Embedding Sustainability Instruction Across Content Areas: Best Classroom Practices From Informal Environmental Education

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ABSTRACT

Environmental education (EE) facilitates students' scientific and environmental literacy, and addresses content areas including sustainability, ecology, and civic responsibility. However, U.S. science content compartmentalization and EE's interdisciplinary nature historically made it a fragmented curriculum within U.S. schools. To gain a better understanding of effective EE instruction that can be transferred to traditional K–12 classrooms, we researched the interactions between a recognized environmental residential camp and students and teachers from six participating schools using grounded theory methodology. Our research identified the residential learning center's objectives, methods of instruction, and objectives' alignment to the delivered curricula. Data generated included lesson plans, survey responses, and interviews. Students ($n = 215$) identified wilderness and geology activities as the activities they wanted to experience more; they also identified developing curiosity and a sense of discovery as the most meaningful. Whereas most student-identified meaningful experiences aligned with the center's curricular objectives within the optional units, categories emerged that were not explicitly targeted in the unit activities but were embedded throughout the curriculum in sustainable practices, data collection, and reflections. We propose that embedded activities and implicit instruction can be included across content areas within K–12 classrooms. Teacher modeling and implicit instruction will require minimal classroom time, and facilitate students' scientific and environmental literacy in topics such as sustainability and citizen responsibility. © *2017 National Association of Geoscience Teachers*. [DOI: 10.5408/16-167.1]

Key words: sustainability, environmental education

INTRODUCTION

In order to build students' understanding of sustainability, we must facilitate effective learning about the complex interactions between our society and the environment. Whereas several movements attempted to include this content in our schools' curricula, the majority of programs have had limited success. Cumulatively the programs that address society and environment have become known as environmental education, or EE.

It is through EE that instructors can address topics such as sustainability, ecology, and citizen responsibility. However, EE is interdisciplinary in nature. This results in a major challenge since EE lacks a formal niche in the K–12 curriculum. Another challenge is that effective EE includes outdoor components. In order to improve sustainability instruction within traditional science classrooms, we researched the instruction and interactions within an environmental education center that is recognized for its successful EE teacher and student programs, the Great Smoky Mountain Institute at Tremont (GSMIT). We recognized that since EE exists within a fragmented curriculum and K–12 teachers must address extensive state-mandated content, effective sustainability instruction—and broader EE instruction—must be streamlined and easily incorporated into classroom activities and daily routines. Therefore, our GSMIT research determined which best practices might be transferrable to the formal classroom without consuming teachers' limited instructional time.

Definitions of Environmental Education

The definition of EE has evolved over the years, but central components have remained constant. Stapp (1969) explained that the purpose of EE "is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution" (p.34). In this definition are found two major components: knowledge and action. The knowledge segment is represented by two areas: ecological principles and problem-solving skills. The action component in Stapp's definition is simply explained as motivation to work toward a solution.

Other documents used to establish a definition for EE include the U.S. Environmental Education Act of 1970 (Public Law 101-619, which established the Office of Environmental Education), the 1972 Belgrade Charter (UNESCO workshop, which developed an international goal for EE), the 1977 Tbilisi Declaration (EE framework, principles, and guidelines) and the North American Association for Environmental Education (NAAEE) *Excellence in Environmental Education: Guidelines for Learning* (NAAEE, 2004). Through examination of these historical documents, Walker (2012) identified three specific content areas of environmental education: (1) knowledge of ecological principles, (2) issue identification and solution, and (3) civic responsibility and motivation. Effective EE includes using appropriate pedagogical strategies to facilitate student

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TABLE I: History of environmental content within our schools.

Nature study	In 1911, Comstock and Gordon published the *Handbook of Nature-Study*, which provided teachers/readers with observation-driven investigations to guide their instruction/study of nature and made nature study more accessible to the public (Comstock and Gordon, 1939).
Outdoor education	In 1918, a Los Angeles school set up a campsite where students cleared the land and built crude log cabins. In 1919, a resident outdoor camp was established by the Chicago Public Schools. In the 1930s, the educational value of school camping pushed for schools to incorporate positive outdoor education experiences (Hammerman, 1978).
Conservation education	In the 1950s, conservation curricula closely followed the view of conservation proposed by Aldo Leopold, who pushed for balance between sensible resource consumption while maintaining habitat quality (Carter and Simmons, 2010).
Environmental education	The U.S. Environmental Education Act of 1970, the 1972 Belgrade Charter, and the 1977 Tbilisi Declaration brought environmental issues in to U.S. classrooms. Content included aspects of earlier efforts resulting in broad unfocused curricula, which was then refined by the NAAEE (Carter and Simmons, 2010).

learning in all three of these content areas. McComas (2003) outlined the ideal environmental science curriculum, and noted, "An environmentalist who takes action without understanding the science behind his cause is just as uninformed as the student who scores high marks on the ecology test and fails to understand that there are rational causes worth fighting for" (p. 178). Therefore, the absence of one component will not only limit the success of a program, but also can be detrimental to its mission.

U.S. ENVIRONMENTAL EDUCATION: THE FRAGMENTED CURRICULUM

U.S. schools have addressed environmental content for over a century. Beginning in 1911, the *Handbook of Nature-Study* focused upon nature through observation-driven investigations (Comstock and Gordon, 1939). This study of nature transitioned into education in outdoor environments, and then conservation education in the 1950s, based on the views of Aldo Leopold. U.S. environmental education began in the 1970s, with incorporation of environmental issues in U.S. classrooms in 1977. Table I provides a summary of programs and the core goals of each.

Being interdisciplinary in nature made it difficult for EE to fit into the disciplinary curricular system that was in place since 1918 with the Commission on the Reorganization of Secondary Education. Geared to preparing students for vocational training, this curriculum reorganization involved reducing the number of sciences offered in high school to accommodate college entrance requirements. One result was that high school science subjects were divided up into what we often see today: general science followed by biology, chemistry, physics, and maybe earth science (DeBoer, 1991). With this scientific discipline isolation, it was difficult to address topics, such as sustainability and civic responsibility, which overlap various science domains.

In our educational system EE was usually either ignored or viewed as a supplement to the existing science curriculum. McComas (2003) found that 10 of 13 secondary biology textbooks had only a discrete chapter or section addressing ecology and over half of these books included it in the final chapters, all but guaranteeing that this important content would only be covered if time allowed. Effective EE instruction also requires students to address issues beyond science (Disinger, 2001). Although some aspects of EE fit into the existing curricula of science, the civic mindedness involved with sustainability would be better taught in social studies. In our current educational system, the two are usually not connected. There may be potential for integrative, interdisciplinary incorporation of sustainability concepts in K–12 classrooms with the Next Generation Science Standards (NGSS Lead States, 2013). However, the states/schools we researched had not adopted NGSS during this investigation, and only 14 states had adopted NGSS by January 2015 (Heitlin, 2015).

Effective instructional methods that can address the three EE content areas are outdoor education, experiential education, inquiry investigations and analysis of case studies (Walker, 2012; NAAEE, 2004). Students need to have an outdoor experience on which to frame their learning of ecological principles. They need to conduct inquiry-based investigations to develop ownership of the information and analyze case studies to guide their decisions formulated from that new understanding. This process leads to deeper levels of understanding and requires a larger level of commitment from both the teacher and student (Walker, 2012). A critical analysis of the EE programs at the GSMIT revealed significant positive short-term effects and retention of gains in environmental stewardship and awareness 3-months after the student experience (Stern, et al., 2008).

METHODS

In order to determine the characteristics of effective environmental education that can be transferred to traditional classroom settings, we observed and analyzed the instruction and interactions between the GSMIT, a residential environmental learning center, and participating schools. This process allowed researchers to extrapolate the best practices for sustainability instruction into other learning environments. In many cases where curricula include social responsibility and civic mindedness, topics of sustainability are superficial and focused on behaviors such as recycling—not deeper constructs such as shifting values toward more sustainable development (Scott, 2015). Elements of effective instruction transfer between formal and informal settings with the ideal learning experience including a balance of each. Therefore, this study involved analysis of data generated on both sides of a dynamic relationship. The research questions guiding this investigation included (1)

What are the outlined objectives of the residential environmental learning center; and (2) What methods of instruction are used by the residential learning center to meet the stated learning objectives and how does this align to the delivered curricula?

Study Site

Established in 1969, GSMIT is considered to be not only a leader in residential environmental learning centers, but also it is one of the longest running programs in the United States. GSMIT has an active research agenda designed to improve instruction and evaluate impact on student learning (Walker, 2012). The contributions of GSMIT, through the engagement of teachers in EE and Education for Sustainable Development (ESD), pushes the discussion of sustainability beyond that of superficial topics to that which facilitates deeper change. By engaging educators (formal and informal) and education researchers in a systematic focused effort, we will begin to understand how these efforts contribute to a larger sustainable movement.

Data generated from GSMIT include lesson plans, interviews with three members of the educational leadership, interviews with six teacher naturalists, and an interview with the director. The authors research sustainability, environmental education, and informal education and have interacted with GSMIT's programs, both on site and through virtual instruction. Walker also involves preservice teacher courses in experiential learning at GSMIT. We wanted to understand which aspects of the GSMIT experience students were taking away, and which can offer potential transferability for traditional school environments.

Annually, students in grades six to eight from 62 schools attend GSMIT programs. The "school season" runs from September through November and again from February through May. Of these schools, 39 are public and 23 are private. The length of stay ranges from three to five nights, with an average stay of 3.53 days (Walker, 2012). Furthermore, 86% of these schools participate in cooperative teaching, which requires classroom teachers to teach during a portion of the GSMIT experience. Therefore, the total sample is self-selected, and represents those schools and/or teachers who value experiential learning. From this population, we identified a purposeful criterion sample of six schools, with schools that (1) participate in cooperative teaching; (2) span the average length of stay (e.g., four schools that stay for three nights, and two schools that stay five nights); (3) include public schools (3) and private schools (3); and (4) participated during February and March. Our selected population was comprised of three schools from urban areas (Nashville, TN [2]; Mobile, AL), and three schools from rural areas within Tennessee. Collectively, the participating students had little exposure to outdoor education, and none specifically within the Smoky Mountains National Park. Data generated from the schools included seven interviews with lead teachers, who coordinate travel and participate in instruction during the GSMIT experience, six interviews with school administrators (one interview/school), and surveys of the participating students ($n = 215$). Data are reported by each school case study, and identified as Case 1 through Case 6.

Data Analysis

The contributions from both the school and GSMIT were interpreted together as a grouped pair. This unit of analysis was essential because none of schools had the same experience at GSMIT. GSMIT tailors their program to meet the individual needs of each school, its students and teachers. Participating teachers preselect the GSMIT units in which they want their students to participate. For each unit, GSMIT has identified objectives and corresponding activities to accomplish them, and these units/activities are typically three to four hours in duration, and conducted either as morning or afternoon sessions. Therefore, impressions of field observations are specific to each case study. These data inform the analysis based upon grounded theory methodology (Strauss and Corbin, 1998) of the cooperative teaching model, and thus represent the unique interactions between each teacher and each naturalist instructor that occur during each collaborative lesson. Data for this investigation were generated via examination of 42 lessons/unit modules, interviews with seven teachers and 10 naturalist instructors, and surveys of 215 students.

Immediately after the residential program, students were asked to complete an open-ended questionnaire/survey, which is a variation of the minute-paper and muddiest-point assessment technique used by Smith-Sebasto and Obenchain (2009). Students responded in writing to the following questions: (a) What was the most meaningful thing you learned? (b) What was the most confusing aspect of your experience? and (c) What was the experience you would like to repeat or topic about which you would like to learn more? Smith-Sebasto and Obenchain (2009) explained that because this technique only requires students to respond using one or two sentences, it is effective with all students, including those who struggle with writing or are reluctant to speak. They also reinforced that it is important for the individual administering the questionnaire to demonstrate respect for the students' thoughts and opinions. The data generated from these surveys were transcribed, coded, and analyzed.

All coding was conducted by one researcher, and a second researcher checked the validity of the codes across all data. Coding proceeded through a reductionist coding approach in grounded theory (Strauss and Corbin, 1998), and often involved multiple coding of students' open-ended responses, which were separated out according to emerging themes.

OUTCOMES

What Are the Outlined Objectives of the Residential Environmental Learning Center?

GSMIT identifies their main objective as connecting people to nature. There are four strands at the heart of this mission: (1) experiential learning of nature, (2) biodiversity within nature, (3) stewardship, and (4) life skills (Walker, 2012). These concepts are woven through all aspects of the GSMIT experience and curriculum via both explicit and implicit (i.e., embedded) instruction.

The experiential learning through nature involves participants' realization that they are part of a bigger system, and includes development of understanding of deeper concepts such as how one's actions influence ecosystems or how choices and behavior influence culture and community. Participants gain an understanding of biodiversity when they are able to perceive the infinite complexity of natural systems and how all components are interconnected

TABLE II: Teachers' perceptions of the delivered curriculum by targeted strand.

Stated GSMIT Objective	Number of Teachers	Percent	Representative Quote
Experiential learning/discovery	3	50	"I want them to know it is ok and it is fun to be out there to touch things and to get dirty. That's part of science, and that's what makes it cool, all of those things." (Case 6)
Nature/biodiversity	6	100	"I want them to develop a greater appreciation for nature and to know that it's not a scary place." (Case 6)
Stewardship	2	33	"[the students]... to develop habits of stewardship that will go beyond Tremont to home and the community." (Case 4)
Life skills	6	100	"Life skills, we are building the responsibility, mom and dad are not there to take care of them so it is building that independence." (Case 1)

and dependent upon one another. Ecological and organism variations and sustainability play a large role in understanding this concept because life itself impacts how ecosystems work and that each organism, no matter how small, has a purpose. The concept of stewardship involves humankind's responsibility to not only protect these natural systems, but also to learn about them and gain understanding of the interactions between systems.

Data generated from teacher interviews included the importance of students' gaining life skills. Table II presents teacher perceptions of the overall message. All teachers ($n = 6$) responded that they wanted their students to develop a connection with nature, GSMIT's primary objective. One teacher remarked that she/he wanted students to realize that nature is "not a scary place." A third of the teachers responded that they wanted their students to develop a sense of stewardship ($n = 2$), and transfer this stewardship "beyond Tremont to home and the community." Half of the teachers responded that they wanted their students to develop a curiosity for the natural world and a sense of discovery ($n = 3$). No teachers specifically mentioned that they wanted their students to develop an increased awareness of the national park, but we cannot assume that they perceive this to be an undesirable objective. All teachers responded that they wanted their students to develop life skills during the experience ($n = 6$). The quotes in this table provide an example of the types of responses that were coded into each category.

What Methods of Instruction Are Used by the Residential Learning Center to Meet the Learning Objectives and How Does This Align to the Delivered Curricula?

Student perceptions of the experience are influenced by the GSMIT units in which the schools participated. We analyzed GSMIT schedules of instructional activities within the units, and the surveys detailing student perceptions of the activities they would like to spend more time doing, and the aspects of the experiences they found to be most meaningful. The list of GSMIT units in which sample schools participated were coded into content areas that reflected the major theme or topic of the lesson. This coding scheme revealed nine initial categories: (1) Astronomy; (2) Wilderness Navigation; (3) Ecology/Ecosystems; (4) Friends/Social; (5) Geology; (6) History; (7) Physical Exercise; (8) Teamwork; and (9) Wildlife. Student questionnaire responses from the experience about topics they would like to know more about fall into these categories. Two additional categories emerged from the coding process: (10) Other and (11) Nothing. Additionally, two categories emerged *that did not align with the explicit content of the lessons specifically,* but to the overall GSMIT experience itself. These categories were (12) Connection to nature and (13) Self-awareness. These two categories are embedded as a part of the entire GSMIT experience and implicitly incorporated within several lessons.

Table III presents topics, GSMIT activities, and percentages for student responses with respect to experience they would like to do more often. The total number of possible respondents is different for each activity ($n = 106$, through $n = 215$) because GSMIT custom tailored activities to each school group, and not all schools selected to participate in the same available units. The enjoyment of these activities and the desire for more of them ranged from a low of 1.7% (wilderness navigation) to activities favored by approximately one quarter of participants: 25.6% (wilderness activities) and 22.5% (geology activities). One student response that did not align with these topics indicated that he/she would not like to repeat any aspect of the experience.

All 215 students participated in features of the experience that *were not the primary objective of a specific lesson* but are considered to be important characteristics of the program. Importantly, GSMIT also required students to *reflect* on their experiences, and analyze the relationship of the activity to the "big picture." Eleven students' responses identified that having the opportunity to connect with nature was something of which they would like to do more (5.1%). GSMIT activities were specifically designed to provide students an opportunity to interact with nature on their own, and all students participated in these program aspects (Fig. 1). Sixteen of the students responded that this—interacting with nature on his/her own—is something that they would like to do more (7.4%).

Analysis of students' responses for aspect of the program they would like to do more of supported the following:

- 25.6% of the students wanted to spend more time interacting with wildlife.
- 22.5% of student said they would like to learn more about the geology of the park and repeat the hike to the falls.
- 12.8% of the students wanted to repeat the all-day hike because they enjoyed the physical challenge component of that experience.

TABLE III: Student perceptions of the aspects they wanted to experience more often.

Topic	GSMIT Activities	Total	Responses	Percent
Wildlife	Stream life, wildlife, salamander monitoring and the scientific method, insect search, night walk	215	55	25.6
Geology	Geology hike to the falls	129	29	22.5
Physical exercise	All-day hike	133	17	12.8
Friends/social	Campfire, games, hired entertainment, storytelling, music	215	26	12.1
Ecology/ecosystems	Life in the forest, little creatures, trees are tremendous, Freddie the fungus, eco-Jeopardy	196	19	9.7
Astronomy	Astronomy	133	12	9.0
History	Cades Cove, Native American cultures & history, Little Greenbrier School, Walker Valley living history	152	12	7.9
Self-aware	Solo sit, solo hike, getting lost on trails	215	16	7.4
Nature	Unplugged, explore, view/scenery	215	11	5.1
Teamwork	Cooperation course	106	4	3.8
Wilderness navigation	Wilderness navigation, explorations	177	3	1.7
Nothing	n/a	215	1	.5

FIGURE 1: Students experienced natural environments at GSMIT, including within group hikes. However, students also appreciated the opportunity to connect with nature on their own (GSMIT).

- 12.1% of student wanted to repeat the social activities like the campfires, storytelling, and musical performances.

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One teacher pointed out how the experience helps build life skills: "Nature has a way of sorting things out. In the classroom students can scrounge up a pencil or paper, but if the only thing you brought [to GSMIT] was a hoodie you're going to be cold." A total of 215 students ($n = 215$) completed the student questionnaire/survey, and these data support the importance of developing these life skills. Table IV presents student identifications of the most meaningful aspect of the experience.

Students' identified meaningful aspects included the less-favored development of life skills (12.1%) and awareness of environmental issues in the national park (12.6%) to the most-favored meaningful aspect of the experience, development of curiosity for the natural world and a sense of discovery (32.1%). Other issues addressing sustainability, an opportunity to develop a connection with nature (19.1%) and stewardship (14.0%), were rated in the middle of the spectrum. Ten percent ($n = 22$) of students' responses did not align with the established objectives. The student responses in the "other" category did not have an

TABLE IV: Student questionnaires: student-identified meaningful aspects of the experience.

GSMIT Category	Number of Students	Percent	Representative Quotes
Nature	41	19.1	"The most meaningful thing that I learned is that you should take time to stop, look around, and enjoy nature."
Stewardship	30	14.0	"To be careful with nature and that everything around you is to help us live."
Discovery	69	32.1	"When you look at things with a child's glance you learn more, and you have a better time."
Awareness	27	12.6	"I learned that the Smokies have the most diverse population of salamanders"
Life skills	26	12.1	"I learned that if you work together, you can do anything"
Other	22	10.2	"It is the memories with my BFF's [friends]"
TOTAL (N)	215	100	

underlying theme that would support the development of an additional category.

EXPLICIT VERSUS IMPLICIT INSTRUCTION

Many of the aspects of the GSMIT residential camp that students wanted to participate in corresponded directly to the lessons their schools selected when planning their residential EE-experience—confirming that instructional objectives were successful at engaging the students. However, there were also topics that emerged that were not directly aligned to the school-selected units' planned activities, but were embedded throughout the greater GSMIT experience. The only two topics that emerged that were *not* related to any specific lesson, and were a component of *all* lessons, were the opportunity to connect with nature, and solitary opportunities to interact with nature. These categories, specifically unaligned to objectives within the GSMIT units, emerged as activities that students wanted to experience more (Table III). Further student support emerged within the nature category (Table IV) for the most meaningful experience of the EE experience. The overarching objectives, as defined by the GSMIT staff and teachers, were clearly aligned to the delivered outcomes in all other categories. However, these objectives were not specifically outlined to any one class or activity, but incorporated into the entire experience and extended beyond traditional instruction.

Aspects of the Experience That Go Beyond Instruction

During the GSMIT experience, students participated in many activities that were aligned with the objectives and themes that were not explicitly taught in regular instruction. These lessons or activities are an embedded and *implicit* part of the experience and extend beyond regular instruction. Our observations at the camp revealed several of these implicit learning opportunities including (1) zero food waste at meal times, (2) custodial captains, (3) data connection at the weather station, and (4) reflection time on the relationship of activities to the overall picture of sustainability. As part of the GSMIT EE experience, these aspects play an influential role for the students receiving the delivered curriculum.

Food Waste

At the first meal time, the GSMIT staff explains to the students how the logistics of meal time work. Staff explain where students will get the food, how they can get second servings, and how they will be expected to clean up after themselves. Furthermore, they explain that food is energy and that we should conserve energy any way we can. They inform the students that food waste is excess food that you take but don't eat. They encourage students to make sure they like something first before they load up their plate with it, and even then they should only take what they can eat comfortably. The staff then reminds the students that if they want more they can have seconds, thirds, and fourths. The staff then explains that they will be collecting food waste at the end of each meal and that they will chart the amount accrued by the group over the duration of the visit.

Teacher interviews revealed that this aspect of the experience offered students an opportunity to see firsthand how wasteful they are in their daily lives, and also how much students take for granted that there is an abundance of inexpensive food. Students can also begin to understand how their choices add up and that collectively they can make a difference. However, one teacher minimized the significance of this experience by expressing concern for students who already undergo social pressures related to eating disorders. This teacher sees the competitive aspect of achieving zero food waste as putting unnecessary guilt on students, forcing them to overeat even though they are full. This concern is addressed by the staff daily by reminding the students that eating is not a competition, but the reason for doing this activity is to raise awareness. The majority of the schools in this study challenged their students to make wise decisions, to be accountable, and to improve (Fig. 2). This perspective is in line with that of the GSMIT staff; they understand if there is some food waste, but want to see the amount of student food waste decrease throughout the duration of the GSMIT encounter. This will indicate that students are thinking critically and making informed decisions.

Custodial and Food Captains

During the experience, students are expected to take responsibility for not only the cleanliness of the facility, but also the day-to-day functioning of the facilities. This is accomplished through the implementation of custodial and table captains. Each student assumes these roles at least

FIGURE 2: A consistent theme running through the GSMIT experiences is the zero food waste policy. Campers are encouraged to only take what they will eat, although food is not limited. All schools participate and strive to be part of the Zero Food Waste Hall of Fame (GSMIT).

once during his or her program at GSMIT. Custodial captains coordinate the cleanup of dormitories and table captains direct the family style meals and cleanup of the cafeteria. All teachers in this study confirmed that this is an important aspect of the experience that helps the students develop life skills and responsibility. One teacher pointed out that these expectations often conflict with the students' perception of entitlement, and by assuming these responsibilities allows them to see that they can be self-reliant.

Weather Data

Every morning at GSMIT, students meet at 7:45 AM to collect weather data. This experience is usually voluntary, but some schools require students to participate at least once during their time at GSMIT. This activity allows students an opportunity to not only collect data, but also read instruments, interpret results, and make predictions. The staff member who leads this activity explains to participating students that they are scientists and collecting data for a longitudinal study. This allows the students to view themselves as scientists, and it encourages them to explore other science-related experiences if they are interested. After students record their measurements and make a few calculations, they present their findings to the rest of the group and make a forecast. All of the students, teachers and staff then use this information to determine how they will dress and what supplies they will need to take with them to be prepared for the day. Having the students present this information reinforces how science is connected to their daily lives. Participating in the scientific data collection process also allows students to create new knowledge and expand their thinking beyond the role of a consumer of scientific information. Although the latter is an important objective for the experience and is accomplished with the majority of the students, we observed that several students repeated the weather data gathering more than once. This subset of students connected to this aspect of the program, and it was apparent that they enjoyed contributing to the process.

Reflections on the "Big Picture"

Within the GSMIT experience, students are asked to reflect on each experience, and analyze how the completed activity aligns with the "big picture" of Earth sustainability, particularly the natural environmental and human interactions. Some teachers were skeptical that their students would participate in the writing/journaling activity and produce quality reflections. However, students actively reflected throughout the GSMIT experience. One teacher stated, "In the classroom my students struggle to stay on task. They search for any reason to stray off topic. I never thought my students would be able to do this. But as we just saw they love it, they want more time."

Outcomes of Experiential Learning

Teachers identified that the aspects of the program that go beyond regular classroom instruction are essential to the success of the GSMIT EE experience. A teacher from Case 6 stated, "The things kids learn at Tremont can't be taught. They have to be experienced." This teacher explained that the embedded, *implicit* aspects of the outdoor learning environment are often overlooked in the formal classroom. "In today's classroom we don't allow students time to learn from experience." Teachers thought that the increased testing in schools has forced them to use more explicit instruction, and only teaching what will be tested. For example, when we asked teachers about issues related to attending GSMIT, all of them expressed frustration with state or standardized testing. Teachers felt that the pressure to cover all of the standards and benchmarks takes up too much class time to allow for deep experiential learning, and the consistent reinforcement of sustainable content was difficult given the time constraints in their current testing-centered environment. A teacher explained how this impacted the way children learn:

> *Experiencing something it is different than looking on page 4 (of a textbook), learning this word or this fact. Students today are experts of finding answers in the book. I could give my students a college Spanish book, and they could find the answers…. That it doesn't mean they know anything about it. Out there (at GSMIT) what is the answer? What are you really looking for? The world, the content, is a lot bigger, and students find their own questions (Case 1).*

The experiential component of GSMIT was an important aspect for all of the teachers and, more specifically, they wanted their students to experience natural wild places.

All of the teachers recognized that the pristine environment of the national park was an essential part of the experience, but unfortunately, few teachers thought that they could achieve a similar effect in natural spaces near their schools. This view is not supported by GSMIT staff. They want students to actively engage nature and make new discoveries when they return home, and not only think that they can experience nature at GSMIT. A member of the instructional staff described how the GSMIT experience could be a powerful part to establishing lifelong learning:

> *Ideally the Tremont experience should complement the formal classroom, because in a formal classroom the student is given the structure to fill their curiosity in an efficient way. They can establish background knowledge. When they come to Tremont that structure is still intact, but there is also the opportunity to be a little bit looser with it. To allow them to really go in whatever direction they want with questions, and with the curiosity…. It gives them the opportunity to see that education is valuable and it can also be fun, and it can be relevant to their personal life both here and at home.*

This staff member continued by explaining how all children have a natural curiosity, like a small ember, and schools should support and encourage that ember to grow into a flame. The GSMIT experience in this metaphor would be a fuel that, when added, would ignite a much larger desire for learning; like fire this excitement for learning is also easily spread. In this explanation, the staff member expressed how the GSMIT experience is intended for students *to take what they have learned back to their school and community*. Although most of the schools supported this idea of connecting what the students learn back to their school and home, only one school acknowledged that students bring back an excitement for learning. In fact, one school intentionally schedules the trip to GSMIT the week before spring break to reduce this level of excitement. The school's rationale was that it wanted to reduce levels of jealousy and resentment for students who could not attend the GSMIT program.

DISCUSSION

This research revealed that when students engage in environmental education concepts in a residential setting, they preferred natural, outdoor experiences in which they engaged with wildlife and experienced the geology of the area. Students found that the most meaningful component of an outdoor, environmental education experience was the development of curiosity for the natural world and a sense of discovery. Although many student-identified variables and objectives were purposively addressed by the staff of the environmental residential center, other variables emerged in students' comments that were only tackled implicitly, and embedded within the GSMIT experience. Students' self-awareness of nature as individuals, and opportunities to enjoy nature, also ranked among their self-identified meaningful activities. However, these experiences were not part of the stated activity objectives, but were addressed through implicit instruction as a theme that ran through all activities. This self-awareness was undoubtedly facilitated through the required student reflections that asked students to place their experiences at GSMIT within the larger framework of the environment, human impact, and sustainability.

GSMIT residential experience also focused upon several concepts that were consistently addressed. First, students became conscious consumers of their food. They also assumed responsibility for their surroundings, and they served in a scientific role to *produce* scientific data and analysis instead of only consuming it. Teachers remarked on the positive impact these activities had on students.

Teachers also remarked on the role of reflection time. All participating schools ($n = 6$) implemented reflection time in their classrooms after the GSMIT experience, with one surprised teacher remarking that some students who exhibited problems sitting quietly were able to accomplish and enjoy this task. Additionally, half the schools ($n = 3$) implemented some form of the "no food waste" meals.

RECOMMENDATIONS

Our research results suggest methods for classroom implementation of sustainability education and other EE concepts. The dynamic relationship between GSMIT and participating schools helped us determine the best practices that are transferable and will help schools incorporate interdisciplinary environmental topics such as sustainability and civic responsibility into their regular curriculum. Not all schools will be able to attend a residential environmental learning center, but aspects of the experience can be incorporated within a traditional classroom setting leaving students with a lasting understanding of these most important concepts.

GSMIT impacted students' perceptions and attitudes with the scheduled activities, but more importantly for K–12 classrooms, the embedded practices and implicit instruction influenced participants. EE and sustainability are interdisciplinary and should be included across disciplines, but classroom time is an issue in formal educational settings. Therefore, our research suggests that implicit instruction and embedded instruction hold the most promise for formal educational settings to develop sustainability awareness and sustainable practices in our future citizens.

Through consistent modeling of sustainable practices, teachers across all content areas can address sustainability and civic responsibility with minimum time requirements. A minimal time commitment is especially important, given that teachers consistently remarked that they used explicit instruction for content that would be covered in state or standardized tests. Modeling sustainable practices, such as recycling, zero food waste, and weather data collection, and reflecting upon the experiences and activities, can impact students and connect them to larger issues with the environment.

However, our research indicates that one barrier to this approach may be the attitude of teachers: We must develop and facilitate teacher confidence and EE content so that teachers will feel comfortable incorporating similar activities within or near their schools. Another barrier is the fragmented curriculum, since sustainable practices go beyond single disciplines and address issues that all students need for sustainable living. Although modeling and implicit instruction appear to be the appropriate vehicles for instruction, teacher preparation or professional development programs often do not include these techniques. Modeling is

typically used in teacher education for classroom management strategies, since it demonstrates a philosophy that should permeate every aspect of teaching. We propose that a similar argument can be made sustainability education, since modeling best environmental practices, and reflecting upon their impact, can influence the behaviors and actions of our future citizens.

These current barriers may also be perceived as opportunities for teacher educators to explore in order to implement sustainability education across multiple disciplines with minimum time requirement—for lasting student impact. We propose that now is the time to act in teacher preparation and professional development programs, since the Next Generation Science Standards call for more integrative, interdisciplinary inclusion of scientific concepts—including sustainability—across the curriculum.

As we look at the delivery of content, we propose that we need to go beyond the traditional views of instruction to include both implicit, embedded instruction and experiential learning. When we engage students at any level with difficult concepts such as environmental literacy and sustainability, we must include ecological principles, and issue identification and civic responsibility.

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