survey items reflecting teachers' perceptions of student outcomes to reduce the data. The PCA resulted in two internally consistent factors (Table 3). The first factor, consisting of eight items, was termed as "21st century skills" (Cronbach's alpha = 0. 936). We labeled the second factor, made up of three items, as "environmental literacy" (Cronbach's alpha = 0.910). An index was created for each factor by calculating the overall mean of each of the component items. The items comprising each index are in bold text in Table 4. Two additional survey items, reflecting student learning inside and outside teachers' curriculum goals, did not compose a reliable factor (Cronbach's alpha = -0.480), and were thus retained as separate outcomes measures (Table 4).

Table 4. *Teacher perceptions of student outcomes: factor loading results from principal component analysis with varimax rotation and Kaiser normalization, reducing data from 13 to four dependent variables to be used in the analysis.*

Teacher Perceived Outcomes		Component		
		1	2	3
21st Century Skills	Students' motivation to do well in school.	**0.843**	0.211	0.109
	Students' ability to work together collaboratively.	**0.843**	0.066	-0.219
	Your classroom environment.	**0.832**	0.155	0.068
	Students' relationships with each other.	**0.825**	0.227	-0.145
	Students' motivation to learn new things.	**0.812**	0.188	0.065
	Students' problem-solving skills.	**0.774**	0.239	-0.008
	Students' actual academic performance.	**0.773**	0.339	0.105
	Students' critical thinking skills.	**0.689**	0.394	0.103
Environmental Literacy	Students' knowledge about the environment.	0.145	**0.938**	0.006
	Students' awareness of environmental issues.	0.215	**0.895**	0.034
	Students' level of concern about the environment.	0.357	**0.832**	0.123
Out-curriculum learning	Student learning outside of your curriculum goals.	0.306	0.169	0.769
In-curriculum learning	Student learning relevant to your curriculum goals.	0.424	0.05	-0.608

Independent samples t-tests were conducted to compare teachers' perceptions of student outcomes for groups receiving different degrees of preparation and follow-up, as described above.

Levene's test was applied to test the assumption of equal variances for each t-test, and Cohen's d effect sizes are reported for cases in which statistically significant differences in means were observed ($p < 0.05$). Cohen's *d* scores of 0.2 are considered small (yet still meaningful), 0.5 medium or moderate, and 0.8 large (Cohen 1988).

Results

Preparation and Student Outcomes

Our sample resulted in slightly more 6^{th}-8^{th} grade teachers than 5^{th} grade, and the majority of teachers reporting preparation data specifically teach science as at least one of their subjects (Table 5). Demographic information from attending students' schools reflect a variety of school types, including a majority of public schools, but also private and religious schools (Table 6) Most schools' student body was majority white, and nearly half of the student groups came from suburban schools (Table 6). Table 7 outlines the descriptive statistics of the student-reported outcomes used in this analysis—EE21, satisfaction, and behavior. Means and standard deviations for individuals subfactors that make up the EE21 index can be found in Table 3, in the methods section.

Table 5. *Grade level and subject taught by teachers who reported preparation for students used in the first analysis, examining the relationship between pre-visit preparation and student-reported outcomes.*

Grade Level	Subject Taught	# of Teachers	Total/Grade Level	Total
Grade 5	Comprehensive	66	114	287
	Science	33		

	Not Science	15	
	Multiple subjects, includes Science	46	
	Multiple subjects, does not include Science	8	
Grades 6-8	Science	107	173
	Math	6	
	English/Language Arts	6	

Table 6. *The number of student groups who came from schools with specific demographics outlined by racial majority, urbanity, and school type in the first analysis*

	Frequency	Percentage
RACE		
Majority White	111	38.7
Majority Black	18	6.3
Majority Hispanic	82	28.6
No Majority	33	11.5
Missing Data	43	14.9
Total	287	100
URBANITY		
Urban	57	19.9
Suburban	136	47.4
Rural	49	17.1
Uncertain	18	6.3
Missing Data	27	9.3
Total	287	100
SCHOOL TYPE		
Public	220	76.7
Private-Not Religious	19	6.6
Private-Religious	20	6.9
Missing Data	28	9.8
Total	287	100

Table 7. *Means and standard deviations for student-reported outcomes.*

	N	Min.	Max.	Mean	SD
EE21	287	1.88	7.77	5.81	1.01
Satisfaction	287	4	10	7.61	1.14
Behavior	287	0	1	0.48	0.23

Independent samples t-tests revealed that all three student outcomes were more positive for groups that received moderate to high logistical preparation (Table 8). The strongest effect size was for the EE21 outcome. Satisfaction and behavioral outcomes exhibited smaller effect sizes. Satisfaction and EE21 scores were also more positive for groups receiving moderate to high levels of subject matter preparation and preparatory lessons, though effect sizes were small. No statistically significant differences were observed for groups that used materials supplied by program providers or those that received a pre-field trip visit.

Table 8. *Results of independent-samples t-test comparing student outcome means between groups receiving different amounts of pre-visit preparation.*

		EE21			Satisfaction			Behavior		
		Mean (SD)	t (df)	Cohen's d	Mean (SD)	t (df)	Cohen's d	Mean (SD)	t (df)	Cohen's d
Prep. Logistics	Yes	5.92 (0.92)	3.91*** (50.12)	0.72	7.68 (1.12)	2.47* (285)	0.39	0.49 (0.23)	2.23* (285)	0.35
	No	5.14 (1.36)			7.22 (1.22)			0.41 (0.23)		
Prep. Subject	Yes	5.91 (0.98)	2.73** (285)	0.34	7.72 (1.15)	2.48* (285)	0.32	0.49 (0.23)	1.06 (285)	--
	No	5.56 (1.06)			7.36 (1.09)			0.46 (0.22)		
Prep. Lessons	Yes	5.97 (0.89)	2.97** (242.72)	0.35	7.78 (1.09)	2.60* (283)	0.31	0.48 (0.24)	0.31 (283)	--
	No	5.61 (1.13)			7.43 (1.17)			0.47 (0.22)		
Use of Pre-Visit Materials	Yes	5.87 (1.00)	0.61 (282)	--	7.77 (1.14)	1.48 (282)	--	0.50 (0.23)	0.78 (282)	--
	No	5.79 (1.02)			7.55 (1.14)			0.47 (0.23)		
Pre-trip Visit	Yes	5.79 (1.00)	-0.25 (283)	--	7.56 (1.03)	-0.46 (283)	--	0.49 (0.24)	0.2 (283)	--
	No	5.82 (1.01)			7.60 (1.17)			0.48 (0.23)		

* p<0.05, ** p<0.01, ***p<0.001

Preparation, Follow-up and Teacher Perceptions of Student Outcomes

Data used in this analysis came from subset of teachers from the previous sample. Again, most were 6th-8th grade teachers and a majority of the teachers taught science at least part of the time (Table 9). School demographics also reflect similar trends, with students coming from mostly suburban schools, and most schools being majority white (Table 10). Public schools made up over half of the sample, but private and religious schools are also included. Table 11 shows the means scores for teacher-reported student outcomes.

Table 9. *Grade level and subject taught by teachers who reported preparation and follow-up for students used in the second analysis, examining the relationship between pre-visit preparation, post-visit follow-up and teacher-reported outcomes.*

Grade Level	Subject Taught	# of Teachers	Total/Grade Level	Total
Primary (Grade 5)	Comprehensive	19	29	75
	Science	7		
	Not Science	7		
Secondary (Grades 6-8)	Multiple subjects, includes Science	9	46	
	Multiple subjects, does not include Science	4		
	Science	21		
	Math	5		
	English/Language Arts	3		

Table 10. *The number of student groups who came from schools with specific demographics outlined by racial majority, urbanity, and school type in the second analysis*

	Frequency	Percentage
RACE		
Majority White	34	45.3
Majority Black	2	2.7
Majority Hispanic	17	22.7
No Majority	7	9.3
Missing Data	15	20
Total	75	100
URBANITY		
Urban	18	24
Suburban	29	38.7
Rural	9	12
Uncertain	10	13.3
Missing Data	9	12
Total	75	100
SCHOOL TYPE		
Public	50	66.7
Private-Not Religious	5	6.7
Private-Religious	8	10.6
Missing Data	12	16

Total	75	100

Table 11. *Means and standard deviations for teacher-reported outcomes.*

	N	Min.	Max.	Mean	SD
Environmental Literacy	73	2	5	4.05	0.80
21st Century Skills	73	1.5	5	3.63	0.93
In-curriculum Learning	73	1	5	4.23	0.92
Out-curriculum Learning	73	1	5	4.08	0.89

Only two of the teacher-reported student outcomes exhibited statistically significant differences for certain types of preparation and follow-up (Table 12). Teachers' perceptions of 21st century skills outcomes were more positive for groups with moderate to high amounts of subject matter and lesson preparation, each with moderate effect sizes. They were also higher for teachers reporting moderate to high levels of lesson-related follow-up activities. Teachers' perceptions of curriculum-relevant learning were more positive for groups with moderate to high degrees of logistical, subject matter, and lesson preparation, with moderate to large effect sizes. They were also higher for those reporting higher degrees of subject matter and lesson-related follow-up.

Table 12. *Results of independent-samples t-test for pre-visit preparation, post-visit follow-up and teacher perceptions of student outcomes.*

		Environmental Literacy			21st Century Skills			In-Curriculum Learning			Out-Curriculum Learning		
		Mean (SD)	t (df)	Cohen's d	Mean (SD)	t (df)	Cohen's d	Mean (SD)	t (df)	Cohen's d	Mean (SD)	t (df)	Cohen's d
Prep. Logistics	Yes	4.07 (0.81)	0.36 (70)	--	3.66 (0.95)	0.89 (70)	--	4.36 (0.90)	3.19** (70)	1.14	4.15 (0.89)	1.44 (70)	--
	No	3.97 (0.81)			3.39 (0.77)			3.45 (0.69)			3.73 (0.90)		
Prep. Subject	Yes	4.13 (0.78)	1.04 (70)	--	3.84 (0.73)	2.38* (44.94)	0.59	4.53 (0.59)	3.42** (38.56)	0.86	4.05 (0.93)	-0.42 (70)	--
	No	3.93 (0.84)			3.29 (1.09)			3.76 (1.12)			4.14 (0.88)		
Prep. Lessons	Yes	4.13 (0.80)	0.94 (69)	--	3.92 (0.76)	2.69** (69)	0.65	4.48 (0.68)	2.25* (69)	0.55	4.23 (0.62)	0.89 (69)	--
	No	3.96 (0.81)			3.35 (0.97)			4.00 (1.04)			4.05 (0.96)		

Use of Pre and/or Post-Visit Materials	Yes	4.21 (0.83)	1.02 (71)	--	3.95 (0.92)	1.77 (71)	--	4.42 (0.77)	1.04 (71)	--	4.16 (0.96)	0.43 (71)	--
	No	3.99 (0.79)			3.50 (0.91)			4.17 (0.97)			4.05 (0.88)		
Pre-trip Visit	Yes	4.14 (0.71)	0.48 (71)	--	3.71 (0.62)	0.51 (31.18)	--	4.07 (0.73)	-0.73 (71)	--	4.14 (0.77)	0.28 (71)	--
	No	4.02 (0.82)			3.61 (0.99)			4.27 (0.96)			4.07 (0.93)		
Follow-up, What Happ.	Yes	4.07 (0.71)	0.37 (69)	--	3.74 (0.85)	1.04 (69)	--	4.43 (0.69)	1.62 (69)	--	4.18 (0.86)	0.93 (69)	--
	No	4.00 (0.86)			3.51 (0.96)			4.07 (1.03)			3.98 (0.91)		
Follow-up Subject	Yes	4.03 (0.76)	0.20 (67)	--	3.75 (0.87)	1.62 (67)	--	4.49 (0.96)	2.53* (48.16)	0.62	4.14 (0.77)	0.80 (67)	--
	No	3.99 (0.85)			3.40 (0.94)			3.94 (1.13)			3.97 (1.00)		
Follow-up Lessons	Yes	4.01 (0.84)	-0.14 (69)	--	3.94 (0.83)	2.17* (69)	0.56	4.58 (0.58)	2.33* (69)	0.63	4.17 (0.92)	0.55 (69)	--
	No	4.04 (0.79)			3.45 (0.93)			4.06 (1.01)			4.04 (0.88)		

* $p<0.05$, ** $p<0.01$, *** $p<0.001$

Program Observations and Open-ended Responses

Teacher responses for the open-ended questions on the follow-up survey were qualitatively coded. Our qualitative findings are also based on observations and ongoing conversations with visiting teachers during the trip. Comments from 40 teachers, as well as conversations with teachers on site, reflected three significant themes relevant to successful field trips: the importance of preparation, curriculum integration, and collaboration with the host organization. These themes were evident for a number of programs. We share the details of one particular program that illustrates these common themes. Not all programs contained similar elements. However, teachers regularly cited similar themes as important to their students' experiences, with some lamenting the lack of such support for better integration in their classrooms.

In our example program, accompanying teachers were given an electronic teacher guide prior to the field trip, which provided background information on the organization and field trip site, explained what should happen before, during, and after the field trip, and provided resources for teachers that accompany students on the program. Resources included videos designed to introduce students to scientific equipment that will be used on the field trip and exercises for practice, as well as lesson plans for activities to familiarize students with the program content. Detailed logistical information was shared with teachers and groups including maps, what to bring, itineraries, and rules. Prior to the field trip, teachers attended a workshop, and an educator from the site visited the classroom to prepare students for the instruments they would be using on-site and the habitats they would be visiting. On the trip, it was clear students and teachers were well prepared. Everyone was dressed and ready to wade into the swamp, students were comfortable using all instruments in the backpacks provided, and groups were careful not to disturb the habitat they walked through, making a novel, complex field trip experience run extremely smooth.

One teacher from this program commented, "My students love [this] field trip. The curriculum is top notch and included collaboration between the Park Service and local science teachers, so it is meaningful and useful." This program was developed with the help of local teachers and designed to accomplish science curriculum goals. The program provider not only listed what curriculum standards were being covered by the field trip and supporting materials, but also included a curriculum guide for the whole school year with suggestions of how and when to incorporate field trip preparation and follow-up lessons into the classroom, such as analyzing and presenting data collected on the field trip. Based on conversations with teachers and survey responses, it was apparent learning associated with the field trip did not end when the students left the site. Teachers usually collected student workbooks completed during the trip and often mentioned to the group that this information would be used for future activities. Program evaluations were given to all teachers, seeking feedback on how it could be continually improved. This collaboration and focus on curriculum alignment created a field trip experience that teachers felt was relevant to the students and valuable in meeting their own teaching goals.

Discussion

Our findings support the idea that factors influencing field trip success may often occur before and after the trip (Storksdieck, 2006). Consistent with prior studies (Gennaro, 1981; Stern et al. 2008; Stern & Frensley, 2017), we found preparing students in the classroom prior to environmental education field trips to be associated with more positive outcomes. Logistics preparation was the most strongly related factor to self-reported student outcomes, supporting the concept that students do better in a learning environment if they understand what is expected of them, such as rules and procedures (Wong & Wong, 2018). Out-of-school experiences, such as field trips, are typically novel to students, and while this may be an important aspect of student interest in and appreciation of the field trip, it can also hinder overall learning if the novelty is distracting (Orion & Hofstein, 1994). Logistical preparation can inject a reasonable level of comfort, balancing the influence of potentially overwhelming novelty (Jarvis & Pell, 2005).

Subject matter and lessons preparation were related to more positive EE21 and satisfaction outcomes. Pre-visit preparation specific to the subject matter of the field trip can enable students to connect what they are learning on the field trip to prior experiences in the classroom (Rennie, 2007). This idea is supported by constructivist learning theory, which states that people learn by fitting together new information with what they already know (Olusegun, 2015). These findings are also important when observing field trips through the lens of the experiential learning cycle. Reflection, conceptualization, and experimentation of knowledge gained from prior experiences will influence future experiences. Information assembled during preparatory lessons are ingredients for students to create new knowledge and be able to properly reflect on field trip experiences (Kolb 2015). Teacher-perceived outcomes were also linked to preparation. Consistent with Anderson and Zhang (2003), the findings suggest pre-trip planning and curriculum fit are some important drivers of teacher-perceived field trip success.

Follow-up activities were also associated with better student outcomes, consistent with prior studies of single programs (Farmer & Wott, 1995, Storksdieck, 2001). Encouraging students to make cognitive connections after the field trip helps to complete the experiential learning cycle by engaging in the reflective observation and abstract conceptualization stages (Falk & Dierking, 2000; Kisiel, 2006; Kolb, 1984). These exercises may not only help students organize recently gained knowledge, but may also lay the groundwork for active experimentation, as students learn to apply their gained understanding in new situations. Simply put, following up after an experience prepares students for the next.

Organizations that provide EE field trips should thus consider how they can work with attending teachers to integrate the field trip experience into the classroom, including adequate logistical and subject matter preparation and follow-up content and activities. In some cases, teachers were invited to visit the site prior to the field trip or attended workshops provided by the host organization. Prior studies have found that when field trip materials were co-developed with teachers and organizations, they were judged to be more effective and were more likely to be used (Dewitt & Osbourne, 2007).

Quality follow-up activities observed in this study included written reflections about environmental issues, activities to interpret data collected on the field trip, or applying the scientific method in a new setting. Qualitative comments from teachers reflect that follow-up as well as preparation is more easily facilitated when there is a level of collaboration with the host organization, ensuring the program fits with the curricula and motivating teachers to connect the field trip experience to learning in the classroom. EE providers should think about ways they can promote field trip reflection and follow-up activities in the classroom, such as providing take-home materials or suggesting field trip-related lessons integrated with classroom curricula.

Limitations and Recommendations for Further Research

While our research corroborates the findings of prior research and add to the mounting evidence on the value of pre- and post-field trip activities, it also suffers from certain limitations. First, although we achieved a broad and diverse sample of program providers across the country, we cannot claim that the sample is statistically representative. Moreover, our study was limited to single-day programs for 5^{th} to 8^{th} graders in the United States. Therefore, we cannot confidently generalize beyond these age groups. The logistical complexity of the study limited our ability to conduct follow-up surveys with participating students. Thus, our follow-up measures are limited to teachers' perceptions of student outcomes. Future efforts would be enhanced if they could collect longer-term outcomes measures. Furthermore, the response rate for teachers in the follow-up survey was low (75 out of 207 teachers who were surveyed on-site responded to the follow up online survey). Future studies may consider incentives for teachers to encourage responsiveness. Finally, we were unable to conduct detailed qualitative (or other) research on the qualities of the pre- and post-visit experiences that took place outside the field trips. Future research could examine whether the nature of these experiences relates to the outcomes of field trip programs.

Conclusion

This study lends empirical evidence on a national scale of the value of preparation and follow-up for environmental education field trips by demonstrating statistical trends across a large sample of EE field trips. Connecting these field trips to the classroom can lead to better outcomes. Collaborative input from both schools and organizations that provide field trips can help to foster these connections. Teachers have the power to improve field trip outcomes for their students by introducing content to their students in the classroom both before and after programs and clarifying logistical expectations for the experience. Program providers can make it easier for teachers to do so by providing high quality easy-to-use materials and other opportunities to collaborate on-site and/or in curriculum development.

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CHAPTER 3 – Reflection and Conclusion

Introduction

In life, I seek transformation through following my passions. Discovering what inspired me professionally was a winding road, but when I started working in environmental education (EE), I knew I had found my place. Two years ago, I made the decision to go back to graduate school and be a part of a team working on a national environmental education study. I saw it as an opportunity to travel the country and advance my career. Little did I know that I was stepping into the deep end, and when I came up for air, I wouldn't be the same person anymore.

Background on project

After a few years running informal environmental education programs, I jumped on the chance to return to my alma mater and work with one of my favorite professors. He and a colleague from Clemson had received funding for a national study examining what works in environmental education field trip programming. My first semester back in school, I dove headfirst into learning theory and research methods. Before I knew it, we were on the road, traveling to different states across the country, scribbling notes and surveying everyone in sight. My specific part of the research project sought to discover what teachers were doing to prepare and follow-up with students before and after the field trip, and how these experiences related to the program's success. We returned from collecting data in the summer, and I've spent the last eight months crafting and explanation of what we found.

Purpose and structure of chapter

Through my studies, I have come to understand how important it is to reflect upon, break down, and reconfigure knowledge generated from meaningful experiences (Kolb, 2015). When I started the graduate school experience, I wrote a paper about my philosophy on education, outlining my past experiences of what I knew and believed about environmental education and how to do it well. Reading it towards the end of my master's, I realized how much I have grown. I've gained a theoretical understanding of how people gain knowledge and sociological undercurrents of education. I've participated in a large-scale research project, using the scientific process to answer my own questions. I've gotten the chance to observe dozens of EE programs and interact with hundreds of professionals in the field. Each of these aspects lends me to reflect upon what I learned about environmental education during my time in graduate school and how I will apply it moving forward.

What I learned from theory

Gaining an understanding of learning theory and seeing it applied in the field has been the foundation of my recent work. Although I had taught science in both formal and informal classrooms, I took my first course in educational psychology in graduate school. The course, Learning and Cognition, introduced me to constructivism as a paradigm for learning. Applying constructivist-based theories to my previous experiences in education highlighted a new way understanding the underlying processes at play. After observing dozens of environmental education field trip programs across the country, I was able to make connections to a variety of different learning theories. Three main philosophies stand out as representations of the factors influencing learning on field trips: constructivism, experiential learning theory, and ecological systems theory.

Constructivism learning theory asserts learning is an active process whereby learners construct new understandings based on prior knowledge. Learners are not blank, receptive slates; they instead bring with them different experiences to any new learning environment or situation. Learners play an active role in the learning process, integrating new ideas into their current structure of knowledge (Fosnot, 2005). This is incredibly important to understand for organizations providing field trips. Students attending these programs learn through the lens of their past experiences. Allowing students to play a role in the learning and connecting it to their lives can have a profound impact on creating a relevant experience. Using a constructivist paradigm to create programs can result in a student-centered, collaborative process solving real world problems and reflecting on learning progress (Klein & Merritt, 1994).

In the field, I observed a program that did this particularly well. Students role played as engineers and were tasked with preventing water quality issues in their local lake. They learned about different land management and ecosystem engineering techniques to prevent erosion. Students worked in groups to collect data, researching different mitigation techniques. At the beginning of the day, they built a model that they thought would prevent soil erosion. At the end of the day, after all their research, they were able to fix their model based on what they learned and test it to see if it improved. Throughout this field trip, students were coming up with their own questions and given the tools to answer them. Collaborating with peers to solve real world problems in their community created an engaging learning experience.

Constructivism serves as a backdrop for the other two relevant theories, the first of which is experiential learning theory. Experiential learning served as the theoretical framework for my empirical research project. It allowed me to conceptualize how students learn and to think deeply about the mechanisms of holistic field trips. Experiential learning theory defines learning as a process where the transformation of experiences drives the creation of knowledge. This process is framed in a four-step cycle, where learners (1) have a concrete experience, (2) reflect on the experience and draw out inconsistencies with prior understanding, (3) think abstractly and formulate a modified understanding, and (4) plan to apply constructed knowledge in a new experience (Kolb, 2015). Thinking of EE field trips as concrete experiences provided a guide to illuminating the important relationship between these trips and the classroom. What is happening in the classroom before an experience? After the experience, how are students reflecting on and applying new knowledge?

My observations in the field and continued research sought answers to these questions. The experiential learning cycle, whether providers knew it or not, was utilized across the country to plan and execute successful field trips. Organizations provided resources to facilitate planning and preparation for field trip experiences, as well as reflection and follow-up activities. Some teachers took advantage of these resources and incorporated them into their curriculum, some did not. Conversely, even if not provided resources, it was clear that some teachers went the extra mile to properly prepare for, execute and reflect upon the field trip experience. Many EE field trips contain hands-on experiences, but the ones that reflect properly going through the experiential learning model were noticeably different. Students came in understanding the concepts of why they were doing what they were doing, the activities were relevant, and they could use what they were doing/what they learned in the future. These experiences were not devoid of novelty, simply well-structured with clear expectations so that student learning could be enhanced.

There were several other important factors present on the EE field trips I observed that influenced student learning. These relate to the systems in which students interact while on the field trip experience, such as social relationships with others, current events, religion, or students' own culture. These factors are well explained through ecological systems theory, which theorizes an individuals' development is influenced by the entire ecological system in which it grows (Bronfenbrenner, 1979). It is broken down into four smaller systems. The microsystem immediately surrounds the individual and consists of interactions with a students' friends, family, teachers, and on a field trip, the educators. The mesosystem includes interactions ***between*** those previously listed, surrounding the individual, for examples, other students interacting with each other or the educators. The exosystem includes broader social systems surrounding a student, such as local politics, their parent's jobs, or their neighborhood. The broadest system at play in field trips is the macrosystem, which includes a student's culture, values, customs, socioeconomic status, and religious identity. Ecological systems theory is partially constructivist in nature. These systems lend a hand to thinking about a student's prior experience and ways of understanding, which consequently affect how they construct knowledge.

Influences from these systems were often noticeable on the EE field trips I observed. If a student had a negative interaction during the field trip, such as getting scolded by the teacher or teased by other students, it could impact their learning for part of or all of the experience. Additionally, interactions between others could impact student learning, such as an accompanying teacher correcting the educator leading the field trip, or chaperones chatting loudly during the lesson. Each individual student has their own experience. This experience is influenced by factors they bring with them, such as their family, culture and religion. It is also influenced by factors occurring on site. Interaction of the systems surrounding students are not necessarily a deterrent to learning, and organizations can capitalize on some of these factors, such as the social nature of field trips. A 2008 review of field trips by Dewitt and Storksdieck emphasized the social context of field trips as important factor influencing their success. Field trips serve as a situation where students can interact with each other, their teachers, and new educators in a different manner than they are used to. Capitalizing on this aspect rather than suppressing the socialization can be tricky. Programs trying to promote social learning should be thoughtful in design, and educators can be trained to become better facilitators of these environments. For example, taking a less didactic approach, encouraging students to communicate their thoughts with peers, and designing experiences that involve group discovery and collaboration are each examples of approaches that could encourage social learning.

Diving deep into learning theory while in graduate school has laid the foundation for me to become a much better environmental education professional. Before, I was a tree without roots, thriving as a teacher but unable to connect to the resources that would make me grow taller. My recent studies have given me time to develop these roots, and now I feel prepared to stretch my limbs far and wide when I enter back into the field of EE. In addition to theoretical foundations, I have cultivated a bounty of lessons learned regarding executing valuable research, designing and delivering effective EE programs, and making the most out of a dynamic master's experience. Together, these lessons have shaped my philosophy on education and promoting sustainability both professionally and personally.

Lessons learned as a researcher

To be honest, I was not entirely stoked on doing a research project for my masters. In my eyes, I was never going to end up on the path to becoming a researcher or academic. Now, at the end of the project, I am certain I could not have learned as much if I did it any other way. The research allowed me to immerse myself in broad field of EE and pull back the cover on the mechanisms that drive successful programs. Connecting theory to practice and measuring the effects of different program elements has given me a much deeper understanding than years of simply running my own programs. There are key aspects of planning, measuring, analyzing, and writing my thesis that I reflect upon as valuable lessons.

One of the most refreshing aspects of my research was a true introduction to social science. I had a degree in science and worked in science education, but like most of my fellow graduate students in human dimensions of natural resource management, social science was new to me. Much of the planning of our project had already happened prior to me joining the team. I was left to start drafting what part of the project I wanted to carve out, what questions I wanted to ask, and to help start putting together a sample. I learned quickly that in social science that you have to work hard for your sample. Dealing with human subjects takes time, consideration, and continued, thoughtful communication.

Our study sought to observe EE field trips, survey students at the end to see how the program impacted them, and survey teachers and educators on the program to find out other information that may affect the field trip. We simply had to contact EE field trip providers such as parks, get them on board, and create a schedule. This process turned out to be quite labor intensive. I did not take into account how much time it would take to effectively communicate the research, and how much of an iterative process it would become. Getting organizations on board wasn't hard. But figuring out if their programs would work and explaining our needs was a different story. Being available to communicate with host organizations and interpret our study became a continuous process. I still answer questions from places we visited. Over time it was clear to me that this must be at the core of EE research: human relationships. Maintaining good relationships with organizations has been fundamental to the effectiveness of this study. They are not only the gatekeepers of how the data is collected, but also how the results of the research are used.

After planning my research questions and maintaining meaningful relationships with our sample, the next step was to design measurement tools to collect data. There are a variety of ways to approach survey design. As I reflect on my experience in this, one main point stands out: Never lose sight on what you want to know. Repeat: What am I trying to find out, and what will help me figure out how to measure it? It seems like a simple task for a graduate student, but as a first-time researcher, I was constantly distracted by everything else I was learning and trying to decide what I should and should not apply. For example, I wanted to know what teachers were doing before and after field trips, if they were using any supplementary education materials, and why. I often got bogged down trying to operationalize large theories, draw out every aspect of the theory and apply it to my research questions. I instead should have only focused on the parts of theories that helped figure out what I wanted to know. I think if I had stayed focused, I could have developed a survey that was more concise and easier to use in my analysis. As I planned my survey, I was focused on fitting it perfectly to theory instead of looking forward to plan a way to analyze the data. Planning for analysis is difficult for a statistics novice, but I think it is always important to consider when developing quantitative measurement tools. My takeaway from survey design is always to have both eyes on the prize – what you want to know – with one foot behind you in theory and literature, and the other foot ahead of yourself in analysis.

The next step in the research process was to get out in the field and collect the data—the moment I had been waiting for. I was beyond excited to travel, network, and discover new parts of the US. It was a whirlwind, and before I knew it I was back home in Blacksburg, ready to see what we had found.

I cannot emphasize this enough: I was not prepared for data cleaning and organization. I found myself completely overwhelmed at times trying to make decisions regarding my data. I was constantly finding inconsistencies between responses on teacher surveys and information given to me by the organizations. It made me want to panic. With hundreds of teacher responses for hundreds of student groups, how could I be sure it was all valid? This process was one of the many moments that made me appreciate my advisor, who patiently responded each time with: it depends… what is your question, what elements are important to know to answer this question? I learned to relax and work through the inconsistencies one at a time. I began jotting down notes on a document of any and every change I made to my database. I kept a master database with all the information I needed synced together and always made sure I pulled from this when creating new databases for analysis. Every little check, edit, change, or reorganization was recorded with notes explaining why I made those decisions. Little by little, I chipped away at the cleaning process. In many ways, this research project has been incredibly novel, and I'm proud of all the new things I've accomplished. But for some reason, nothing makes me quite as proud as imagining the squeaky-clean database I organized. It has the answers, and I created it.

After cleaning the data and running analyses, I finally got what most researchers are looking for—positive results! As much as I was afraid of statistics on the forefront, it turned out to be quite fun. I was able to look at the data in a variety of ways and concluded with clear results: there is a relationship between preparation, follow-up and student outcomes. I then entered into a vortex of all scientific research—articulating what these results mean and why they matter. The discussion has been the hardest part of writing, yet the most rewarding. I've become content with the fact that this process does not include one large a-ha moment when everything comes together. Rather it is many, many small a-ha moments, after many pages of reading and cross-referencing. It has resulted in me rethinking entirely what my study means and the impact it can have. My greatest ally in this process has been time and collaboration. I've had the ability to write, get feedback, edit, and rewrite numerous times. As tedious as it seemed, it allowed me to make connections I had not previously made. I realized that by the end, the results themselves have so much more meaning than before. It is not what we know or found out that is the most important. It's the context in which this new information fits.

What I would do differently

If I had to do it over again, there are a few things I would consider doing differently. As I said earlier, I would be more focused on what I want to know, and I would approach using theory in a different way. I also took time to incorporate learning theory into my empirical study, and I would have benefitted from applying that approach earlier on. One of the major challenges of planning my part of the research project was hypothesizing the best way to survey teachers. We were very unsure of the time we would be able to have with the teachers on site and did not want to overburden them with a lengthy survey. We intentionally made it much shorter than the student survey, banking on the second survey they would take online to answer many of our questions. Retrospectively, I would do a few things differently. First, I would make the on-site survey longer. Teachers usually did not have much to do while students were taking the survey and were often waiting around. This sometimes led to the teachers being impatient and rushing the students. Additionally, only 30% completed the follow-up survey, so the more information we can get on-site from all the teachers, the better. It may also help keep the teachers occupied while the students take their survey. Second, I would have modified my survey to ask specifics of what teachers were doing in terms of preparation and follow-up. Now that I know there is a relationship between preparation, follow-up and student outcomes, I wish I had gathered more information detailing what that looks like in action. This could have also benefitted from interviews with select teachers. It was difficult figure out how to interview teachers during the pilot study, and we were unsure of its utility. However, moving forward with future iterations of this study, I think interviewing teachers would be enlightening. Working on my side of the study the past two years has illuminated how important classroom connections are to field trip success.

Hearing teachers' experiences in their own words could fill in the gaps of understanding how to maximize the impact of EE.

What I learned as a practitioner

I started graduate school to advance my career and become a better EE practitioner. My focus coming in was that by doing the data collection—observing over a hundred EE programs across the country—I would instantly see and know what it takes to put on a great program. But often when observing a great program, it wasn't clear how to articulate exactly what made it great. What I have learned as a practitioner comes from transforming my observations—examining trends of multiple program elements and connecting theory to practice. As I imagine my future self as the director of education at a nature center, there is so much I've learned in the past two years that I am eager to apply. Two major themes come to the forefront: overall program design and instructor practices. My observations in the field combined with the writing process of my empirical study really made me more thoughtful of the genesis of a program. Programs seemed to be more successful when the EE field trips were intentional—that is, they emerged from addressing the needs of the local education system. They were developed with the input of local school systems and became part of the broader learning community. Collaboration among local schools and EE organizations lends itself to creating meaningful out-of-school experiences and allows the program to adapt to student needs over time.

The second theme, instructor practices, is incredibly important. An instructor can make or break a program, even with the best planning. EE organizations often do not have the funding to offer full-time, stable jobs for educators, and turnover for these positions is high. There are a variety of ways to mitigate this issue depending on where you work. One method I found interesting that I hope to employ in the future is partnering with a local University to have their pre-service teachers work as educators. Pre-service teachers can earn college credit while gaining valuable teaching experience. Organizations with limited funds seeking motivated educators could benefit from this model. Moreover, these individuals go on to become school teachers and hopefully bring their experience in EE to the classroom. This connects back to the idea that effective EE programs are a community effort—that schools, EE organizations, and local universities can work together and learn from each other to best support students in the community.

How my teaching philosophy has changed

When I started my studies almost two years ago, I wrote a paper outlining my personal teaching philosophy. I was fresh out of working as an EE practitioner, and as someone who had recently felt they had found their calling in life, I was beyond eager to give my two cents. Reading it now, I'm entertained by idealism and humbled by the aspects that hold true. For example, I expressed that learning about the environment can not only expand our knowledge of the natural world, but also facilitate understanding of ourselves. I really believed in the power of EE to promote positive youth development, and through my studies I am even more confident today of that capability. I also emphasized community-based programming, as well as power of passionate educators delivering EE programs. From what I observed, these also held true as important elements of good programs. But after incorporating lessons learned from theory, observation, and the research process, I notice there are some key changes to my teaching philosophy. I used to very much believe if you got kids outside in nature and disseminated some facts about the environment from a knowledgeable person, that was enough. Simply facts. If the students saw nature, liked it, and heard about the issues, they would care and change their future behavior to be more pro-environmental. This experience taught me that knowledge is not what makes a good educator, and being in nature is not necessarily what makes a good program. I was content believing that positive vibes, pretty trees, and cool outdoor spaces could transform students—but it is so much more than that. Therefore, the overall biggest change to my teaching philosophy steps back from thinking about how nature can change peoples' perspectives, and more towards how carefully constructed programs and thoughtful educators can change perspectives. Well structured, physically and socially engaging programs with a clear take home message, delivered by supportive, passionate, and genuine educators have the ability to impact students and conservation as a whole.

Conclusion

I made the choice to go into environmental education because I wanted to make a positive difference in the world. This study has provided me the wisdom to understand it takes a whole lot more than good intentions to make a change. But instead of feeling down, I come out on the other side of this study feeling incredibly hopeful. I've met so many passionate people around the nation who are dedicating their lives to connecting students to nature in hopes of creating a more sustainable future. I have learned that in environmental education, it is not the space we bring them to, but how we create an experience in that place that is meaningful. I find that notion empowering, and I look forward to creating these experiences for years to come.

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