

Principles for better environmental education field trips for early adolescent youth in the United States: an empirical study

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ABSTRACT

Which approaches lead to better outcomes for participants in environmental education (EE) field trips? This manuscript builds upon previous large-sample quantitative research that identified effective elements of single-day EE field trip programs for early adolescent youth across the USA. In this mixed-methods study, we observed 87 EE-focused school field trips in the USA and then surveyed youth participants immediately afterwards. We used the student surveys to quantitatively distinguish the top-performing quartile of programs from the bottom quartile. We then examined in-depth qualitative fieldnotes on each program in the top and bottom quartiles. Our analyses revealed six key principles that distinguished the programs with the most positive student outcomes from those with the least positive: (1) ensuring basic needs (physiological and safety) are met; (2) ensuring instructional clarity; (3) providing emotional support for students; (4) highlighting the novelty of the activities and setting; (5) maintaining or restoring student attention; and (6) providing a cohesive and thematic experience with clear purpose. There are many ways to embody the six principles. We share examples for each.

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1. Introduction

School field trips focused on environmental education (EE) for early adolescent youth represent a powerful opportunity to enhance environmental literacy and other positive outcomes across a diverse spectrum of participants (e.g. Hemby, Powell, and Stern 2024; Stern, Powell, and Frensley 2022). Many reviews (e.g. Behrendt and Franklin 2014; DeWitt and Storksdieck 2008; Rickinson 2001; Stern, Powell, and Hill 2014; Van

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De Wetering et al. 2022) and reports (e.g. Fenichel and Schweingruber 2010) have provided empirical evidence or expert-based opinions on how to make these programs more effective – that is, how to design and deliver them to enhance the outcomes of participants. However, experimental and comparative studies that isolate and test the contribution of specific aspects of programs that improve outcomes have been rare in the literature (Stern, Powell, and Hill 2014).

Some quasi-experimental studies have focused on singular elements of program delivery or design, such as the degree of pre-trip preparation or follow-up (e.g. Lee, Stern, and Powell 2020; Smith-Sebasto and Cavern 2006), contextual elements, such as the naturalness of the setting (Dale et al. 2020; Kiewra et al. 2023); or educator characteristics (e.g. O'Hare et al. 2020). Others have examined multiple pedagogical elements across a small sample of programs (e.g. Ballantyne, Fien, and Packer 2001; Ballantyne and Packer 2002; Alon and Tal 2015). We are aware of only one large-sample study of EE-focused school field trip programs ($n=299$) that examined each of these types of variables concurrently, including program design and delivery, educator characteristics, and contextual variables (Powell, Stern, and Frensley 2023). That study conducted quantitative field observations of 66 programmatic, educator, and setting characteristics to determine which were most powerfully associated with student outcomes.

The current study builds upon this recent large-scale quantitative study through a mixed-methods approach by observing 87 EE-focused school field trips for students in grades 5-8 (primarily ages 10-14), recording in-depth qualitative notes on the specific techniques and practices of each program, and surveying participants immediately after to quantitatively measure student outcomes. This paper compares the top-performing and bottom-performing programs using qualitative data to examine more complete stories of each program to identify broad principles and record key examples of each in the field. The results indicate the importance of implementing six key principles to enhance outcomes.

2. Literature review

2.1. EE school field trips for early adolescent youth

This study is limited to EE-focused field trips that take place away from school grounds within the course of a single day for students in grades 5-8 (primarily ages 10-14). This age range, which is marked by rapid development of higher-order moral reasoning, cognitive abilities, and identity formation (Kohlberg 1971; Kroger 2006; Piaget 1964), represents a critical period for developing a wide array of intellectual, personal, and social skills and other outcomes commonly associated with EE programs (Kahn and Kellert 2002; Sobel 2008; UNESCO 1977), including enhanced knowledge, academic motivation and performance, curiosity, self-confidence, social skills, and *environmental literacy*, which involves helping them to develop the knowledge, skills, attitudes, and dispositions to work toward solving the environmental challenges of our time (Ardoin et al. 2018; Powell et al. 2019; Stern, Powell, and Hill 2014; Thomas et al. 2019). Moreover, school field trips represent an important opportunity for environmental educators to help meet curriculum standards and reach more diverse audiences (e.g.

Powell et al. 2019). Schools, especially public schools, may represent the broadest cross-section of the demographic make-up – socioeconomic, racial, ethnic, and otherwise – of the USA. As such, school field trips provide EE opportunities to students who might not otherwise choose, or be able, to attend (Anderson, Stern, and Powell 2024; Hemby, Powell, and Stern 2024; Warren et al. 2014).

2.2. What drives EE field-trip program outcomes?

Prior research has identified a number of specific practices, techniques, and contextual variables linked with more positive student outcomes. Powell and colleagues' study (2023) found eleven characteristics most consistently associated with more positive student outcomes, including smaller group sizes, naturalness of the setting, novelty of the experience, place-based pedagogy, verbal engagement, quality questions, quality transitions between program elements, and the degree of responsiveness, comfort and clarity, and emotional support exhibited by the on-site educators. Researchers have also linked pre-experience preparation and post-experience follow-up (Lee, Stern, and Powell 2020; Orion and Hofstein 1994; Rudmann 1994; Smith-Sebasto and Cavern 2006), the degree of relevance of the program content to the participants' lives (Alon and Tal 2015; Stern, Powell, and Hill 2014), and the presence and quality of storytelling (Alon and Tal 2015) to more positive student outcomes, among other factors. Multiple studies have also examined the effectiveness of specific pedagogical approaches, such as issue-based, place-based, and investigation-focused techniques (Powell, Stern, and Frensley 2023; Stern, Powell, and Hill 2014; Van De Wetering et al. 2022), though these techniques on their own tend to meet with less consistent results.

These and other prior studies suggest that there are multiple pathways to achieving success. However, many of the promising factors for enhancing programs represent specific practices or techniques, rather than broader principles to guide overall design and implementation. For example, prior research has suggested that high-quality transitions between program elements can enhance program outcomes (Powell, Stern, and Frensley 2023). Employing meaningful transitions might be a helpful technique. Rather than being the key to a great program, however, transitions more likely contribute to a higher-order principle, such as making a program feel more cohesive or holistic, or maintaining students' attention between program elements. Similarly, investigation-focused or issue-based programs can be implemented well or poorly (Powell, Stern, and Frensley 2023). For example, focusing on water pollution as a basis for structuring a field trip to an aquatic ecosystem doesn't guarantee better or worse learning outcomes on its own. Rather, the higher-order principles of active engagement, student autonomy, and focused attention might be the critical elements. Identifying these principles, along with ways to embody them, can enable practitioners to better determine context- and audience-specific means to achieve better outcomes, rather than focusing on singular practices that have proven useful in other cases. In other words, one might ask, 'How can I make this program feel cohesive and holistic?' instead of 'What transitions can I plug in between program elements?'

Theory can serve as a link between empirical observations of singular practices and the higher-order principles we seek. Three theories have particular relevance to EE field trip programs, each with key insights on how a program's characteristics may

influence students' abilities to learn. First, **Maslow's Hierarchy of Needs** suggests that people's basic needs must first be met before we can expect them to fully engage in any shared learning experience (Maslow 1954). In the EE field trip context, this means first ensuring the basic physical and psychological needs of students are met. If students are overly hungry, cold, tired, or feel unsafe or unwelcome, it may be unlikely for meaningful learning to take place.

Self-Determination Theory (Ryan and Deci 2000) speaks to the importance of intrinsic motivation for effective learning and identifies three psychological needs that promote its cultivation: competence, autonomy, and relatedness. In the EE field trip context, promoting feelings of competence among students may hinge upon the clarity of instruction, positive feedback, responsiveness to students' needs and questions, and aligning challenges to the ability level of the students. If students know what is expected of them and feel capable and supported in fulfilling those expectations, we can expect elevated feelings of competence. Feelings of relatedness emerge when students feel safe, emotionally supported, welcome, and understood. These feelings can emerge from the creation of a friendly and welcoming environment and/or from making connections between on-site experiences and students' lived experiences at home (Frensley et al. 2022). Students feel autonomy when the experience allows them the freedom to explore and make decisions about how they learn and spend time while on-site. Educators can have powerful influences on promoting each of these psychological states.

The Reasonable Person Model (Kaplan and Kaplan 2009) emphasizes the importance of how people cognitively process their environments, suggesting three domains important for the reasonable interpretation of, and response to, information: model-building, being effective, and meaningful action. People use mental models, or cognitive maps, to make sense of the world around them. Supporting *model-building* in the EE field trip context calls for ensuring students have enough background information upon which to build new knowledge; providing them with a clear purpose for their participation in activities; and sequencing and connecting program elements such that participants can develop a cohesive meaning from the experience. This last component is related to the concept of communicating an interpretive theme, or an underlying 'so what?' or deeper meaning, commonly associated with interpretive experiences (Ham 2016). It also aligns with findings associated with the power of storytelling in promoting positive outcomes from communicative and educational experiences (Maxwell and Dickman 2009; Stern and Powell 2013; Stern 2018).

Being effective involves two components: (1) maintaining (or restoring) clear-mindedness or attention and (2) enhancing feelings of competence and confidence. The latter elements are already addressed within the Self-Determination Theory framework, in terms of both producing feelings of competence and relatedness, which can enhance confidence. The former might involve reducing monotony, providing a variety of ways to engage, and highlighting the novelty of settings and experiences. These practices align with other theories and empirical findings as well, especially those speaking to the positive influences of novel settings and experiences on learning (Dale et al. 2020; Orion and Hofstein 1994; Powell, Stern, and Frensley 2023). In considering the importance of novelty and model-building together, one might expect

an inverted U-shaped curve, in which moderate degrees of novelty are ideal, as too much novelty might preclude effective model-building, while not enough might hinder Kaplan and Kaplan's concept of effectiveness through attention depletion (Boeve-de Pauw, Van Hoof, and Van Petegem 2019; Cors et al. 2018; Falk 1983).

Finally, *meaningful action* relies on perceptions that actions have a valuable purpose and that people feel that they are heard and respected. This again speaks to the importance of providing students with a clear purpose, or 'so what?', in association with their field trip activities as well as the creation of a positive and emotionally supportive environment, similar to the creation of *relatedness* within Self-Determination Theory.

In summary, EE school field trips provide a critical opportunity to engage diverse students at a time when they are forming higher-order knowledge, motivations, attitudes, skills, and identities. Prior research has identified specific practices associated with more positive student outcomes. These practices, however, may not apply broadly across a wide array of programs or contexts. Rather, identifying higher-order principles may help practitioners to develop context-specific practices to creatively enhance their experiences. This study seeks to identify these principles and provide examples from the field about how they might be embodied.

3. Methods

In the Spring of 2022, we set out to replicate the quantitative 2018 national study conducted by Powell, Stern, and Frensley (2023) while adding a substantial qualitative component. The intention was to (1) use a comparable questionnaire to measure participant outcomes; (2) observe programs and record the extent and quality of use 66 program characteristics for quantitative analysis; and (3) add a significant qualitative note-taking effort to provide more detail on the specific techniques and practices of each program and the reactions of participants. This third objective, we felt, carried the potential of identifying higher-order principles for effective program delivery and is the focus of this manuscript.

All procedures were reviewed and approved by the Institutional Review Boards of Virginia Tech (IRB-15-1031) and Clemson University (Clemson IRB2021-0615). Study objectives were shared and verbal consent was received from program providers and teachers prior to data collection. The study's objectives were communicated to students prior to their participation as well through a consent script. Student participation in surveys was explained to students as voluntary, and all student-level information that was collected in the study was anonymous. Students provided no personally identifying details and could choose not to participate with no consequence.

3.1. Site selection

Our sampling scheme was designed to maximize diversity in the quality of programs and audiences served in terms of geography, race, and ethnicity. We began with results from the original sample from the 2018 field season and divided the observed programs into those serving majority White, majority Latinx, majority Black, or no-majority student groups.¹ We then used group-level outcome scores for each

program (group means from student surveys) to identify the top quartile and bottom quartile within each demographic category. We aimed to sample programs from at least three program providers within each group (top and bottom within each demographic majority). We also aimed to maximize geographic variability when options existed to do so.

From February to May 2022, we successfully sampled programs from 21 organizations from the original 2018 sample. Some providers had paused their programming or shut down entirely following the COVID-19 pandemic. We therefore added two program providers to the new sample, based on logistical feasibility. Our final sample consisted of 87 EE-focused school field trip programs provided by 23 unique organizations, with a minimum of two programs per provider organization, across 16 states (AZ, CA, FL, GA, IN, KS, MA, MD, MO, NY, OH, OR, TX, VA, WA, WI).

3.2. Outcomes measurement

In January 2022, during the training of the field team and pilot testing of research protocols, we observed comprehension challenges among students attempting to complete the original EE21 survey (a broad measure of environmental literacy and other common outcomes of EE programs: see Powell et al. 2019). To address these comprehension challenges, which were likely attributable to changes in education during Covid-19 pandemic (Fisher et al. 2022; König and Frey 2022; Kuhfeld, Lewis, and Peltier 2023), we shortened the survey and administered it orally. To ensure the shortened scale continued to measure the underlying crosscutting outcomes, we adapted single items from the EE21 scale to measure (Table 1): enjoyment (Q1), connection to nature (Q2), learning (Q3), interest in learning more, or curiosity (Q4), place connection (Q5), and overall program influence/impact on student (Q6) (Table 1). We chose these specific items on the basis of their reliable performance in prior field seasons (Powell, Stern, and Frensley 2023), the extent to which they reflected concepts of consistent interest to the field (Ardoin et al. 2018; Powell et al. 2019; Rickinson 2001; Stern, Powell, and Hill 2014), and our assessment of how easily they would be understood when read aloud. Each item was measured on a 0-to-10 scale. Students marked their responses on answer sheets that contained shortened versions of each question (see Supplemental Materials). We also created a Spanish language version of the answer sheet to ensure accessibility for native Spanish speaking

Table 1. Program-level means and standard deviations of items comprising the program outcomes index ($n=87$).

Items	M	SD
Q1: How would you rate this program overall? (<i>Satisfaction</i>)	7.92	1.05
Q2: Did this program make you want to spend more time in nature? (<i>Connection to Nature</i>)	6.76	1.31
Q3: How much did you learn about how people and the environment influence each other? (<i>Learning</i>)	7.15	1.02
Q4: Did the program make you want to learn more? (<i>Curiosity</i>)	6.61	1.48
Q5: Did the program make you care more about places like this one? (<i>Place Connection</i>)	7.71	1.04
Q6: How much did the program influence you? (<i>Influence</i>)	6.05	1.32
<i>Program outcomes index</i> (unweighted mean of all items)	7.10	1.06

students, though we only read the instructions and items in English. Overall, administration of the survey averaged eight minutes, and our research team reported no major challenges. Ninety-eight percent of students completed immediate post-experience surveys across the sample, resulting in 1,245 surveys.

Based on the prior statistical validation of the single-factor EE21 scale (Powell et al. 2019), we expected the six items to similarly constitute a single scale measuring the overall quality of each program's outcomes for participating students. Confirmatory factor analysis (CFA) confirmed the validity of the unidimensional factor ($S-B \chi^2 = 26.71$; CFI = 0.993; SRMR = 0.017; RMSEA = 0.040 (0.023, 0.058); Cronbach's $\alpha = 0.89$). For details on data cleaning, scale development, factor loadings, and further validity assessment, see the [Supplemental Materials](#) online. The resulting **program outcomes index** was created by taking the mean of responses to all six items for each student. These means were then scaled up to the group level by taking the mean of all students' scores on a particular program. For statistical justification of this scaling up to the group level, please see the [Supplemental Materials](#) online.

3.3. Program observations

Following pilot testing of observational protocols on 13 programs as a larger research team, four field researchers observed a total of 87 programs from February through May of 2022, systematically recording observations of 66 programmatic, educator, and contextual characteristics, following the same system described in Powell, Stern, and Frensley (2023). While these quantified data were not used in the present study directly, they provided cues for field researchers to pay attention to theoretically and empirically supported characteristics with high likelihood to influence student outcomes (Powell, Stern, and Frensley 2023). The current study focuses on the qualitative notes created by the field researchers immediately following their on-site observations (same day). Researchers used a template for recording and synthesizing their field notes that included the following elements: observer name(s); date; program name, provider, and location; and a 0 to 10 score of their own overall assessment of the quality of the program, followed by the following prompts:

1. Describe in one paragraph or less why you gave the program this score.
2. Provide a summary of the program you observed. What happened? Give us the 'big picture' overview from start to finish. *Aim for about 500 words or less.*
3. What were the essential elements that really defined this program? What made or broke it? *Provide evidence below (anecdotes, quotes, etc.) and note the program or educator characteristics being described in each.*
4. Please provide examples of any additional interesting anecdotes you observed. These may be excellent (or terrible) examples of other characteristics of the program not included above. *Provide evidence (anecdotes, quotes, etc.) and note the program or educator characteristic the anecdote describes.*

The principal investigators reviewed fieldnotes, which were posted in a shared folder online, on a weekly basis during the field season, posed questions and requested

additional details. Field researchers revisited their notes following these comments and provided clarifications and additional content.

In the field, the researchers were instructed to follow a single group of students through the entire field trip in cases when large groups were broken up into smaller groups. Only observed subgroups were surveyed. Pairs of researchers were instructed to stay together for the first field trip they observed at a site and whenever subgroups were not created. In these cases ($n=24$), they synthesized their program notes together into a single document. In all other cases, a single researcher was responsible for observation and notes. This resulted in 765 single-spaced pages of qualitative notes (11-point font) – 8.8 pages on average per observed program. Photos were retained to record elements of setting and props. Researchers were also instructed to specifically note differences they observed when they were able to observe multiple programs provided by a single organization.

3.4. Qualitative comparative analysis

We used the group mean of the *program outcomes index* to separate the top-performing programs, in terms of student outcomes, from the lowest-performing programs. Because Latinx respondents in the United States commonly exhibit a positive bias in survey responses (Davis, Resnicow, and Couper 2011; Davis et al. 2019), and the prior national study of EE-focused school field trips exhibited this same pattern (Powell, Stern, and Frensley 2023), we first separated the sample into groups that were majority Latinx and those that were not.² We also divided the sample by grade level, as the prior national study also detected significant differences in outcomes based on grade level, with younger students exhibiting more positive responses (Powell, Stern, and Frensley 2023; Stern, Powell, and Frensley 2022). This enabled us to identify the top and bottom quartiles for three subsamples: Latinx majority 5-6th grade ($n=21$; top five and bottom five included in the sample); Non-Latinx majority 5-6th grade ($n=45$; top 11 and bottom 11 included in the sample); and Non-Latinx majority 7-8th grade ($n=20$; top five and bottom five included in the sample). We only observed one Latinx majority 7-8th grade program, so it was excluded from analysis. Removing the middle-performing groups from the analysis provided an opportunity to analyze qualitative data from programs with distinctly different outcomes.

The core team of principal investigators, the first four authors, first reviewed all fieldnotes associated with programs in the top and bottom quartiles within each subsample (356 pages of qualitative notes). We paid particular attention to organizations ($n=4$) that had programs within both the top and bottom quartiles, because overall program design was often similar within an organization, but other circumstances could be driving the differences. Each investigator took extensive notes on their review and wrote a summary memo with preliminary hypotheses about what factors might be driving differential outcomes between the top and bottom quartiles. These hypotheses were informed not only by the content of the qualitative notes, but also the team's prior field trip studies (e.g. Dale et al. 2020; O'Hare et al. 2020; Powell, Stern, and Frensley 2023) and a broader review of prior research (as discussed in the literature review, above). Each investigator reviewed the others' memos followed by a three-hour meeting to discuss and debate our interpretations of the data. This

led to two additional rounds of reviews of all notes and three subsequent meetings to settle on the final factors, or ‘conditions,’ for consideration in a more formal qualitative analysis. In some cases, specific factors were discarded because the qualitative notes did not contain consistent enough treatment to determine their nature – for example, predispositions of the attending students and the degree of potential relevance of content to students’ lives. In other cases, specific factors scaled up into broader principles. For example, notes on weather exhibited no pattern related to outcomes, except in cases where students were clearly unprepared for it. Thus, rather than tracking weather further across programs as a potential explanation for outcomes, we tracked the extent to which students’ basic needs were met. The extent to which students were actively engaged and the educator adequately managed class behavior was subsumed into an overarching condition of managing students’ attention. With the goal of identifying combinations of characteristics that best separated top-quartile programs from bottom-quartile programs, we settled on eight broad characteristics, or principles, to systematically investigate in subsequent readings of the qualitative notes (Table 2).

We followed the general logic of Ragin’s (2009) qualitative comparative analysis, which aims to identify the sets of causal conditions necessary and/or sufficient to create a particular outcome, in our case being a member of the top-performing or bottom-performing group of field trip programs within our sample. For each program, we identified whether each hypothesized condition was clearly present to a high degree, clearly not present, or only present to some moderate degree, resulting in a three-point scale. In the case of ‘theme,’ the middle level indicated that the research team could

Table 2. Hypothesized causal conditions and their definitions.

Condition	Definition
Basic needs	Students’ basic physiological and safety needs are met.
Emotional support	Positive communication and responsiveness by the educator. Positive communication is defined as the extent to which the educator communicates with care and respect, encourages participation, and provides positive feedback. Responsiveness is defined as the extent to which an educator responds to students’ immediate emotional or academic requests, questions, or other cues to better meet student needs. Schoolteacher or chaperone behavior was also considered, if it appeared to impact the overall emotional climate of the experience.
Instructional clarity	Expectations, instructions, and content are communicated in an age appropriate way so that students clearly understand what is expected of them and can fully participate in programmatic activities and/or experiences.
Novelty	The extent to which the place and/or the experience provide(s) a unique and/or uncommon experience for the students.
Cohesiveness	Rather than feeling like a collection of disparate activities, the components of the program are clearly connected to each other through a logical sequence, transitions, internal references, and/or connection to a central topic or deeper theme.
Theme	A clear theme or message was conveyed that provides the students with a clear understanding of the purpose of the experience. The theme is the central point/message the educator is trying to convey about the topic (Ham 1992).
Attention management	Note: This is one way to create ‘cohesiveness.’ The extent to which the program holds students’ attention for the duration of the program.
Autonomy	The degree to which students appear to have the ability to make choices about how they experience or participate in aspect(s) of the program.

Table 3. Conditions of programs in the top and bottom quartiles of *program outcomes* scores.

Condition	Top quartile			Bottom quartile		
	Fully	Partially	No	Fully	Partially	No
Basic needs met	100%	0%	0%	67%	24%	10%
	High	Medium	Low	High	Medium	Low
Emotional support	90%	10%	0%	19%	48%	33%
Instructional clarity	71%	29%	0%	38%	38%	24%
Novelty	100%	0%	0%	57%	33%	10%
Attention	67%	33%	0%	24%	38%	38%
maintenance						
Cohesiveness	43%	57%	0%	0%	33%	67%
	Clear	Discernable	Absent	Clear	Discernable	Absent
Theme	33%	67%	0%	0%	24%	76%
	Moderate	Low	None	Moderate	Low	None
Autonomy	29%	29%	43%	14%	43%	43%

discern a likely theme from the field researchers' notes, but the degree to which it was clearly communicated to students was less certain. Each principal investigator coded each program on their own. We then met to compare our results. We first noticed that no observed program exhibited what we consider to be a high degree of autonomy, so we adjusted that scale to moderate, low, or none (see [Table 3](#)). We spent approximately six hours over multiple meetings discussing all discrepancies within our scoring. We then each re-coded the data, discussed a few minor discrepancies and reached consensus. This resulted in a spreadsheet containing 336 cells (eight conditions across 42 programs – see [Supplemental Materials](#)).

Following the core team's complete review, the four members of the field research team were invited to review the preliminary findings to note any discrepancies between the investigators' interpretations of their notes and their own, and to provide justifications for any recommended changes to the codes. Out of 336 codes, the field research team's review resulted in 13 total changes. In each case, the changes were minor, moving from one category to the adjacent category – for example, from 'low' to 'medium'.

4. Results

4.1. Overall trends and propositions

The final valid sample included 1,214 surveys from 87 programs (see [online Supplemental Materials](#) for details on data cleaning). Our analyses revealed some clear trends separating the top- and bottom-performing programs ([Table 3](#)). All programs in the top quartile, across all sub-samples³, shared the following characteristics:

1. The basic physical and safety needs of students were fully met.
2. Educators provided medium ($n = 2$) to high ($n = 19$) emotional support.
3. Educators provided medium ($n = 6$) to high ($n = 15$) instructional clarity.
4. The experience had high novelty.
5. Educators managed student attention, such that it never dropped below a 'medium' score.
6. The experience was at least moderately cohesive and thematic.

Two additional programs met these basic criteria but were in the bottom quartile. Each of these two cases had middle (less certain) scores for cohesiveness and theme. No program that was clearly cohesive and thematic was in the bottom quartile. Four other programs that were in the bottom quartile met criteria 1 through 5 above, but not the sixth. Autonomy exhibited no clear pattern between the top and bottom quartiles. Thus, the analysis resulted in the following propositions:

- Programs that meet all six of the criteria listed above (to a high degree) are most likely to achieve more positive outcomes for participants.
- Programs lacking a clear theme/purpose or are not at least somewhat cohesive are likely to achieve less positive outcomes.
- No combination of factors achieves perfect prediction, as the qualities and circumstances of visiting student groups and other unmeasured contextual factors will always be relevant as well.

We also examined differences in group size (observed subgroups) and length of the programs to assess the need to control for these variables. The average group size for top-quartile programs was 13.3 and 14.5 for the bottom-quartile programs. Average program lengths were 240 min for top-quartile programs and 215 min for bottom-quartile programs. Independent samples t-tests indicated no statistically significant differences between the two quartiles ($p > 0.05$).

4.2. Principles in action

We provide examples and discuss lessons learned regarding each of the key conditions shared in [Table 3](#) to develop principles for enhancing EE field trips in future practice. The resulting principles are shared in [Table 4](#), along with examples of practices to achieve each.

4.2.1. Meeting basic needs

While students complained of being hot, cold, tired, hungry, or thirsty on multiple programs, failing to meet basic needs went beyond mild discomforts. In one case, for example, students arrived poorly prepared for cold weather, most wearing t-shirts and shorts on a blustery 48°F day. The situation became particularly problematic when they were made to sit still for a full hour outdoors. Students drew their knees up into their t-shirts and began complaining within the first ten minutes. Toward the end of the hour, students began getting up to hop in place, sometimes at the urging of their chaperones to try to get warm. Without adequate gear, the students were unable to focus on the program activities.

In another case, a shallow water ocean program, students felt unsafe. The educator started the program by teaching students how to use dipnets and told them a story about his own painful experience stepping on a man o' war jellyfish. He provided no guidance on how to spot these jellyfish or what to do if stung. Within five minutes of entering the water, one student screamed and started crying. A man 'o war jellyfish had wrapped its tentacles around the boy's leg. The educator, when made aware of

Table 4. Key principles and example practices for enhancing student outcomes from single-day school EE field trip programs.

Principle	Example practices
Ensure that basic needs of students are met	• Work with visiting groups to ensure they know what is expected of them and what they might need to be comfortable on-site. • Address safety issues in a reassuring way. • Establish a gear library for lending out gear. • Be attentive and responsive to student cues of discomfort.
Provide adequate emotional support	• Provide genuine positive feedback. • Use identity-based language to convey to students who they can be while on-site (explorers, scientists, friends). • Demonstrate care by checking in. • Normalize failure, inquisitiveness, and risk-taking. • Be responsive to questions and non-verbal cues. • Train educators on how to convey warmth and clear expectations.
Provide clear instructions	• Have a plan for making expectations clear for students throughout the experience. • Consider using pre-visit materials or visits to set clear expectations, provide basic vocabulary, or equipment training. • Demonstrate and enable students to practice with new equipment. • Ensure equipment is in consistent working order across individuals or groups. • Articulate a clear purpose for each activity. Why are we doing this?
Make experiences novel	• Emphasize/use/immerse in novel aspects of the setting. • Consider novel ways of interacting or viewing elements of the environment.
Manage students' attention	• Don't stay still for too long. • Avoid long fact-based lectures or sedentary presentations. • Ensure some variety in activities/content. • Don't leave students waiting around with nothing to do. Plan activities for unexpected down time. • Ensure enough roles, particularly in group work, to keep all students occupied.
Provide a cohesive and thematic experience	• Consider <i>why</i> the students are performing each activity and clearly communicate this to the students. If there is no clear 'why,' consider whether the activity should be included at all. • Develop a holistic theme for a field trip that clearly articulates the purpose of activities and ties them all together. • Use the underlying theme to provide connections and meaningful transitions between all elements of the program. • Plan sequencing to demonstrate the theme. • Make sure all students could answer, 'what was the point of this field trip?'

the incident, hardly looked concerned. He told a chaperone to walk the boy back to the nature center to get help, with the tentacles still wrapped around the boy's leg. After a short pause, rather than addressing the incident with the group, the educator simply went back to the business of using his dipnet to look for animals. The students were clearly frightened. 'Can we go back and sit down?' 'I'm scared!' 'This doesn't feel safe.' The educator didn't seem to notice and continued with his net. The visiting school teacher interjected, 'Can we have a quick reminder on how to spot the man o' war?' she asked, clearly frustrated that he hadn't already addressed this. The educator responded, 'That's really unfortunate that happened. We shouldn't have any more trouble with that though. But in addition to man o' war, there are things that can hurt us out here - that can stab through the mesh of our nets or sharp objects on the bottom of the ocean to watch out for. As for the man o'war you should be able to see them floating,' he said dismissively. Many students stopped participating in the activity and returned to the beach as the educator continued to use his dipnet to find animals to show them. Students were afraid to continue to participate, as their psychological need for safety was not met.

Other educators spent time to set students at ease at the beginning of their programs. For example, a number of instructors allayed students' fears by ensuring them they would be nearby if they saw anything that frightened them. Some talked about what it might be like to see animals, including predators, during their day, and assured students of their safety in various ways – sometimes anthropomorphizing the animals ('It is probably more scared than you'), noting that the animal is not interested in them but rather going about their usual activities, or providing clear guidance on what to do. Others talked about their personal benign experiences with dangers in nature. In one example, the educator made it a point to address students' fears about ticks. Early into the hike, the educator paused along the trail to study a long piece of grass that hung over the dirt path. The students pointed out an insect that sat on the tip of the grass blade. The educator plucked the grass and held it up so the students could take a closer look. 'This is a tick,' she stated. The kids gasped and took a step back. 'Well, look, see it can't jump onto my hand,' the educator held her arm close to the tick without touching it. 'See how it's reaching out with its little legs, trying to get me? Nah nah nah,' she teased. 'Look out for the ticks on these grasses, and you're safe as long as you don't brush against them,' she told them. 'Let's send this one on its way,' the educator threw the blade of grass into the forest. 'Whenever you see one today, feel free to carefully pluck it and send it into the forest. We'll be helping the next hiking group that comes behind us.' For the rest of the day, the students scrutinized the grasses as they walked, cheering for one another whenever one of them spotted, plucked, and sent a tick away from the trail.

Many educators also checked in regularly with students and offered support when needed, like a bathroom break, water, gear, or even some friendly commiseration and assurance that they'd be moving on soon. One organization had an organized check out system for warm weather gear in what they referred to as a 'gear library.' At the beginning of students' visit to the site, they were led in small groups to gather what they would need to be comfortable for the day while other groups used the bathrooms or received their introductory orientation to the site.

4.2.2. Emotional support

Emotional support refers to specific behaviors that educators can use to ensure that students feel welcome, respected, and emotionally safe to participate and learn (Pianta, La Paro, and Hamre 2008; O'Hare et al. 2020). These can include instances of 'affinity-seeking,' or demonstrations of positive forms of likeability, such as smiling, frequent eye contact, active listening, lending a hand, or leaning forward (Bell and Daly 1984; O'Hare et al. 2020; Pianta and Hamre 2009; Stern and Powell 2013); positive communication, when the educator encourages participation, praises students for their efforts, or checks in on their wellbeing (O'Hare et al. 2020; Pianta and Hamre 2009); and responsiveness, which involves acknowledging and positively reacting to students' needs, requests, questions, and non-verbal cues (Jacobson 1999; O'Hare et al. 2020; Stern and Powell 2013). Taken together, these elements can create a warm and supportive environment that can enhance student experiences and learning (Furrer and Skinner 2003; Merritt et al. 2012).

Examples of emotional support from our observations included simple positive communications, like high-fives, ‘nice job, everyone,’ and referring to students as ‘friends.’ In some cases, we witnessed special attention to creating a positive climate upon arrival to the field trip site. For example, at one site, the instructors invited the students to share what it was they were most excited to see and learn about during their visit. They then indicated to the students that they would do their best to meet all of those desires by working together. Emotional support also sometimes involved reassuring students that trial and error is an appropriate part of exploring and learning, rather than focusing on the ‘correct’ answer. Sometimes, this involved using identity-based language to set appropriate expectations, such as ‘today, we are going to be scientists,’ followed by a discussion of what that means. Acknowledging that science and exploration often (and sometimes necessarily) involve failure can lower students’ vulnerability associated with risk-taking.

Emotionally supportive behaviors also included being responsive to the needs of students by paying attention to both verbal and non-verbal cues. This does not necessarily mean that educators knew the answers to all students’ questions. Rather, emotional support could involve responding in a meaningful way that acknowledged the students’ concern or curiosity. For example, ‘That’s a great question. What do you think? Let’s look that up together when we get back to the nature center.’ Responding to non-verbal cues could include checking in on students who seem sad or frustrated in a kind and caring way, or shifting activities when students’ behavior shifts.

These types of approaches yielded more positive outcomes than neutral behaviors, such as going through the motions of teaching without generating meaningful connection with individual students. We also witnessed distinctly negative behaviors in this respect. We witnessed an educator saying ‘I hate kids,’ others scrolling their phones during lessons, and others taking heavy-handed or threatening approaches toward students or even belittling those having trouble following directions or who didn’t know the right answer. Sometimes, these negative behaviors happened right up front on a field trip. Other times, they emerged as the field trip went on, often when activity instructions were unclear. Student behavioral issues were more common when students did not clearly know what was expected of them, sometimes spurring negative responses from educators.

4.2.3. Instructional clarity

Instructional clarity enables students to know and understand what is expected of them and how they can fully participate in an activity. It can also enable students to better understand the purpose of their activities (see also 4.2.6, below). According to past research (e.g. Lee, Stern, and Powell 2020; Powell, Stern, and Frensley 2023), as well as this study, both clear on-site instruction and pre-trip preparation activities can support instructional clarity and enhance student outcomes. Some programs sent advanced materials to the classroom or even visited, either virtually or in-person, to clarify students’ expectations, cover relevant vocabulary, or introduce specific techniques.

Many programs used specialized instruments, such as compasses, microscopes, dipnets, dichotomous keys, water quality testing instruments, and other tools. Students’ use of these tools and their overall learning experience often hinged on the quality

of instructions provided by the educator. Strategies that appeared to work particularly well on-site included step-by-step demonstrations, practice before use, and clearly articulating the purpose of the activity. For example, when asking students to use a microscope, one educator first asked them to pick up the glass slide and hold it in the air, followed by taking the eye dropper and sucking up some water from the beakers. After checking that each student had done this correctly, he then explained and demonstrated how they should put a single drop of water on the glass slide, and then cover it with the plastic coverslip. After once again checking that each student had completed these steps, he continued the instructions on how to focus the microscope and what they should be seeing. He then walked around and helped students who were struggling to focus their microscope. This allowed each student to successfully complete the activity while also building their competence and self-efficacy.

The value of practice was clearly demonstrated by comparing two similarly-designed programs at the same site. In one, the educator first demonstrated how to properly use the dip net on land and had the students mimic her actions. She then led them to the water and had them practice again, providing helpful tips to students who needed further instruction. During the activity, students caught an abundance of sea creatures and were heard making comments like 'I am getting good at this!' and excitedly yelling, 'Look what I caught!' In contrast, the other program's educator only gave brief verbal instructions on how to use the nets. This led to a lack of success using the nets, which then led to a lack of engagement, an increase in off-task behavior, and less positive outcomes scores.

The articulation of a clear purpose can also contribute to instructional clarity. For example, during one program, the students were tasked with conducting a pH test. Without much introduction to the activity or its purpose, the educator told the students 'the closer you get to the middle the better, always aim for 7.' Without any further context, students were confused and were soon off-task once they had recorded their results. A similar result was observed when a water color change resulted from a dissolved oxygen test, but the educator provided no explanation of its meaning. In contrast, a similar program had students complete pH, dissolved oxygen, and salinity tests. To introduce the activities, the educator explained that rather than thinking about the results of these tests as good or bad, they should think about who (or which species) the water is good for. Each station had simplified instructions on a laminated sheet with pictures and diagrams that students were able to easily follow. At the conclusion of the activity, the educator walked students through a list of aquatic species and the water quality measures necessary for their presence. These students were better able to stay on task and drew meaningful conclusions from their measurements.

Purposeful preparation, or lack thereof, can also play a large role in instructional clarity. In one program, for example, the testing kits and their accompanying instructions were not consistent across groups. Some were missing critical components. The educator had to scurry from group-to-group to assess the situation and address different issues in each. Due to the time this took, the educator pivoted to conducting the dissolved oxygen test herself. In her flustered state, she failed to discuss the meaning of the test. In cases with nicely prepared kits and instructions, students were better able to stay on task.

4.2.4. *Novelty*

Novelty occurs when an experience feels new, unique, or unfamiliar (Jenkins 1969; Pearson 1970; Garst, Williams, and Roggenbuck 2009). Research suggests that novel experiences can inspire curiosity, learning, appreciation for new perspectives, and collaborative and collective action (Dale et al. 2020; DeWitt and Storksdieck 2008; Keltner et al. 2014; Garst, Browne, and Bialeschki 2011; Orion and Hofstein 1994). Simply being outside and doing hands-on activities does not necessarily make an experience feel novel to its participants. Rather, environmental educators can take advantage of what is unique and special about the field trip location. What perspective, point of view, resource, animal, or process can be highlighted and engaged with? Is there an immersive or unique way to interact with this environment? Is there a unique way to introduce content?

We all too often observed programs that felt like classroom science that simply happened to take place somewhere else. While there is nothing inherently wrong with a classroom approach to learning science, like looking through microscopes or filling out datasheets, programs that focused on novel aspects of their setting or created novel ways of interacting with their setting or subject matter tended to yield more positive outcomes. For example, one could conduct simple soil testing in the schoolyard. Why travel all the way to a national park to do the same? In some settings, students' excitement about new scenery was quickly dashed when the educators instead shifted their focus to something more mundane without connecting that content to the unique aspects of the place. For example, if students arrive on a mountaintop with a glorious view, immediately moving them indoors or to a place in the forest to look at leaf litter can deflate student excitement and engagement.

In other cases, educators emphasized what was special about their locations, in terms of habitat, ecosystem services, upstream and downstream effects, biological diversity, relationships between elevation and plant species, or other themes. Some programs enhanced novelty through immersion in familiar habitats, such as wading knee deep in a cypress swamp or implementing a slow-paced solo sensory walk on a short trail through a forest where students would encounter prompts to engage with different components of the ecosystem. Sometimes, programs took place in mundane locations. These could also be made novel to the students through the nature of the experience. Can students take off their shoes and feel the texture of the grass under their feet, find each other's tracks, get down on all fours and observe how ants carry materials across the sidewalk? Field trip sites commonly have novel components. Emphasizing novel experiences and calling attention to these components can enhance outcomes. In cases of extremely high novelty, attention to ensuring feelings of safety might help to attenuate distractions or fears (see 4.2.1).

4.2.5. *Maintenance of student attention*

Students' attention during programs waned for a number of reasons, most commonly due to a lack of engaging activities, a lack of variety in program structure, poor planning, or logistical problems. Some programs we observed involved long lecture periods. Those stretching beyond 20 minutes tended to erode student attention, especially those that were indoors and used PowerPoint slides. When students are

on a field trip, these conditions may conflict with their expectations of a more active and engaging experience.

Even in cases with highly engaging activities, attention can wane if the program feels too repetitive. For example, one program brought students on a nature hike and used an engaging technique known as claim, evidence, reasoning (CER). Students made observations and identified plants using evidence to support their claim and reasoning to back it up as they hiked through the forest. During the first half of the 2.5-hour program, students were engaged, asking good questions, and staying on-task. After a quick break for lunch, the program continued with the same exact approach for the rest of the day. As the program went on, most students lost interest, leading to off-task behavior and class management issues for the educator.

Many programs involved group work. In some cases, there were not enough roles during an activity for each member of the group to participate. In other cases, some groups finished well ahead of others and were asked to wait patiently until everyone was finished. In both cases, this led to off-task behavior and a decline in student engagement. We witnessed similar outcomes during games in which students who were 'out' were not given a task to keep them busy. In another case, poorly planned logistics led to attention problems. During this program, the students split into three groups to collect soil data at three different sites, requiring a bus to carry students back and forth. The bus inevitably got off schedule leading to students waiting up to 10 min for the bus to arrive after finishing data collection at their current site. Less positive outcomes were witnessed in each of these situations.

The maintenance of student attention benefits from good planning (ensuring variety and avoiding students waiting around with nothing to do) and responsiveness of educators in the moment. For example, in one program, when one group was waiting for another, the educator decided to engage her group of students in a scavenger hunt activity – seeking out the most interesting rocks they could find during a geology-related program and then making hypotheses about their form.

4.2.6. Cohesiveness and themes

As emphasized by the reasonable person model (Kaplan and Kaplan 2009), students benefit from understanding the purpose underlying their activities. Otherwise, their field trip experiences may seem like a series of disjointed events devoid of any coherent meaning. For example, many programs we observed involved rotating through stations. In one program, after a basic introduction to the site and its history, students rotated through a series of four different games, one focused on deer, another on camouflage, and two others on team-building and collaboration. In another program, a brief safety talk was followed by three stations: (1) how to survive in this ecosystem if stranded; (2) a series of hands-on team-building exercises; and (3) identifying aquatic organisms from a nearby lake using microscopes. Educators failed to provide meaningful connections between the content at each station or any meaningful conclusion as to what the students were supposed to get out of the overall experience.

In other cases, activities were woven together with a coherent theme introduced at the beginning of the field trip, reinforced within each activity and/or in transitions

between them, and summarized at the end of the visit. For example, in one program focused on a large wetland system, students were introduced to the concepts of food webs and the importance of water to this ecosystem. Throughout the experience, the educator used short interpretive stops, an active animal-spotting experience, a sensory walk, and two planned water-based activities to demonstrate key concepts about plant and animal adaptations, food webs, and ecosystem interactions (e.g. alligators making habitat for other animals and changing water flow; humans changing the flow and quality of water). During each stop along the trail and each planned activity, the educator reinforced the central theme that all parts of the ecosystem rely on water and that the organisms here, and we (the people living nearby) can have a strong influence the health of this place, and therefore, our own health. The connections were not always explicitly stated, but sometimes revealed through question-and-answer, through an example (e.g. an activity using sponges and water collected from the wetland to demonstrate how water quality can change), or a story (e.g. the history of changes in water flow and quality based on nearby dams or other forms of development). In each case, students could clearly understand the 'so what?' of the information shared or the activity. The conclusion used questions that brought students to share the central theme aloud in their own words.

The most successful programs provided a clear 'so what?' or central purpose. They connected all pieces of the experience to that central purpose or theme through intentional sequencing, meaningful transitions that linked together different pieces of the day (e.g. 'Now that we've just examined what's in the water here, think about what you might find as you make observations up the hill at your next station.'). and a solid introduction and conclusion. One program was structured as a complete investigation, beginning with observation and progressing through the development of a research question (about the health of a freshwater ecosystem), hypotheses, data collection, analysis, and conclusions (based on the presence of specific macroinvertebrates). In each case, programs could easily satisfy curricular requirements while also providing a more holistic experience and take-home message.

When students go home after a field trip, most could probably answer the question, 'What did you do on your field trip?' Using thematic communication to build a more cohesive experience enables them to answer a deeper question, 'What was the point of the field trip?' With this in mind, the non-cohesive programs described in the first paragraph of this section might have been able to tie their programming together with a theme like, 'A healthy community requires healthy interactions between its parts,' to link the otherwise seemingly disparate activities and give them a clearer and more holistic purpose.

5. Discussion and conclusions

This mixed method study combined qualitative analysis of observations with quantitative outcomes measures of single-day EE school field trip programs for adolescent youth in the USA to identify six key principles that appeared to enhance student outcomes on those programs. We have provided examples from our field observations and summarize the key principles and example practices in [Table 4](#). We posit that

there are many more ways that educators can embody these principles than those we observed in this study. We thus encourage educators to use their creativity and imagination in their pursuit, rather than trying to follow rigid practices that may or may not fit their contexts and audiences.

Each principle is attainable and trainable. Our fieldwork reveals, however, that we should not assume that all educators already know how to achieve them. In some cases, the same program run by different educators had varying scores for each principle and meaningfully different outcome scores. This suggests that only so much can be accomplished through program design. Training is critical to applying the principles. We witnessed many instances of negative class climate, with no attempts at emotional support; of poor instructional clarity; of failing to capitalize on the novel aspects of a place or a resource; and of severe attention depletion of students. We also saw many instances of field trips that felt like a series of disconnected activities without a clear purpose, in which students would be hard-pressed to understand why they were required to go on the field trip or what they were supposed to get out of it. We even witnessed instances where students were too cold or felt too unsafe to fully participate. We also, however, witnessed extremely positive instances of each principle in action. Our hope is that highlighting these principles can help program providers to reconsider the design of their programs as well as their staff trainings and will spur creative conversations among all parties involved in developing and delivering high quality experiences for students.

5.1. Limitations and future research

This study comes with some important caveats. First, no combination of principles provided perfect predictions. Student groups arrive with diverse skills, backgrounds, class climates, and pre-conceived notions. They can also arrive under varying circumstances (e.g. a chaotic bus ride or one with discipline issues). Even the most brilliantly designed program may not always achieve the best outcomes for students. Moreover, other principles, not identified in our study, may also contribute to high quality experiences. For example, other studies have found practices such as making content relevant to students' lives (Stern, Powell, and Hill 2014), asking questions that encourage critical thinking (Powell, Stern, and Frensley 2023), immersing in natural settings (Dale et al. 2020; Kiewra et al. 2023), storytelling (Alon and Tal 2015), and focusing on environmental issues (Ballantyne, Fien, and Packer 2001) to enhance student outcomes.

To take an even broader perspective, field trips are inevitably embedded within classroom experiences that come before and after the visit (Lee, Stern, and Powell 2020; Rudmann 1994; Stern and Powell 2020). This study did not account for experiences beyond the site visit, yielding only a comparative assessment of on-site conditions. Future research could expand on our comparative approach to study the influences of pre-visit preparation and post-visit follow-up. One might expect pre-visit preparation in particular to interact meaningfully with how students experience novelty on-site (Lee, Stern, and Powell 2020; DeWitt and Storksdieck 2008). Furthermore, looking beyond the site visit might yield greater insights not only into students'

preparation, but also into pedagogical approaches that might typically extend beyond the field trip, including issue-based learning, investigation-focused approaches, reflection, and other techniques that might complete the experiential learning cycle (Kolb 2015; Stern and Powell 2020).

Our methods may have also constrained our findings. We focused on a small subset of potential outcomes of EE field trips. Future studies might consider different sets of outcomes and different methods for measuring them, ranging from open-ended responses to survey questions to focus groups to visiting school teachers' assessments. Regarding data collection, our qualitative analysis passed through two sets of researchers – the field researchers and the principal investigators. Thus, the findings are inevitably colored by our own interpretations and potential biases. Our observations and coding processes were strongly grounded in prior research and theory. A different team might have keyed in on different programmatic elements, however.

Finally, the principles we have identified may or may not apply directly to other forms of environmental education beyond single-day field trips. For example, studies of residential (multi-day) programs have highlighted the importance of student autonomy (freedom and decision-making; Frensley et al. 2022). This characteristic did not emerge as a key distinguisher of the top vs. bottom-performing programs in the single-day field trips we observed, possibly due to their shorter duration and different expectations associated with each experience. We encourage researchers to continue to explore these ideas in a wider array of contexts to continue to build knowledge at the level of principles, while leaving adequate space for educators to flex their creativity to enhance student experiences.

Notes

1. The original sample contained no other ethnic/racial majorities.
2. We determined group majorities through conversations with their school teachers.
3. Results from individual subsamples (Latinx majority, 5-6th grade; Non-Latinx majority, 5-6th grade; and Non-Latinx majority 7-8th grade) are shared in the [Supplemental Materials](#). The results show no meaningful variance across subsamples.

Authors' contributions

Marc J. Stern: Funding acquisition, Conceptualization, Methodology, Analysis, Project administration, Supervision, Writing – original draft, Writing – reviewing and editing. Robert B. Powell: Funding acquisition, Conceptualization, Methodology, Analysis, Project administration, Supervision, Writing – reviewing and editing. B Troy Frensley: Methodology, Analysis, Writing – reviewing and editing. Kelley C. Anderson: Analysis, Writing – reviewing and editing. Lydia Ann Kiewra: Data collection, Data interpretation and analysis. Malia Pownall: Data collection, Data interpretation and analysis. Talia Schmitt: Data collection, Data interpretation and analysis. Emily G. Thorpe: Data collection, Data interpretation and analysis. All authors approve of the final version of the manuscript and agree to be accountable for its content.

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Data availability statement

Summary quantitative data is available in the [supplemental materials](#). Additional quantitative data with information that may identify program providers removed may be made available upon request to the corresponding author.

References

- Alon, N. L., and T. Tal. 2015. "Student Self-Reported Learning Outcomes of Field Trips: The Pedagogical Impact." *International Journal of Science Education* 37 (8): 1279–1298. <https://doi.org/10.1080/09500693.2015.1034797>.
- Anderson, K. C., M. J. Stern, and R. B. Powell. 2024. "Investigating the Influence of Preparation and Perceived Adult Support on Student Attendance to a Residential Environmental Education Program." *Environmental Education Research* 30 (2): 251–264. <https://doi.org/10.1080/13504622.2023.2247586>.
- Ardoin, N. M., A. W. Bowers, N. W. Roth, and N. Holthuis. 2018. "Environmental Education and K-12 Student Outcomes: A Review and Analysis of Research." *The Journal of Environmental Education* 49 (1): 1–17. <https://doi.org/10.1080/00958964.2017.1366155>.
- Ballantyne, R., and J. Packer. 2002. "Nature-Based Excursions: School Students' Perceptions of Learning in Natural Environments." *International Research in Geographical and Environmental Education* 11 (3): 218–236. <https://doi.org/10.1080/10382040208667488>.
- Ballantyne, R., J. Fien, and J. Packer. 2001. "Program Effectiveness in Facilitating Intergenerational Influence in Environmental Education: Lessons from the Field." *The Journal of Environmental Education* 32 (4): 8–15. <https://doi.org/10.1080/00958960109598657>.
- Behrendt, M., and T. Franklin. 2014. "A Review of Research on School Field Trips and Their Value in Education." *International Journal of Environmental and Science Education* 9 (3): 235–245.
- Bell, R. A., and J. A. Daly. 1984. "The Affinity-Seeking Function of Communication." *Communication Monographs* 51 (2): 91–115. <https://doi.org/10.1080/03637758409390188>.
- Boeve-de Pauw, J., J. Van Hoof, and P. Van Petegem. 2019. "Effective Field Trips in Nature: The Interplay between Novelty and Learning." *Journal of Biological Education* 53 (1): 21–33. <https://doi.org/10.1080/00219266.2017.1418760>.
- Cors, R., N. Robin, A. Mueller, and P. Kunz. 2018. "Towards a More Comprehensive Framework for Investigating Novelty at out-of-School Learning Places for Science and Technology Learning." *Progress in Science Education* 1 (1), <https://doi.org/10.25321/prise.2017.521>.
- Dale, R. G., R. B. Powell, M. J. Stern, and B. A. Garst. 2020. "Influence of the Natural Setting on Environmental Education Outcomes." *Environmental Education Research* 26 (5): 613–631. <https://doi.org/10.1080/13504622.2020.1738346>.

- Davis, R. E., K. Resnicow, and M. P. Couper. 2011. "Survey Response Styles, Acculturation, and Culture among a Sample of Mexican American Adults." *Journal of Cross-Cultural Psychology* 42 (7): 1219–1236. <https://doi.org/10.1177/0022022110383317>.
- Davis, R. E., T. P. Johnson, S. Lee, and C. Werner. 2019. "Why Do Latino Survey Respondents Acquiesce? respondent and Interviewer Characteristics as Determinants of Cultural Patterns of Acquiescence among Latino Survey Respondents." *Cross-Cultural Research: Official Journal of the Society for Cross-Cultural Research* 53 (1): 87–115. <https://doi.org/10.1177/1069397118774504>.
- DeWitt, J., and M. Storksdieck. 2008. "A Short Review of School Field Trips: Key Findings from the past and Implications for the Future." *Visitor Studies* 11 (2): 181–197. <https://doi.org/10.1080/10645570802355562>.
- Falk, J. H. 1983. "Field Trips: A Look at Environmental Effects on Learning." *Journal of Biological Education* 17 (2): 137–142. <https://doi.org/10.1080/00219266.1983.9654522>.
- Fenichel, M., & Schweingruber, H. A. (Eds.) 2010. *Surrounded by Science: Learning Science in Informal Environments*. Washington, DC: National Academies Press.
- Fisher, H. H., G. T. Hawkins, M. Hertz, S. Sliwa, and V. Beresovsky. 2022. "Student and School Characteristics Associated With COVID-19-Related Learning Decline Among Middle and High School Students in K-12 Schools." *The Journal of School Health* 92 (11): 1027–1039. <https://doi.org/10.1111/josh.13243>.
- Frensley, B. T., M. J. Stern, R. B. Powell, and M. G. Sorice. 2022. "Investigating the Relationships among Students' Basic Psychological Needs, Engagement, and Environmental Literacy at a Residential Environmental Education Center." *The Journal of Environmental Education* 53 (4): 186–198. <https://doi.org/10.1080/00958964.2022.2081654>.
- Furrer, C., and E. Skinner. 2003. "Sense of Relatedness as a Factor in Children's Academic Engagement and Performance." *Journal of Educational Psychology* 95 (1): 148–162. <https://doi.org/10.1037/0022-0663.95.1.148>.
- Garst, B. A., D. R. Williams, and J. W. Roggenbuck. 2009. "Exploring Early Twenty-First Century Developed Forest Camping Experiences and Meanings." *Leisure Sciences* 32 (1): 90–107. <https://doi.org/10.1080/01490400903430905>.
- Garst, B. A., L. P. Browne, and M. D. Bialeschki. 2011. "Youth Development and the Camp Experience." *New Directions for Youth Development* 2011 (130): 73–87. <https://doi.org/10.1002/yn.398>.
- Ham, S. 2016. *Interpretation: Making a Difference on Purpose*. Golden, CO: Fulcrum Publishing.
- Ham, S. H. 1992. *Environmental Interpretation: A Practical Guide for People with Big Ideas and Small Budgets*. Golden, CO: Fulcrum Publishing.
- Hemby, T. L., R. B. Powell, and M. J. Stern. 2024. "Availability and Distribution of Environmental Education Field Trip Programs for Adolescent Students in the US: A National Study of Spatial Accessibility." *Environmental Education Research* 30 (2): 214–234. <https://doi.org/10.1080/13504622.2023.2237706>.
- Jacobson, S. K. 1999. *Communication Skills for Conservation Professionals*. Covelo, CA: Island Press.
- Jenkins, J. A. 1969. "An Experimental Investigation of the Effects of Structured Science Experiences on Curiosity among Fourth Grade Children." *Journal of Research in Science Teaching* 6 (2): 128–135. <https://doi.org/10.1002/tea.3660060204>.
- Kahn P. H., & Kellert, S. R. Jr (Eds.) 2002. *Children and Nature: Psychological, Sociocultural, and Evolutionary Investigations*. Cambridge, MA: MIT Press.
- Kaplan, S., and R. Kaplan. 2009. "Creating a Larger Role for Environmental Psychology: The Reasonable Person Model as an Integrative Framework." *Journal of Environmental Psychology* 29 (3): 329–339. <https://doi.org/10.1016/j.jenvp.2008.10.005>.
- Keltner, D., A. Kogan, P. K. Piff, and S. R. Saturn. 2014. "The Sociocultural Appraisals, Values, and Emotions Framework of Prosociality: Core Processes from Gene to Meme." *Annual Review of Psychology* 65 (1): 425–460. <https://doi.org/10.1146/annurev-psych-010213-115054>.
- Kiewra, L., R. B. Powell, M. J. Stern, T. Hemby, and M. H. Browning. 2023. "Is Naturalness Associated with Positive Learning Outcomes during Environmental Education Field Trips?" *The Journal of Environmental Education* 54 (2): 148–162. <https://doi.org/10.1080/00958964.2022.2157369>.

- Kohlberg, L. 1971. *Stages of Moral Development as a Basis for Moral Education*, 24–84. Cambridge: Center for Moral Education, Harvard University.
- Kolb, D. A. 2015. *Experiential Learning: Experience as the Source of Learning and Development*, 2nd ed. Upper Saddle River, NJ: Pearson Education, Inc.
- König, C., and A. Frey. 2022. "The Impact of COVID-19-Related School Closures on Student Achievement—A Meta-Analysis." *Educational Measurement: Issues and Practice* 41 (1): 16–22. <https://doi.org/10.1111/emip.12495>.
- Kroger, J. 2006. *Identity Development: Adolescence through Adulthood*. London, UK: Sage publications.
- Kuhfeld, M., K. Lewis, and T. Peltier. 2023. "Reading Achievement Declines during the COVID-19 Pandemic: Evidence from 5 Million US Students in Grades 3–8." *Reading and Writing* 36 (2): 245–261. <https://doi.org/10.1007/s11145-022-10345-8>.
- Lee, H., M. J. Stern, and R. B. Powell. 2020. "Do Pre-Visit Preparation and Post-Visit Activities Improve Student Outcomes on Field Trips?" *Environmental Education Research* 26 (7): 989–1007. <https://doi.org/10.1080/13504622.2020.1765991>.
- Maslow, A. H. 1954. *Motivation and Personality*. New York: Harper.
- Maxwell, R., and R. Dickman. 2009. *The Elements of Persuasion: Use Storytelling to Pitch Better, Sell Faster, and Win More Business*. New York: Harper Collins.
- Merritt, E. G., S. B. Wanless, S. E. Rimm-Kaufman, C. Cameron, and J. L. Peugh. 2012. "The Contribution of Teachers' Emotional Support to Children's Social Behaviors and Self-Regulatory Skills in First Grade." *School Psychology Review* 41 (2): 141–159. <https://doi.org/10.1080/02796015.2012.12087517>.
- O'Hare, A., R. B. Powell, M. J. Stern, and E. P. Bowers. 2020. "Influence of Educator's Emotional Support Behaviors on Environmental Education Student Outcomes." *Environmental Education Research* 26 (11): 1556–1577. <https://doi.org/10.1080/13504622.2020.1800593>.
- Orion, N., and A. Hofstein. 1994. "Factors That Influence Learning during a Scientific Field Trip in a Natural Environment." *Journal of Research in Science Teaching* 31 (10): 1097–1119. <https://doi.org/10.1002/tea.3660311005>.
- Pearson, P. H. 1970. "Relationships between Global and Specified Measures of Novelty Seeking." *Journal of Consulting and Clinical Psychology* 34 (2): 199–204. <https://doi.org/10.1037/h0029010>.
- Piaget, J. 1964. "Cognitive Development in Children." *Journal of Research in Science Teaching* 2 (3): 176–186. <https://doi.org/10.1002/tea.3660020306>.
- Pianta, R. C., and B. K. Hamre. 2009. "Conceptualization, Measurement, and Improvement of Classroom Processes: Standardized Observation Can Leverage Capacity." *Educational Researcher* 38 (2): 109–119. <https://doi.org/10.3102/0013189X09332374>.
- Pianta, R. C., K. M. La Paro, and B. K. Hamre. 2008. *Classroom Assessment Scoring System™: Manual K-3*. Baltimore, MD: Paul H. Brookes Publishing Co.
- Powell, R. B., M. J. Stern, and B. T. Frensley. 2023. "Which Approaches Are Associated with Better Outcomes? Evidence from a National Study of Environmental Education Field Trip Programs for Adolescent Youth in the United States." *Environmental Education Research* 29 (3): 331–356. <https://doi.org/10.1080/13504622.2022.2145270>.
- Powell, R. B., M. J. Stern, B. T. Frensley, and D. Moore. 2019. "Identifying and Developing Crosscutting Environmental Education Outcomes for Adolescents in the Twenty-First Century (EE21)." *Environmental Education Research* 25 (9): 1281–1299. <https://doi.org/10.1080/13504622.2019.1607259>.
- Ragin, C. C. 2009. *Redesigning Social Inquiry: Fuzzy Sets and beyond*. Chicago, IL: University of Chicago Press.
- Rickinson, M. 2001. "Learners and Learning in Environmental Education: A Critical Review of the Evidence." *Environmental Education Research* 7 (3): 207–320. <https://doi.org/10.1080/13504620120065230>.
- Rudmann, C. L. 1994. "A Review of the Use and Implementation of Science Field Trips." *School Science and Mathematics* 94 (3): 138–141. <https://doi.org/10.1111/j.1949-8594.1994.tb15640.x>.
- Ryan, R. M., and E. L. Deci. 2000. "Self-Determination Theory and the Facilitation of Intrinsic Motivation, Social Development, and Well-Being." *The American Psychologist* 55 (1): 68–78. <https://doi.org/10.1037/0003-066x.55.1.68>.

- Smith-Sebasto, N. J., and L. Cavern. 2006. "Effects of Pre-and Posttrip Activities Associated with a Residential Environmental Education Experience on Students' Attitudes toward the Environment." *The Journal of Environmental Education* 37 (4): 3–17. <https://doi.org/10.3200/JOEE.37.4.3-17>.
- Sobel, D. 2008. *Childhood and Nature: Design Principles for Educators*. Portland, ME: Stenhouse Publishers.
- Stern, M. J. 2018. *Social Science Theory for Environmental Sustainability: A Practical Guide*. Oxford, UK: Oxford University Press.
- Stern, M. J., and R. B. Powell. 2013. "What Leads to Better Visitor Outcomes in Live Interpretation?" *Journal of Interpretation Research* 18 (2): 9–43. <https://doi.org/10.1177/109258721301800202>.
- Stern, M. J., and R. B. Powell. 2020. "Field Trips and the Experiential Learning Cycle." *Journal of Interpretation Research* 25 (1): 46–50. <https://doi.org/10.1177/1092587220963530>.
- Stern, M. J., R. B. Powell, and B. T. Frensley. 2022. "Environmental Education, Age, Race, and Socioeconomic Class: An Exploration of Differential Impacts of Field Trips on Adolescent Youth in the United States." *Environmental Education Research* 28 (2): 197–215. <https://doi.org/10.1080/13504622.2021.1990865>.
- Stern, M. J., R. B. Powell, and D. Hill. 2014. "Environmental Education Program Evaluation in the New Millennium: What Do we Measure and What Have we Learned?" *Environmental Education Research* 20 (5): 581–611. <https://doi.org/10.1080/13504622.2013.838749>.
- Thomas, R. E., T. Teel, B. Bruyere, and S. Laurence. 2019. "Metrics and Outcomes of Conservation Education: A Quarter Century of Lessons Learned." *Environmental Education Research* 25 (2): 172–192. <https://doi.org/10.1080/13504622.2018.1450849>.
- UNESCO. 1977. "The Tbilisi Declaration." In *Intergovernmental Conference on Environmental Education*, 14–26. Tbilisi, GA: UNESCO.
- Van De Wetering, J., P. Leijten, J. Spitzer, and S. Thomaes. 2022. "Does Environmental Education Benefit Environmental Outcomes in Children and Adolescents? A Meta-Analysis." *Journal of Environmental Psychology* 81: 101782. <https://doi.org/10.1016/j.jenvp.2022.101782>.
- Warren, K., N. S. Roberts, M. Breunig, and M. A. T. G. Alvarez. 2014. "Social Justice in Outdoor Experiential Education: A State of Knowledge Review." *Journal of Experiential Education* 37 (1): 89–103. <https://doi.org/10.1177/1053825913518898>.