

ENVIRONMENTAL EDUCATION

RESEARCH BULLETIN

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ABOUT THE RESEARCH BULLETIN

The *Environmental Education Research Bulletin* is a project of ChangeScale in partnership with Dr. Nicole Ardoin at Stanford University. The bulletin is designed to inform environmental and sustainability educators about recent relevant research, with a primary emphasis on informal, field, and residential settings, as well as stewardship behavior, conservation, and related topics. Although other environmental educators and those in related fields might also find this bulletin useful, it does not—nor is it intended to—cover all aspects of environmental education. This Research Bulletin, as well as past issues, is available online through the ChangeScale website: www.changescale.org. Please send questions and feedback to eereseearchbulletins@changescale.org.

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INTRODUCTION

Dear Colleagues,

ChangeScale has collaborated with Stanford University researchers to create this sixth volume of the *Environmental Education Research Bulletin*. The most talented environmental educators we know are conducting place-based programs, working with communities, and using hands-on strategies to make critical links between enhancing environmental awareness, building skills, and supporting informed action. Yet rarely do these committed professionals have time to keep up on the latest research whose beneficial findings may enhance the effectiveness of environmental education programming. To that end, these bulletins aim to help bridge the research-and-practice gap by summarizing recently reported research. In turn, we hope that practitioners may be inspired to infuse their work with recent findings.

In this issue, we include synopses of peer-reviewed journal articles that are particularly relevant for front-line environmental education practitioners. We reviewed issues (published between July and December 2013) of a number of environmental education-related journals, including: *Journal of Environmental Education*, *Environmental Education Research*, *Applied Environmental Education and Communications*, *Australian Journal of Environmental Education*, *Canadian Journal of Environmental Education*, *Journal of Experiential Education*, *International Journal of Science Education*, *Science Education*, *Visitor Studies*, *Journal of Interpretation Research*, *Environmental Research Letters*, and the *Journal of Environmental Psychology*.

Because we are creating this document for you, we are eager to hear your feedback.

Please let us know if there are additional topics you would like to see covered, journals you would like us to monitor,

or an alternative format that may be more helpful. You can send suggestions to eerresearchbulletins@changescale.org. We will take your feedback into account at the beginning of each cycle and try to adapt accordingly.

For another take on these kinds of research summaries, you may want to check out the research blog available from the North American Association for Environmental Education (eelinked.naaee.net/n/eeresearch). You may also be interested in the Relating Research to Practice effort of CILS and the Exploratorium, available here: www.exploratorium.edu/education/relating-research-practice.

We wish you all the best in your important efforts to integrate high-quality research with inspiring practice!



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ENVIRONMENTAL BEHAVIOR

IMPACT OF ECOLOGICAL FOOTPRINT

PROJECT ON ATTITUDES AND BEHAVIORS

Over the past few decades, environmental educators have sought ways to support students as they learn about the environment and consider ways to become engaged in appropriate, relevant pro-environmental behaviors. Rather than simply providing students with scientific information, educators know the importance of helping students develop critical thinking skills and encouraging a problem-solving mindset, both of which support students to later become engaged in environmental action. Further, the authors suggest that interdisciplinary engagement with environmental issues helps with developing norms, values, and behaviors that align with pro-environmental decisions.

In this study, the authors examined the influence of a project-based environmental education program on students' pro-environmental attitudes in a public high school in Haifa, Israel. Specifically, the researchers focused on the concept of an ecological footprint, which is a model that measures total resources consumed in terms of units of land needed to sustain a particular amount of consumption. The researchers wanted to see whether this model could be used in a school setting to influence students' environmental attitudes and behaviors. In exploring the relationship between natural resource generation and depletion, the ecological footprint concept highlights the environmental impacts of consumption. This focus makes it especially relevant to individual and local-scale environmental action.

The research participants included four 10th-grade classes, with a total of 130 students, who completed a seven-month environmental education program. The study also included a second group of 70 students in two 10th-grade classes that served as a control group. Students who participated in the environmental education intervention were taught the concept of the ecological footprint through a project-based curriculum. The project design included several stages, from identifying causes and consequences of the problem to establishing priorities and plans for action. These classrooms calculated the ecological footprint of their high school in four areas: energy, food, transportation, and materials.



Students calculated the ecological footprint of their school to be 320 hectares for the 2008 school year, although the physical area of the school only covered 2 hectares. In response to this discrepancy, the students developed an action program to reduce the school's ecological footprint, suggesting, for example, reducing the use of air conditioning in classrooms or traveling to school via public transportation. The control classrooms did not engage in the ecological footprint curriculum.

To measure the influence of the environmental intervention on students' attitudes and behaviors, the researchers identified five conceptual measures related to attitude and action: ecological worldview, perceived behavior control, personal norms, behavioral intentions, and pro-environmental behavior. For both the experimental and control classrooms, these behavioral aspects were measured using pre- and post-program surveys. The findings showed that personal norms and behavioral intentions related to pro-environmental action were moderately increased among students in the experimental classes following the intervention. Further, while pro-environmental behavior remained the same on the pre- and post-tests for the experimental classes, it decreased for the control group. This suggests that the intervention may have helped maintain pro-environmental behavior among participants, which might have otherwise decreased after 10th grade. No gains due to the intervention were found for the behavioral measures of ecological worldview or perceived behavioral control.

Ultimately, findings from this study suggest that a project-based curriculum using the concept of ecological footprints might have a positive influence on certain pro-environmental attitudes; however, further research is needed in this area to better understand this relationship.

THE BOTTOM LINE:

Environmental education curricula that use project-based learning strategies and employ the concept of ecological footprints to help students envision the environmental impacts their actions are having may be more effective than those focused on knowledge provision alone. However, while theory tells us that engagement is more likely to

lead to the development of pro-environmental behaviors, the relationships between environmental education and specific changes in attitude or behavior are less clear. It is likely that personal norms and intended behaviors are more easily influenced by environmental education than actual behavior, although norms and intentions may influence individual behavior over a longer period of time.

Gottlieb, D., Vigoda-Gadot, E., & Haim, A. (2013). Encouraging ecological behaviors among students by using the ecological footprint as an education tool: A quasi-experimental design in a public high school in the city of Haifa. *Environmental Education Research*, 19(6), 844–863.

CASE STUDY AND INDICATORS OF SUCCESSFUL COMMUNITY BEHAVIOR CHANGE

Changing behavior at both the individual and community level is one of the most important goals of environmental education—it involves people actually solving problems and having a positive impact. However, designing effective programs for promoting behavior change, and evaluating those programs, is often difficult because of the many factors involved. In this study, the authors analyzed the methods used by 15 communities in the United States who successfully increased their preparedness for wildfires. They suggest strategies for designing, implementing, and evaluating successful EE programs for promoting behavior changes.

The authors of this paper built on a previously reported case study on community preparedness for wildfire. The previous study, described in Jakes et al. (2007) in *Human Ecology*, considered how 15 communities at risk for fire had taken steps to improve their preparedness. Using these data, the current authors analyzed the recorded educational strategies and organized them into six basic themes of program purposes and audiences. These strategy themes were: (1) sharing information about risk and risk reduction through community-wide education programs; (2) training staff to promote a new way of thinking;

(3) promoting or enforcing new ordinances or policies through presentations to decision makers, media, and residents; (4) raising awareness with group activities, such as neighborhood association events; (5) changing a social norm with group activities; and (6) empowering residents by developing plans and creating committees.

The authors then identified three goals the fire education programs were aiming to address with the above-named teaching strategies. Having identified the goals, they also suggested potential indicators that could be used to measure whether these goals had been accomplished by an EE program.

The first of these goals was to “provide background on the issue and procedural information about how to solve the problem in order to change attitudes, behaviors, or policies.” In the case of the fire education programs, the authors found these goals were mostly accomplished through one-way communication channels, such as signs and community newsletters (strategy 1). Workshops for local residents and community leaders (strategies 3 and 4) and training programs for volunteer fire fighter staff (strategy 2) were also effective; they complemented the mass media campaigns. Some of the indicators the authors suggest for measuring the success of a program at meeting this goal are the number of program participants, increases in participants’ knowledge, changes in attitudes, increases in belief that actions will matter (efficacy), and increases in evidence of, or observed change of, behavior.

The second goal the authors identified was to “use training and management projects to directly change the environment, and [to] enhance this effort with educational resources to change individuals’ perceptions and skills.” In other words, this goal is about changing both the social and physical environment in regard to the issue, which then makes it more likely for community members to respond to educational resources and make behavioral changes. In the case of the fire education programs, this was accomplished through training the wildfire volunteer staff to adopt new procedures for fire safety (strategy 2). It was also accomplished by developing

visible demonstration areas in the landscape for fire safety, such as community fire breaks and defensible homes (strategy 5). The authors suggest all of the above-mentioned indicators would also be relevant for measuring the success of programs at accomplishing this goal, plus measuring changes in perceived desirability of new action or change and increases in the procedural knowledge for making a behavior change, among others.

According to the authors, the third goal of the fire education programs was to “provide opportunities and experiences to work together.” Strategies and activities that contributed to this included community events to raise awareness and change social norms (strategies 4 and 5) and empower local citizens (strategy 6). The authors found that programs emphasizing learning and working together were more successful at raising awareness and promoting knowledge gains. Community events also increased participants’ willingness to participate and changed the way people viewed their neighborhood and the landscape. These programs helped build social capital and community cohesion, which facilitated neighbors’ ability to respond to fires and other disasters when they happen. Examples of indicators the authors suggested for measuring a program’s success at meeting this goal were an increase in trust of agencies and neighborhoods, and an increase in willingness to work with neighbors to achieve change.

THE BOTTOM LINE:

Based on research with communities that successfully improved their wildfire preparedness, commonly desired goals of such programs include providing knowledge and background on how to solve the problem, changing the environment and conditions, and building community. Researchers suggest that educational activities involving community events and existing community networks (such as neighborhood associations) are particularly successful for promoting meaningful pro-environmental behaviors. Several potential indicators that can be used by educators for measuring the effectiveness of education efforts focused on environmentally friendly behaviors related to such issues, especially at the community level,

include the number of program participants, measuring changes in perceived desirability of the new action, increases in procedural knowledge for taking the action, observed behavior changes, and increased willingness to work with neighbors to achieve change, among others.

Monroe, M. C., Agrawal, S., Jakes, P. J., Kruger, L. E., Nelson, K. C., & Sturtevant, V. (2013). Identifying indicators of behavior change: Insights from wildfire education programs. *Journal of Environmental Education*, 44(3), 180–194.

EVALUATION

FRAMEWORK FOR UNDERSTANDING BEHAVIORS RELATED TO OCEAN PROTECTION

Teaching students to take care of the ocean and the life it supports is essential for promoting the future health of this precious resource. To this end, it is important to increase knowledge of, and caring attitudes toward, the ocean—and especially to promote environmentally responsible behavior. Some education and awareness-building programs propose that increasing environmental knowledge changes attitudes, which in turn changes behavior. However, this linear model of transmission has been questioned as the relationship between these elements is complex and suggests several pathways toward the end of ocean-friendly behavior. These researchers examined this model by measuring students' knowledge, attitudes, and behavior regarding the protection of the marine environment.

This study took place in Taiwan, which has included environmental education in the school curriculum since the Environmental Education Act was passed in 2010. Since Taiwan is an island, many local environmental education curricula have focused on protecting the marine environment, and many of the students have participated in field trips to the beach. The study participants included upper-elementary-aged students from 25 schools across Taiwan; 30 students were chosen at random from each school, for a total of 750 participants.

The researchers designed a questionnaire to measure knowledge, attitudes, and behavior related to protecting the marine environment. The study defined three knowledge concepts related to marine protection: the marine environment, humans and the ocean, and functions of the ocean. Three questions pertaining to each of these concepts were included on the survey.

In terms of behavior, the researchers examined both direct and indirect actions related to taking care of the ocean. Direct actions involved beach- or ocean-related behaviors, such as picking up trash. Indirect actions included using less-polluting forms of transportation, buying less-polluting products, and attending to the pollution caused by daily activities in general. These actions were measured by questions



regarding the frequency with which students estimated they currently engaged in each of these behaviors.

To measure students' attitudes toward the ocean, the questionnaire asked whether the student felt inclined or disinclined (on a scale of 1 to 5) to engage in each of the behaviors mentioned above (for example, picking up trash). There were six additional questions included to measure students' classroom curricular involvement relating to marine topics (that is, if they had covered marine topics in school) and their involvement in field trips to marine museums, the beach, and/or mangrove forests and estuaries. The questionnaire went through three phases of analysis and was tested for reliability before it was used. The final questionnaire included 25 items.

The results showed students had a fairly high amount of knowledge about the ocean, on average answering 71% of the knowledge content questions correctly. For ocean-protective behaviors and attitudes, the students uniformly reported medium to high levels. In terms of attitudes, students reported feeling more inclined to take behaviors that were directly supportive of the marine environment rather than those that were indirect; on the other hand, they reported actually engaging in behaviors that were indirectly protective of the ocean, versus direct behaviors such as beach or ocean-related behavior. This could be, in part, because the students have more opportunities to engage in behaviors indirectly protective of the ocean, and, perhaps, they are more rarely at the beach.

One of this study's most significant findings was that knowledge, attitudes, and behaviors were not all correlated. This finding undermines the thesis that knowledge directly affects attitudes and behaviors. In addition, although behaviors and attitudes toward those behaviors did correlate, the correlation was very low. Attitudes protective of the environment only predicted 2% of behaviors protective of the environment.

Another finding the authors highlighted was the relative effectiveness of field trips versus classroom learning. Students who had reported visiting a marine museum, beach, or coastal wetland with their classes had more pro-environmental attitudes and behaviors compared with students who had not taken such trips. Students who had covered topics such as marine biodiversity, marine resources, and marine natural sciences in class were slightly more likely to report pro-ocean attitudes and behaviors, although the effect was much smaller than among field trip participants.

Overall, although field trips were relatively more effective than classroom learning, both field trip and school curricular involvement together only predicted 6% of marine-protective attitudes. The authors suggest that their study results imply that marine environmental protection knowledge, attitudes, and behaviors are mainly constructed from sources of information outside of the curricular efforts directly aimed at addressing these subjects.

THE BOTTOM LINE:

The relationship between environmentally related knowledge, attitudes, and behaviors, specifically when focused on the marine environment, is complex and nonlinear. In fact, at times, knowledge, attitudes, and behaviors may not be correlated at all. Connections among these elements may be facilitated, however, if an educator helps create a bridge. Moreover, field trips are relatively more effective than classroom settings for promoting pro-marine environmental attitudes and behaviors.

Wen, W., & Lu, S. (2013). Marine environmental protection knowledge, attitudes, behaviors, and curricular involvement of Taiwanese primary school students in senior grades. *Environmental Education Research*, 19(5), 600–619.

TEACHING METHODS

FRAMING CLIMATE CHANGE FOR SPECIFIC AUDIENCES

In the realm of environmental education, educators often struggle with figuring out how to discuss an inherently depressing topic such as climate change in a way that is empowering and facilitates engagement, rather than creating a desperate sense of hopelessness. Communicators and researchers alike debate the effectiveness of negative framing, or telling people about the potential dangers of climate change, as compared to positive framing, which explains how people can improve the state of the world by taking action to reduce climate change.

Because recent studies in climate change science and social psychology suggest that negative framing may not be the most effective approach in convincing people to act against climate change, educators and communicators often assume that negative framing should be avoided. Until this study, however, researchers had not investigated whether the *object* of the negative framing—that is, the person, environment, or species that climate change puts in harm's way—has an effect on intended environmental actions. Previous studies had also overlooked whether the objects of positive framing—the beneficiaries of actions that mitigate climate change—changed a person's interest in mitigating his or her own carbon emissions.

This study investigates how positive and negative framing, as well as the objects of each type of framing, affect a person's interest in taking action to lower his or her own carbon footprint and engage in citizen science activities. The authors surveyed 3,456 adults, the overwhelming majority of whom lived in the United States and self-identified as birders. Each survey participant also indicated an interest in a citizen science program that allows participants to collect data and share the actions they take to reduce their carbon footprints via an online mapping platform.

The survey included two topically related questions, and other questions related to basic demographics. Every survey participant received the same first question, which measured the participant's level of concern about climate change. The participants were randomly given one statement out of five potential options: (1) a



control statement about the citizen science platform; (2) a statement about how climate change negatively impacts humans; (3) a statement about how climate change negatively impacts birds; (4) a positive statement about how climate change can be mitigated by collective action; or (5) a positive statement about how climate change can be mitigated by collective action for the good of future generations. All statements were then followed by a question asking the participant how much he or she is interested in reducing his or her carbon footprint and participating in the citizen science platform. Participants ranked their interest numerically on a scale of one (not at all interested) to seven (very interested).

The authors measured the impact of the different framings by comparing the numerical difference in interest participants expressed in the survey. Each of the framings—the two negative framings and the two positive framings—were compared to the control, and the authors determined whether the numerical difference in interest expressed by participants given the framed statements was significantly different from the interest expressed by participants who were given the control statement.

The two negatively framed statements had very different outcomes. While the negative human framing was statistically undifferentiated from the control, the negative bird framing showed a statistically significant increase in participant interest in acting to reduce carbon footprints. This suggests that the object of the negative framing in climate change communication can impact how much a person seeks to mitigate his or her own carbon emissions.

The two positively framed statements were statistically indistinguishable from each other, but each of them did show a significant increase in interest in acting when compared to the control statement. This indicates that the concept of collective action against climate change may increase a person's interest in acting against climate change, whether future generations are explicitly included in the collective action concept or not.

Out of all of these framing methods, the frame that most increased intent to act was the statement that discussed

how climate change harms birds. Because the study surveyed birders almost exclusively, the authors suspect that negatively framing climate change may more strongly impact a person's interest in acting if the object of the framing is an object of significance to the person.

The study is not necessarily generalizable to the larger American public, as the study's participants were of such a specific subpopulation and were not randomly chosen to participate in the surveys. However, these findings do introduce a new idea: that the object of negative framing matters in climate change communication. By extension, it also suggests that U.S. educators will need to present the public—people who have diverse backgrounds and interests—with different framings of climate change in order to maximize the effectiveness of climate change communication efforts.

THE BOTTOM LINE:

Explaining how climate change negatively impacts an object of importance—not necessarily a human—may have a significant, positive impact on a person's interest in mitigating his or her carbon footprint. To enhance effectiveness of communication efforts, educators should adapt their manner of presenting climate change to an audience depending on that audience's interests and values.

Dickinson, J. L., Crain, R., Yalowitz, S., & Cherry, T. M. (2013). How framing climate change influences citizen scientists' intentions to do something about it. *Journal of Environmental Education*, 44(3), 145–158.

PROMOTING CREATIVITY FOR INNOVATIVE PROBLEM SOLVING

Historically, the sciences have been considered fact-based disciplines that discover truths about the world. In contrast, the humanities have traditionally been assigned to the realms of personal interpretation and nuance. In keeping with this, creativity—a manifestation of human interpretation—traditionally has been designated to the realm of the humanities and is often left out of science.

However, in the face of complex and rapidly changing environmental issues, some researchers call for an alteration of our conceptualization of science. The author suggests one way this can be done is by facilitating and fostering creativity in the scientific realm, thus strengthening collaboration across disciplines by incorporating creativity into the curriculum.

The author argues for the importance of students having the ability to respond to complicated problems in a way that addresses the complexity of issues; this would require moving beyond simple programmatic adjustments. To accomplish this, educators must shift their orientation and learning processes to foster and cultivate the creative process. This, in turn, will free students to think beyond conventional paradigms and create innovative solutions.

The author suggests incorporating creativity into higher education programs that focus on environment and resources. As an example, the author examines Australian Education for Sustainability programs, which the author suggests would benefit from incorporating from incorporating current, innovative thinking about sustainability. The author suggests six areas of potential emphasis: systemic and holistic thinking; interdisciplinary skills; critical thinking; working with stakeholders; foresighted thinking; and dealing with complexity and uncertainty.

To illustrate the use of these creative thinking processes, the author uses the example of the world's dependency on cars. The author argues that viewing this issue in terms of the ways that transportation creates value for growing economies would foster thought around interconnections. It would also shift the focus from simply eliminating cars to creating alternative transportation methods. Problem solving regarding this issue would require interdisciplinary voices, including people from car companies, engineers and scientists, government officials in charge of infrastructure, and community support, among others.

Finally, the author says that incorporating creativity into the overall curriculum must start with teachers

as facilitators of the process. By incorporating learner-centered approaches, such as independent group problem-solving tasks and in-depth classroom discussions around controversial issues, teachers can help create the next generation of creative problem solvers for sustainability-related issues.

THE BOTTOM LINE:

To live more sustainably on this planet, we must push past traditional paradigms to find new, innovative solutions. Yet, we cannot do so without fostering creative and forward-thinking individuals, and the best way to do this is through the education system. If we foster creativity among students through learner-centered experiences, we can help create more innovative and imaginative advocates for our planet.

Sandri, O. J. (2013). Exploring the role and value of creativity in education for sustainability. *Environmental Education Research*, 19(6), 765–778.

INCORPORATING PLAY INTO EARLY CHILDHOOD ENVIRONMENTAL EDUCATION

Early childhood education has increasingly incorporated environmental education; however, a divide exists between the traditional pedagogical approaches to early childhood education and environmental education. On the one hand, environmental education emphasizes combining experience with knowledge and values to foster environmental literacy, as well as pro-environmental values and actions. On the other hand, early childhood education emphasizes play-based, open-ended activities. This qualitative study examined teachers' views on the effectiveness of different types of play for developing children's environmental knowledge. The authors developed a pedagogical model that combines approaches of early childhood education and environmental education.

Views of play-based learning have evolved over time. Open-ended play was historically viewed as providing exploratory experiences that led to learning. More recent research provides a more nuanced perspective, acknowledging that culture and context affect play, play is value- and gender-laden, and interactions between children and teachers during play support learning. This more nuanced view has created space for considering “pedagogical play,” the idea that many different forms of play exist, each of which may be appropriate for different circumstances and learning goals. The authors compare teachers’ and students’ engagement with three approaches to play in relation to environmental learning:

- Open-ended play, where the teacher simply provides materials that suggest an environmental or sustainability concept
- Modeled play, where the teacher models ways to use materials before letting children play
- Purposefully framed play, where the teacher provides opportunities for open-ended play, followed by modeled play, and then teacher–child interactions

The authors hypothesized that purposefully framed play best supports the integration of environmental education into early childhood education settings.

To determine the ways each play type supports environmental learning and teaching, the authors studied the implementation of the three play types in 16 early learning centers in Melbourne, Australia. The authors provided professional development to teachers around the three types of play, and then filmed each teacher implementing each play type focused on a particular environmental or sustainability concept. They followed with group interviews with the children, in which they showed the videos and discussed what the children were doing and learning in each play type. The teachers were also interviewed. The authors qualitatively analyzed interview transcripts and teacher-planning documents to discern ways teachers understand the relationship between play and environmental content.

The authors found teachers believed a combination of open-ended play, modeled play, and teacher–child

interaction was most effective, though not necessarily in the order specified by the purposefully framed play in this study. Teachers were interested in the range of ways different play types could support both learning and teaching. One teacher, for example, discussed how the three play types provided a clearer role for the teacher in supporting students’ environmental learning in a play-based setting. Several teachers commented on the synergies between the play types. Students, for example, could implement what they learned during modeled play or teacher–student interactions in their open-ended play, and they could gain confidence and experience in open-ended play that supported more cooperation during other play types. Combining different play types also created opportunities for differentiation: children could engage in teacher–student interactions if they wanted to go deeper with content, or in open-ended play if they did not.

The authors conclude that purposefully framed play may help reconcile the approaches to environmental education and early childhood education. Their findings support the notion that open-ended play by itself is not as effective at promoting deep learning as a combination of play types. Finally, the authors recognize the need for further research into the effect of the order and timing of play types on learning, such as if they are best combined into a single session or spread across multiple days.

THE BOTTOM LINE:

As environmental learning is increasingly incorporated into early childhood education, it is crucial to determine how best to integrate environmental content knowledge into play-based approaches. A pedagogical model that combines open-ended play, play modeled by the teacher, and child–teacher interactions provides an effective framework for supporting children in developing environmental literacy.

Cutter-Mackenzie, A., & Edwards, S. (2013). Toward a model for early childhood environmental education: Foregrounding, developing, and connecting knowledge through play-based learning. *Journal of Environmental Education*, 44(3), 195–213.

USING DRAMA IN ENVIRONMENTAL EDUCATION

This research considers the role of drama in environmental education. Studying the arts in school can increase student interest, motivate students' self-expression, present different viewpoints in an accessible way, and enhance the understanding of abstract topics. There is relatively little research, however, on the role the arts—particularly drama—can play in education on pro-environmental attitudes, knowledge, and behaviors.

The authors used a simplified model of environmental behavior that views intention to change behavior as a proxy—and necessary precursor—to adopting a behavior. Intention is influenced by knowledge, attitudes, and beliefs. The authors applied this model to five case studies; they then used these case studies to develop a narrative. The cases included drama-related interventions from three theater companies offering environmentally themed plays, one oratorio (musical composition) performed in community festivals, and one play-building workshop in which high school students were given information and asked to design a theater piece around the material. Data gathered from each site varied, but included observations, surveys, and interviews with participants, as well as surveys and interviews with audiences. Data were collected before and after the drama intervention. In some cases, a third survey was administered several months following the intervention.

Findings were divided into four categories: (1) knowledge and awareness of consequences of the environmental issue, attitude, or behavior; (2) beliefs and attitudes toward the environmental issue or topic; (3) intention to change one's own environmentally related behavior; and (4) changes in environmentally related behavior. In four of the cases (two theater companies, the play-building workshop, and the oratorio), audience members and/or participants demonstrated an increased understanding of environmental issues after the drama intervention, compared to before. One case study—the oratorio—offered data suggesting that the program positively affected environmental beliefs and attitudes of audience members and participants. The

oratorio and the play-building experiment significantly impacted respondents' intention to change behavior. Two theater companies were able to provide data on energy and water consumption behaviors following their programs; in both cases, findings indicate decreased consumption.

Based on these findings, the authors suggest that drama can positively influence environmental knowledge, beliefs, and attitudes, and can successfully influence an intention to adopt pro-environmental behaviors. The authors also suggest positive results stemming from the non-confrontational nature of drama and an ability of these programs to provide simple, actionable solutions to environmental issues, including turning off lights or taking shorter showers. Drama can also inspire future engagement in environmental issues.

Further, the authors posit that drama is an even more successful medium when students are able to create their own plays, allowing them the chance for self-exploration and deepened engagement with the material. The positive impacts of this type of program can be extended by allowing students to perform their pieces for peers or younger students. The authors warn, however, that the content for these pieces should be developed by skilled practitioners to avoid errors in information. Students should also be given ample time to prepare for their performance, and the use of drama should be integrated with other classroom-based activities.

THE BOTTOM LINE:

Drama can be used to make environmentally related information more accessible and appealing, with positive results related to current knowledge, attitudes, and behaviors, and providing the opportunity to spark future engagement. Students who are involved in the process of creating their own dramatic piece can exhibit positive changes in their environmental learning and behavior if the appropriate scaffolds are used.

Curtis, D. J., Howden, M., Curtis, F., McColm, I., Scrine, J., Blomfield, T., Reeve, I., & Ryan, T. (2013). *Drama and environment: Joining forces to engage children and young*

people in environmental education. *Australian Journal of Environmental Education*, 29(2), 182–201.

FOSTERING CIVIC PARTICIPATION IN ENVIRONMENTAL POLICY

Environmental education (EE) and education for sustainable development (ESD) scholars have noted the importance of increasing civic political involvement to address environmental and sustainable development goals. However, few papers have directly addressed how educational experiences might foster greater engagement in the political realm. Authors of this conceptual paper first sought to understand what EE and ESD research has been conducted related to fostering collective civic action through learning experiences. Finding that this topic has been underexplored in EE and ESD, the authors turned to previous research in political science, psychology, and education to provide a conceptual framework for promoting environmental political engagement.

For the review of previous research, the authors searched seven databases that included journals in the fields of EE, ESD, and environmental psychology. The authors used the following keywords to search the articles' abstracts or titles: political, civic, action, democracy, and democratic. They also reviewed several relevant edited volumes, books, and dissertations.

Although many issues have been explored that are tangentially related to fostering environmental political participation, the authors found the topic has not been fully addressed in a direct sense. The topics that have been explored include political conflicts over curricula, methods of fostering environmentally responsible behaviors, individual attitudes toward environmental political action, and factors influencing the development of pro-environmental attitudes.

The authors found that some EE scholars have examined issues related to political efficacy, which is a key factor in predicting political engagement. Political efficacy is a person's sense that his or her individual action has, or

could have, an impact on the political process. It is often defined and measured in terms of both external efficacy—the belief that individuals can influence the democratic process—and internal efficacy—the belief that individuals possess the political competencies needed to participate in the political processes. The authors found that some limited research has been done that directly examined environmental political efficacy. One such study—authored by Dresner in the *Journal of Environmental Education* in 1990—found that college students who participated in a simulation of the legislative process aimed at energy conservation developed a sense of greater environmental political efficacy. Several studies also found that when individuals believe their actions can make a difference, they are more likely to be involved in environmental community action groups.

The authors' review also found that some scholars have sought to identify factors related to environmental political participation. Lubell, in a 2002 *Environment and Behavior* article, for example, reported that individuals are more likely to be involved in environmental activism if they prioritize environmental sustainability over their economic self-interest.

Based on their review, this paper's authors argue that, while the research done so far is valuable for educators interested in fostering students' environmental participation, there is a need to research this topic more directly. Using prior research on fostering political participation by political scientists, psychologists, and general educators, the authors propose a theoretical framework—and a research agenda based on this framework—for EE and ESD scholars. At the crux of their argument is that much of what has been learned in political science, psychology, and education could be useful to fostering environmental political actions, specifically; however, research is needed to find out if these findings hold true, as environmental issues are unique compared with other political subjects.

The authors suggest that one of the main findings from political science, psychology, and education is the importance of political efficacy and political interest

in predicting political participation, such as voting, contacting officials, and joining political organizations. Political efficacy, as discussed above, is the sense that what one does actually makes a difference. The authors define political interest as a person's willingness to pay attention to politics at the expense of other endeavors. Research in various social science fields has indicated that political efficacy and political interest are particularly important to consider when educating for political participation. This is because political efficacy and political interest are both factors that can be fostered and that have a direct and significant influence on a person's resulting participation in political issues.

The authors identified three key elements in building political interest and efficacy, and suggest ways of using these elements to foster environmental political participation:

- 1. Learning about and discussing political issues:** Providing students an opportunity to learn about and process political issues within the context of environment and sustainability issues could be effective for increasing their sense of political efficacy and interest. Examples of this are watching environmentally related films and giving students an opportunity to discuss relevant issues with their peers.
- 2. Participation in political processes:** Participating in activities on large and small scales—such as voting, political campaigning, democratic decision-making, mock elections, and school governance—can increase internal political efficacy, especially when action leads to achievement of a political goal.
- 3. Identifying with a group:** Identification and affiliation with politically minded groups, communities, and peers strengthens one's own political involvement and positively influences external political efficacy. In the environmental context, this could mean creating an environmental action group at school or a peer group related to sustainability and conservation.

THE BOTTOM LINE:

Individual behavior changes alone are not enough to address today's mounting environmental challenges. Instead, collective civic participation in environmental political processes is needed. If we want citizens to effectively engage in the democratic process and influence environmental policy, we must bolster political interest and efficacy. Although more research needs to be done to confirm that lessons from political science, psychology, and education are relevant for fostering environmentally related political participation, it is not too early for educators to start experimenting with these lessons in their classrooms. Such lessons include engaging students in discussions about environmental political issues and creating ways for students to identify with a group interested in environmental issues.

Levy, B. L. M., & Zint, M. T. (2013). Toward fostering environmental political participation: Framing an agenda for environmental education research. *Environmental Education Research*, 19(5), 553–576.

USING BOTANICAL GARDENS TO TEACH ABOUT CLIMATE CHANGE

Worldwide, botanical gardens attract nearly 200 million visitors every year. These visitors can participate in a range of experiences, from free-choice visits to more structured field trips. Yet, the effectiveness of these learning environments for outcomes related to knowledge gain has not been widely evaluated. In addition, the use of botanical gardens as a context for teaching about climate change is a relatively new idea, and one that is promising.

This paper's authors conducted a study focused on short- and long-term knowledge gain among high school students after participating in a one-day climate change lesson at a botanical garden. The study took place at a botanical garden in Bayreuth, Germany. The participants were 108 high school students from rural environments who attended the program as part of a compulsory annual field trip day. The daylong environmental education

lesson was designed to provide students with three types of knowledge about climate change: system knowledge, action-related knowledge, and effectiveness knowledge. System knowledge comprises the basic knowledge of a certain topic (for example, how greenhouse gases contribute to climate change); action-related knowledge refers to actions or behaviors a person can take (such as saving energy); and effectiveness knowledge is what helps people assess how effective an action or behavior might be (for example, taking a bus instead of driving saves X amount of energy). In addition, the lesson was designed to be able to fit into the school curriculum and complement the content being taught in the classroom, namely the ecology and environmental topics being taught in biology class, and the global climate change unit being taught in geography.

The one-day intervention was comprised of two parts: the first provided background information about the issue of climate change through activities at different workstations; the second consisted of more practical activities around the garden using a different set of workstations. This workstation model was chosen because it provided the students with an opportunity to interact with their peers and educators. It also allowed students to work independently and at their own pace, using self-instructional materials. The students were divided into groups of three to four students to rotate through the workstations together.

The first unit was comprised of nine workstations, eight of which were obligatory and one of which was optional (the knowledge from this workstation was not included in the survey). The workstations were all set up in the garden's seminar room. Each workstation covered a different theoretical topic related to climate change, such as climate changes in the history of the Earth based on ice cores, contribution of food production and transportation to greenhouse gas emissions, and others.

The second unit provided students with more hands-on, practical experience in the garden. Each student received an "explorer booklet" and a map indicating the

locations of the six workstations around the garden. Each workstation focused on a particular plant species and was located where that species was growing in the garden. The students had to find the site on the map, and then use the educational material and observations of the plant to solve tasks. The tasks concerned the many consequences of global climate change on plant species and how these, in turn, affect ecosystems and humans. One of the workstations, for example, was called Playing with Fire. It dealt with Australian fire ecosystems as an example of how arid ecosystems will be affected by climate change. The plants used at this station were two species that live in fire ecosystems.

The effectiveness of both of the intervention units on knowledge gain was evaluated using a multiple-choice pre-test administered one week before the intervention, a post-test administered immediately after (short-term post-test), and a longer-term post-test administered four to six weeks after the intervention. A control group was also asked to take the three tests without participating in the intervention.

Results indicated that the knowledge gain from the intervention was significant immediately after the intervention, and this gain persisted four to six weeks later. No significant effects were found in the control group. The researchers attributed the success of this intervention to the student-centered approach that they used, which allowed students to interact with their peers throughout the lesson.

THE BOTTOM LINE:

Botanical gardens, which draw nearly 200 million visitors worldwide annually, may be important and effective sites for environmental and climate change education, particularly when paired with formal education. In these settings, education is likely to be more effective and have a lasting impact when it is hands-on and collaborative. One way to accomplish this is by using the workstation model, where different tasks are organized at locations around the garden or classroom. This model allows students to interact with each other and the teacher, and it also

provides an engaging way to gain theoretical grounding and learn practical knowledge.

Sellmann, D., & Bogner, F. X. (2013). Climate change education: Quantitatively assessing the impact of a botanical garden as an informal learning environment. *Environmental Education Research*, 19(4), 415–429.

ADULT ENVIRONMENTAL LEARNING IN COMMUNITY GARDENS

Community gardens provide people of all ages with abundant opportunities for informal learning, but they have not often been studied in the field of environmental education. This paper examines how two theories from adult education, public pedagogy, and social movement learning may be used as frameworks for understanding informal adult environmental learning in community gardens.

Public pedagogy, as the author defines it, refers to the processes of education that occur outside formal institutions, including popular culture, dominant discourses, and social activism. Social movement learning is learning that occurs as the result of participation in, or exposure to, a social movement. Both theories focus on free-choice and transformational learning.

The author offers a brief history of community gardens, identifying four eras of note and highlighting the influence of public pedagogy in each: (1) the 1890s to the Great Depression, when gardens were about urban reform and self-help; they contributed to assimilation of immigrants and reinforcement of social mores, ideologies, and class structures; (2) the victory gardens of World Wars I and II, which provided opportunities for self-help, skills training, and subsistence food; they promoted the dominant discourses of nationalistic pride and patriotism; (3) the grassroots community gardens of the 1960s to 1980s, which served as symbols of community development and activism toward ecological revitalization and social justice; and (4) the recent expansion of community gardens and urban greening efforts that began in the 1990s as

part of a social movement to address food safety and health concerns and grew to encompass social justice, community, and identity-building. The author notes that, in each incarnation, community gardens have been sites of public pedagogy and social movement learning.

The author explores the roots of social movement learning theory and outlines the contributions of the various philosophical traditions, principles, and practices that have shaped it, including liberal, progressive, humanist, and radical adult education. The author applies those frameworks, along with ideas from Marxist theorist Antonio Gramsci about ideological hegemony and counter hegemony, as well as from educator and philosopher Paulo Friere on “concientización,” to the current food movement in general, and to community gardens in particular. In short, the author discusses how the food movement—and associated activities such as food preparation, community gardens, farmers markets, and school gardens—could play a role in empowering individuals and communities to challenge dominant ecologically destructive paradigms.

In reviewing the learning that occurs in community gardens, the author notes that learning may be formal, informal, or incidental, and individual or collective. Individual learning may focus on farming, food, or culture, but also may include science, ecology, and the environment. The garden may be a site for sensory and culinary epiphany for the individual learner, or it may provide the setting for the development of a more eco-centric worldview. It may even be a place for therapy, contributing to physical, emotional, mental, and spiritual health. Individuals may also come together to engage in collective learning in community gardens. The author highlights the strong connection between collective learning through the creation of community gardens and the construction of civil society. Planning and bringing about change in the form of a garden, he posits, promotes “communicative interaction,” which can lead to learning and practice of reciprocity, trust, and cooperation. Community gardens may also be sites for the promotion of decolonization and cultural identity, environmental justice, and antiracist and multicultural education.

THE BOTTOM LINE:

Community gardens can be the sites of cognitive, emotional, spiritual, sensory, and physical learning. They can also provide opportunities for learning approaches that are collective, constructionist, synergistic, and transformative; thus, they may be understood within the frameworks of public pedagogy and social movement learning theory. In terms of practice, community gardens hold a variety of possibilities as sites for environmental education. In particular, educators might consider community gardens for their value not only as educational opportunities for individuals, but also as places that foster social capital through building community and connecting to the broader food movement, as well as associated social justice issues.

Walter, P. (2013). Theorising community gardens as pedagogical sites in the food movement. *Environmental Education Research*, 19(4), 521–539.

SENSE OF PLACE

DEVELOPING PLACE-RESPONSIVE PEDAGOGY

This paper's literature review suggests that educational nature trips for youth have been linked to deeper understanding of science, positive environmental attitudes, and the development of environmental actions. Further, teachers can play an important role in facilitating nature experiences for their students. The importance and complexity of out-of-classroom nature excursions requires that teachers scaffold student experiences during these trips to maximize learning. This paper explores the role of teachers in these nature-based excursions and seeks to develop guidelines related to effective practices, with the intention of developing a new theory of place-responsive pedagogy.

The authors use the term *place-responsive pedagogy* to refer to an educator's efforts to create meaningful experiences by connecting students to specific places through purposeful activities that draw upon elements of the site. The study included 18 teachers from four primary and secondary schools in Scotland. The sites of the excursions included three National Nature Reserves and one other natural area near the schools.

The study involved engaging teachers in activities aimed at better preparing them for place-responsive teaching in the outdoors. All teachers attended a workshop to familiarize them with Scotland's outdoor education standards and current research on planning excursions; the workshops also provided information on Scotland's natural heritage. Teachers were required to participate in at least one planning visit to their excursion sites. After their visits, they were tasked with developing a question that would connect the excursion space with a topic that was meaningful to their students. This question would then guide the development of a curriculum relevant to the excursion site. During the process, teachers also engaged in personal reflection and discussion.

Of the 18 teacher cases, data were collected from nine cases through observation, teacher interviews, and recorded video of groups that were in the process of planning trips, as well as the actual class excursions. Additionally, researchers recorded and transcribed audio from workshop discussions, student-produced work, and reflections from teachers.



After compiling and analyzing data from all nine cases, five main factors were identified as contributing to the success of the excursion: school factors, including school support and finances; wider support factors, such as parental help and curriculum requirements; pupil factors, including personalities and prior nature experiences; teacher factors, e.g., personalities and backgrounds; and place-related factors, such as physical and historical traits of the location. Researchers focused primarily on the last two factors when presenting their findings.

Overall, teachers reported major benefits to their practice outside of the classroom after the program. They valued the collaboration and mutual support from their peers in planning outdoor curricula. The evidence suggested that collaborative planning visits, increased time in natural spaces, and opportunities for reflection were critical to excursion making, particularly for educators with less professional experience. Many teachers altered their practice in outdoor settings to be more participatory, open ended, and student directed. As a result, they reported improved relations among students, as well as between teachers and students, along with a greater respect for individual differences.

The project not only impacted the content and implementation of the excursions, but also impacted the teachers themselves. The study found that the approach allowed teachers to reconsider their own perspectives of themselves as educators. The study also found that those who had established a deeper connection with nature were more easily able to teach with a place in mind and generate new meaning for learners through connections with a place. Teachers reported that excursion success was linked to how confident, motivated, enthusiastic, and willing they were to teach in nature. Those who saw themselves as “outdoor people” also noted this as a factor in success, supporting the notion that a teacher’s own life practices can influence his or her teaching.

Using their findings, the authors developed some characteristics to define their term, place-responsive pedagogy. More practical suggestions for educators include emphasizing flexibility, creativity, and an ability to respond

to students’ individual experiences. Additionally, the authors suggest slowing the pace of teaching to allow time for students and teachers to adapt to and develop familiarity with the place.

THE BOTTOM LINE:

Excursions in nature should go beyond simply being present in a place to being effective educational experiences for students. The success of nature excursions relies heavily on the ability of educators to create curriculum that is relevant, not only to the students, but also to the unique place. Part of the ability to develop these place-responsive pedagogies relies on a teacher’s own familiarity and connectedness with the place. To teach about the environment effectively, teachers need to familiarize themselves with these environments and adjust their teaching practices to explicitly emphasize connections between curriculum and place.

Mannion, G., Fenwick, A., & Lynch, J. (2013). Place-responsive pedagogy: Learning from teachers’ experiences of excursions in nature. *Environmental Education Research*, 19(6), 792–809.

USING WRITING TO DISCOVER THAT HUMANS ARE NATURE

How people view themselves as human beings in relationship with their environment is a critical question in the field of environmental education (EE). Learning to be *with* nature, and *care about* nature, are common ways EE speaks about this relationship. But a side effect of such language is the sense that human beings are something other than nature themselves. In this paper, the author argues that human beings *already are* nature and that our very existence is created each moment in relationship with all living and nonliving aspects of our environment. She also proposes a writing method to promote this kind of understanding.

One of the ways that EE has traditionally approached this topic is by attempting to teach people to be less anthropocentric, or human-centered. The author of this paper argues that enabling people to discover they are

an integral part of the universe, engaged in a dynamic human-nature relationship, completely transforms this anthropocentric view. The way to do this, she argues, is to promote engagement with the world, as opposed to only a conceptual understanding of it.

The writing technique the author suggests for helping people actualize this non-human-centered perspective is to encourage the humanization of the world around them. She posits that we can learn from children, who quite naturally do this with their environment. Rather than steering children (and adults) away from this natural anthropocentric inclination, she suggests using this inclination as a means for writing and engaging with the environment. In other words, the author encourages young people to write about the animals, plants, and insentient objects as if they have human senses and feelings. She calls this writing method “interspecies articulation” (that is, articulating for other species). By doing so, the author argues that students develop a deeper understanding of what is shared with the world around them, as well as their dependence on, and connection with, all of it.

To illustrate her point, the author uses writing samples from a previous study she conducted in which people were encouraged to write about the beauty they found in their everyday lives over the time span of one year. One of the excerpts follows:

The trees had dressed in white winter jackets and the sky radiated in its various colors. The river spoke and I realized now that I had heard it already inside the house. Deep sighs came from beneath the ice cover, the water was breathing, and the ice went along with it. I felt that everyone in the universe was making content sounds.

THE BOTTOM LINE:

Through a writing method called interspecies articulation, environmental educators can demonstrate and remind students of their ongoing co-existence with nature. This method encourages students to write about other species and insentient objects, such as rocks and mountains, as if they possess human senses and feelings, using language

such as “the shrub tenderly unfurled its leaves after a long and restful winter sleep.” Interspecies articulation can be practiced through many mediums, including writing, journaling, or poetry. These forms of expression and empathy can provide an opportunity to realize and enhance connectedness with nature.

Rautio, P. (2013). Being nature: Interspecies articulation as a species-specific practice of relating to environment. *Environmental Education Research*, 19(4), 445–457.

PROFESSIONAL DEVELOPMENT

SUPPORTING TEACHERS TO CONTINUE FIELD-TRIP LEARNING IN THE CLASSROOM

Although the literature demonstrates that field trips have potential for long-term impact and acknowledges the importance of follow-up activities to extend the learning, there is little insight into how teachers follow up on the field trip experience once returning to the classroom. The purpose of this study was to describe activities and approaches teachers used in the classroom after a field trip. The authors also examined differences between teachers who did a high amount of follow-through compared with those who did little; the teachers were compared along a number of dimensions, including the subjects they teach and the number of years they've been teaching.

In this qualitative study, researchers interviewed 5th and 6th grade teachers and their students who participated in an Earthkeepers earth education program. A three-day immersive experience, Earthkeepers cultivates students' ecological understandings, develops positive attitudes towards the natural world, and provides students with skills students need to make informed ecological choices within their daily lives. The program is divided into four learning components. Students complete the first two on site and are responsible for completing the final two on their own. Given this program design, teachers must follow-up in some capacity.

Using teacher and student surveys, researchers categorized the twenty-six participating teachers into three groups: those who did low, medium, or high levels of follow-up. Categorization was determined by the frequency and extent to which topics from the program were integrated into subsequent classroom activities. Additional interviews of the teachers in the high and low categories provided insights as to how follow-up activities were implemented, the barriers to implementation, and how these approaches influenced student completion rates of the program.

This research was based on the participation in the Earthkeepers environmental education program. A total of 26 teachers and their fifth- and sixth-grade students participated in the study. The program included a three-day immersive nature experience outside of school, bookended by classroom activities before and after the excursion. The program has four main elements: *knowledge, experience, yourself,* and



sharing (represented by the acronym KEYS). The *knowledge* and *experience* elements happen during the field trip, and the *yourself* and *sharing* elements happen post-trip. *Yourself* involves encouraging students to adopt behaviors that reduce energy and resource use, and increase time spent in nature. *Sharing* encourages students to share their experiences of these behaviors with other students. Specific tasks are associated with completing each element, and students earn metaphorical keys when they've completed them. Each student must keep track of his or her completion of each key, but teachers keep track of overall progress and completion.

To collect data about the outcome of the program, teachers completed post-program surveys where they described follow-through activities they did in their classrooms. Students were also asked to complete post-program surveys, where they described teacher efforts to support the post-field-trip learning experience. After reviewing the surveys, the researchers realized there was a range of follow-up activities, from a great deal to almost none at all. The researchers then categorized the teachers into three groups: those who provided high, medium, and low levels of follow-through with their students. These categorizations were based on how much time was spent doing program follow-through, the extent to which students were involved in environmentally related activities and projects, and how often teachers included ideas or concepts from the program in their classroom activities. Out of 26 teachers, five were in the “high follow-through” category, 17 were in the “medium” category, and four were in the “low” category. The researchers interviewed the nine teachers who were in the high or low categories, asking questions related to their follow-through intensity and content of activities. These interviews helped the researchers learn about and contrast the factors that encouraged, or created obstacles to, teacher follow-through efforts.

The authors found several differences in teaching practices between teachers with high and low levels of follow-up instruction. Teachers with high follow-up ratings taught science for a minimum of two hours a week, while the majority of teachers with low follow-up ratings taught

science for one hour a week. With more class time dedicated to scientific content overall, teachers with high follow-up ratings were able to more easily integrate Earthkeepers concepts into their curriculum. By contrast, teachers who devoted less time to teaching science in the classroom expected students to complete the program independently at home.

Teachers with high follow-up ratings set aside class time for discussion and completion of the Earthkeepers program, helping students plan and execute their new behaviors. These teachers assigned goals and deadlines and created a system where students could track their progress. A teacher's commitment to follow-up assigned importance to ideas learned in the program. Students recognized the sentiment. In classes where teachers did a high level of follow-through, 98% of students completed the *Yourself* key about lessening impact, and 78% earned the *Sharing* key. By contrast, in classes with low levels of follow-up, only 44% of students completed the *Yourself* key, and 29% completed the *Sharing* key.

Teachers in the low-level follow-through category introduced the tasks to students and recognized their accomplishments, but failed to provide support for students throughout the process or integrate the Earthkeepers experience into classroom discussions. These same teachers did not prioritize integration of program concepts into the science curriculum, citing curricular challenges and pressures to meet state standards as obstacles. These teachers also had fewer years of experience with the Earthkeepers program, whereas teachers with high levels of follow-through had participated in the program for at least 13 years, so they had more experience incorporating Earthkeepers topics into existing science lessons.

THE BOTTOM LINE:

Follow-through activities after a field trip program have been shown to strengthen the long-term learning and impact for students. Teachers who provide more follow-through after a field trip are likely to be those who have been engaged in, and committed to, a field trip program for longer, so they have more direct experience with that field

trip program and, therefore, have learned different ways to integrate the program in their classrooms, particularly in the existing science content. Teachers are also more likely to integrate follow-through activities into their classes when they have a substantial amount of time set aside for science content, allowing the inclusion of the field trip follow-through as part of this dedicated time. Facilitating effective field trip follow-through requires supporting teachers with professional development and specific lesson plans that focus on curriculum integration, in-class assistance, and teacher-to-teacher mentoring.

Felix, L., & Johnson, B. (2013). Back in the classroom: Teacher follow-through after an earth education program. *Applied Environmental Education & Communication*, 12(3), 187–196.

SCHOOL GARDENS: TEACHER MOTIVATIONS AND EXPERIENCES

Research and practice suggest that school gardens provide an important opportunity for environmental education in K–12 school contexts, have many benefits for student development and learning, and can support science, social studies, and mathematics, among other subjects. Yet, school gardens can also be difficult and costly to maintain, as the success of school gardens depends largely on the support of teachers and their ability to incorporate the garden into their teaching practice. Thus, this research considered the rationale behind teachers' choices to regularly use school gardens, despite challenges they might face. The research builds on previous case studies that looked at factors influencing decisions to use school gardens for teaching.

The research took place at a school located in a suburban town in the Midwestern United States. The school had maintained gardens on site for approximately 10 years and ran workshops for groups interested in starting school garden programs at other sites. The school gardens were run by coordinators who wrote lessons for use in the gardens; these lessons were connected with state science standards. The coordinators partnered with the

teachers to ensure successful use of the gardens. Within the school, two second-grade teachers and one fourth-grade teacher participated in the study. These teachers were all regular users of the garden and taught a variety of subjects.

The teachers each participated in two in-depth interviews. In the first interview, each teacher shared stories about his or her relationship with the outdoors, particularly as it related to family and education. In the second interview, the teachers built on these stories by describing their teaching experiences in the school gardens and their process for establishing the gardens as a regular facet of their practice. The researchers analyzed these interviews, looking for common themes and substories.

Common to all three teachers were themes of environmental memories, observation of children's behavior, and beliefs about teaching and learning. Additionally, nostalgia was identified in each of the teachers' narratives. The researcher states that nostalgia and the three themes acted as internal incentives for using the school garden, and these internal incentives were translated into actual use of the gardens by the presence of garden coordinators and standards-based curriculum. All three of the teachers described a great deal of time spent outdoors during their childhood. They used this as a foundation for their desire to facilitate outdoor experiences for their students. The teachers also used these memories to contrast against their observations of children, either their students or their offspring. The teachers described children today as being increasingly dependent on technology, at the cost of attention span, creativity, and imagination. Nostalgia played into these themes when the teachers compared their own impressions of modern childhood with memories from their upbringings. The greater the perceived distance between their own experiences and modern-day experiences, the easier it was for the teachers to rationalize the use of school gardens. Lastly, the teachers recognized the gardens as supporting their beliefs about teaching and learning. The three teachers talked about the garden's ability to facilitate hands-on

and experiential learning, which they all considered to be important practices.

These findings are important for environmental education practitioners, especially those who collaborate with teachers in settings that include school gardens. Understanding the reasons and rationale behind the teachers' use of the school gardens can help environmental educators empathize with the connection—or disconnection—that they may observe. Particularly, recognizing the role of nostalgia is critical in developing this empathy. Nostalgia connects strongly with school gardens, allowing teachers to share with their students a value that they hold from their own life experiences. This relationship with the past can be seen throughout environmental education and serves to connect K–12 teachers with environmental education practitioners.

THE BOTTOM LINE:

School gardens can be important places that provide environmental education within K–12 school settings, supporting student development and learning related to science, social studies, language arts, mathematics, and other subjects. Yet, in order for school gardens to succeed, they require support of teachers. Often, nostalgia for their own early-childhood learning experiences is a motivating factor that encourages teachers to make use of school gardens; when teachers reflect on their own learning experiences and childhoods, they may have a stronger desire for today's children to have outdoor and nature-based experiences similar to those of the past. Also, teachers may be motivated by their positive observations of children's learning experiences in these settings and how those observations align with their pedagogical beliefs. Having on-site garden coordinators who help maintain the gardens, as well as lesson plans that connect with standards, can also help make it easier for teachers to use these sites for teaching and learning.

Jorgenson, S. (2013). The logic of school gardens: A phenomenological study of teacher rationales. *Australian Journal of Environmental Education*, 29(2), 121–135.

FOSTERING DIALOGUE BETWEEN STUDENTS AND TEACHERS AROUND ENVIRONMENTAL ACTION

Research has shown that both historical and cultural contexts influence practices and activities in the classroom. This author suggests that learners and teachers may perceive environmental education participation differently, as teachers can have a relatively narrow view of learning processes, yet the dialogue among these two groups related to views of environmental education currently is limited. This article presents a case study on students' participation in environmental management activities at a primary school in a suburban area of Botswana, with a particular focus on the relationship between students' and teachers' perceptions.

The school is located in a community near one of the fastest growing urban areas, where families face challenges related to overcrowding, limited infrastructure, and economic poverty. Recognizing that any effects found would be highly dependent on the specific cultural, socioeconomic, and physical context—and while the research was consciously embedded in a particular cultural and historical context—the author suggests ways for opening up the dialogue between children and teachers that are relevant for a variety of educational contexts. The researcher used observation, focus group interviews, photographs, and drawings with seven adolescents who were participating in environmental education activities related to waste management. The author examined the histories and norms shaping participation in environmental activities, as well as tensions in different interpretations of participation by diverse school stakeholders, such as teachers, students, and administrators.

The author found that the school's focal environmental activities were related to cleaning the campus spaces and picking up litter. The school's environmental committee coordinator held the role of selecting which environmental challenges to target, and worked with other teachers to create rules for the school's

environmental management. The students, however, identified sanitation as the more urgent environmental issue to address. This was highlighted by how the school was being cleaned of litter, but students still had to use off-campus facilities because of unsanitary school toilets.

Despite the teachers' stated desire to enable students to meaningfully engage in environmental activities, the school policy of top-down decision making limited the students' participation to only picking up litter. This approach left little space for creative learner-driven activities around sanitation or other environmental issues. The author also identified a lack of dialogue between teachers and students. In most cases, the teachers were unaware the students had different ideas regarding where to focus their environmental activities.

In an attempt to facilitate a change in the school's policies and teaching methods, the author supported opening up communication between teachers and students. This exchange involved inviting students to identify and choose issues of concern, envision possible solutions, act on selected methods to address these challenges, evaluate the results of their efforts, share progress with the teachers, and invite teachers' support.

After encouraging the dialogue and activities, the author assessed the results of this intervention through interviews with the teachers and students. In particular, the author was interested in identifying barriers and enabling factors for addressing the earlier tensions and empowering students to realize their own visions. The evaluation suggested that there was a shift from teacher-directed forms of participation to activities that were directed by collaborative partnerships of students and teachers, as well as to more children-directed activities through dialogue. The line of communication between teachers and students also appeared more open, although the teachers still made final decisions.

The author found that the scope of the students' participation in environmental activities had expanded

in comparison to before the intervention. Students were now developing alternative waste management procedures for the school, and the students were forming alliances with supportive teachers rather than with the school education coordinator. Students' participation, perceptions, and preferences of the roles they could play in school decisions provided evidence of action competence development.

The author reiterates that encouraging dialogue and striving to create more mutual relationships between teachers and students can be complex on a cultural level, is affected by the historical and social contexts, and is a long-term process rather than a short-term activity. The author maintains, however, that developing new understandings of learners and diverse forms of participation are necessary in order for teachers to enable meaningful student participation in environmental education, and that this has implications for teacher professional development.

THE BOTTOM LINE:

Historical and sociocultural contexts can play an important role in influencing how classroom dynamics and activities are structured. It is helpful to understand this when such contexts are limiting learner participation in environmental activities, since teachers and students may perceive participation differently. Increasing dialogue between students and educators has the potential to reduce misunderstandings and enable students to take more meaningful action as a result of their environmental learning.

Silo, N. (2013). Dialogue—missing in action competence: A cultural historical activity theory approach in a Botswana school. *Journal of Environmental Education*, 44(3), 159–179.

OTHER RESEARCH

FEELINGS OF RESTORATION FROM RECENT NATURE VISITS

Can visiting a natural space result in feelings of restoration, such as calmness, relaxation, refreshment, or revitalization? Established literature corroborates the intuition that there are restorative health benefits to visiting natural spaces, but these findings are complicated and mixed. Previous theoretical work with Attention Restoration Theory (ART) and Psychophysiological Stress Recovery Theory (PSRT) have hypothesized that visiting nature can lead to changes in emotional states and vitality. Researchers have employed a variety of methods in both laboratory and field settings to show that natural environments have the capacity to cognitively rejuvenate positive energy and reduce negative emotions for individuals. These emotional changes vary, however, in studies that target different types of natural environments and among people of different demographics. Yet, without a single sample large enough to also control for visitor profile confounds, it's difficult to make conclusions about how visiting specific natural spaces might affect restorative emotions.

To address this research gap, the authors used a subsample from a national survey conducted between 2009 and 2011 by the British government's Natural England department. Called the Monitoring Engagement with the Natural Environment (MENE) survey, the questionnaire consists of in-home, face-to-face interviews with 142,031 individuals. For this study, a subsample was selected of 4,255 participants who had spent time outdoors in the last week and who also had been asked about feelings of restoration associated with one of those outdoor experiences. When participants were asked if they had spent time outdoors, they were instructed, "by *out of doors*, we mean open spaces in and around towns and cities, including parks, canals, and nature areas; the coast and beaches; and the countryside, including farmland, woodland, hills, and rivers. This could be a few minutes to all day. It may include time spent close to your home or workplace, further afield, or while on holiday in England. However, this does not include routine shopping trips or time spent in your own garden." Just over half the participants were female; ages ranged from 16 to over 65.

Outdoor experiences were further categorized into three broad areas:



an urban green or open space, a rural or countryside area, or a coastal environment. The researchers collected demographics, such as gender, age, and socioeconomic status (SES). Additionally, the researchers examined visit characteristics, such as other accompanying visitors and the types of engaged activity while at the nature space. If the participant had more than one outdoor experience in the last week, one of these experiences was randomly selected for collecting these additional visit characteristics. The main measure examined in all participants was recalled restoration, which was characterized in the survey as the amount that a nature visit “made me feel refreshed and revitalized” and “made me feel calm and relaxed.”

Generally, previous literature findings were replicated in that visits to nature were associated with greater recalled restoration. Mean visit time to nature spaces across all participants in the sample was approximately 160 minutes. Significant differences between types of nature spaces were found for recalled restoration after controlling for demographic and visit characteristic confounds. Visits to urban green spaces were associated with less recalled restoration than rural green spaces. Coastal spaces were associated with the highest amounts of recalled restoration. Exercise areas, such as playgrounds or playing fields, were measured to have the lowest recalled restoration values across all groups. The authors posited this may be, in part, because visits to these locations were often with children; however, after controlling for that factor, the researchers still found this difference, which suggests that other factors may also be at work.

No significant differences were measured when controlling for either gender or SES; however, the youngest age group (participants between the ages of 16 and 24) experienced relatively less recalled restoration from all nature spaces than participants in the older age groups. This finding is in keeping with previous research suggesting that restorative properties of nature may be lowest for those in their late teens. The authors speculate this may be because those in their late teens often use woodlands and natural spaces for less-restorative activities, such as getting away from adults and partying. Previous research has shown that

young adults tend to find nature more restorative again as they get older, especially if they had positive experiences in nature as children.

Among activity types at all nature spaces, eating or picnicking, visiting an attraction, playing with children, or vigorous exercising were all associated with only slightly less recalled restoration than merely walking. The researchers emphasized their surprise at how relatively little direct effect the activity type had on recalled feelings of restoration. The starting point for the activity (e.g., home, work, or vacation), the distance traveled, and the mode of transportation also had no effect on restoration. This may be because 94% of visits started from home and 71% were less than five miles from the starting point; this finding highlights the importance of local green spaces.

This study provides a perspective on the restorative value of visiting nature spaces. By using a large sample size and controlling for confounds in visitor profiles and activity types, this study offers a more nuanced depiction of restorative feelings across different types of nature spaces. Limitations in prescreening, however, mean that this study lacks the data about visitors’ emotional states prior to visiting nature spaces, which might influence the findings. Additionally, study participants are self-selecting the nature visits, meaning that the participants who might most benefit from restorative nature experiences are precisely the ones who spend time in such spaces. Restorative feelings were also only measured for one visit, meaning there could be differences in restorative feelings from multiple visits to such natural spaces. Overall, this study provides a more precise link between nature visits and restorative health benefits, which could influence policy makers in deciding which types of nature spaces receive funding or attention for maintenance. Outdoor and health educators could also use study findings to better advise individuals on the best practices in engaging with nature spaces for restorative purposes.

THE BOTTOM LINE:

Intuitively, people have long believed that taking the time out of a busy schedule to visit a natural space may have restorative health benefits; recently, an increasing number of

studies are supporting this assertion. Although the type of activity that people do outside—such as casually walking, vigorously exercising, or leisurely picnicking—seems to have little effect on the overall sense of restoration that they derive, the type of natural area visited does seem to be important. Certain types of natural areas may offer more restorative benefits than others. Coastal areas, for example, may engender more restorative feelings, while urban green spaces may produce relatively less (although still a significant amount). Yet, despite these differences, urban green spaces remain essential—and are perhaps growing in importance—because of the increasing numbers of people who live in urban areas and, therefore, the enhanced proximity of these urban green spaces.

White, M. P., Pahl, S., Ashbullby, K., Herbert, S., & Depledge, M. H. (2013). Feelings of restoration from recent nature visits. *Journal of Environmental Psychology, 35*, 40–51.

CREATING THE RIGHT AMOUNT OF SCAFFOLDING IN SCIENCE MUSEUMS

Past research suggests that digital augmentation, when used as a scaffolding device in science museums, can have a positive impact on both conceptual (content) and cognitive (thinking process) understanding. There is a danger, however, that “overformalization” can occur from scaffolding devices, and that informal learning behaviors—such as experimenting, asking questions, and collaborating with others—can be diminished. Reduction in these behaviors is problematic because of the unique affordances that informal education settings provide over more formal approaches to learning. This paper’s authors sought to understand the optimal level of scaffolding—or cognitive, affective, and skills-based support—that science museums and informal learning sites can use to encourage both informal behaviors and deeper cognitive learning.

To understand how students respond to different levels of scaffolding, the researchers selected 307 middle-school students to participate in an activity involving completing an

electrical circuit. The research took place at an urban science museum. The students worked in groups of three and were given one of six different conditions for completing the activity and student response sheet; each of the six conditions represented a different level of scaffolding. The first three conditions did not emphasize collaboration, although the students still worked in groups of three. Condition 1 (C1) acted as a control group with no scaffolding; students in this condition completed response sheets individually after the activity. Condition 2 (C2) included an augmented reality device, which offered an animation of moving electrons that the students could use to complete the electrical circuit; they also completed the response sheet individually after the activity. Condition 3 (C3) included the augmented reality plus student response sheet questions, which were read aloud by one of the students in the group before the students began the exercise; in this way, the students were aware of the questions that they would be answering after the activity.

The next three conditions emphasized collaboration with peers in some way. Condition 4 (C4) had the C3 scaffolds plus directions on how to collaborate within their group. Condition 5 (C5) had the C4 scaffolds plus additional knowledge-building prompts, in the form of a bank of ideas from peers; their response sheets were completed collaboratively after the activity. In Condition 6 (C6), the group had all of the C5 scaffolds, but acted collaboratively to complete the response sheet as a group *during* the exercise instead of after the activity.

The researchers used videos of group interactions during the intervention; a survey of conceptual knowledge administered before and after the exercise to measure knowledge gains; the student response sheets from the intervention; and randomly selected post-intervention interviews to collect data on student behavior and learning. The researchers analyzed video data for informal behaviors, such as experimenting with the exhibit and articulating questions not already posed on the student response sheet.

One of this study’s central findings demonstrated the apparent tension between scaffolding for deeper cognitive learning and promoting informal behaviors, such as

conversations, experimentation, and questioning. In general, as scaffolding increased, informal behaviors decreased. However, when students were expressly encouraged to collaborate (C4, C5, and C6), more informal behaviors were observed despite the presence of scaffolding.

Another finding of this study was the value of using the augmented reality tool to support conceptual learning, which, in this case, was the projection of moving electrons. This was demonstrated by the much lower learning gains found in C1 compared with the other groups that had the augmented reality tool. The authors suggest that these tools may be particularly effective for teaching physical science topics, particularly when helping visualize characteristics of phenomena that are not visible.

The researchers found that condition C4 seemed to be the “Goldilocks” in terms of scaffolding. The students in this configuration had the questions posted and instructions to participate in collaborative groups. They demonstrated the highest gains in conceptual knowledge, a relatively high ability to theorize (not as high as C5 and C6, however), and the highest number of informal behaviors, such as experimenting, asking questions, and collaborating with others. While the addition of knowledge-building scaffolds (C5) and completing the worksheet during the exercise (C6) helped the students in terms of their ability to theorize, both of the additional scaffolds had a significant impact on informal behaviors.

THE BOTTOM LINE:

Scaffolding methods, such as providing student response sheets and augmented reality devices, can help enhance knowledge gains in informal learning settings. Augmented reality tools that make visible phenomena that are otherwise invisible—such as animations of moving electrons—are particularly valuable for helping students understand concepts. However, too much scaffolding can also lead to decreases in informal behaviors such as experimentation, asking questions, and collaborating with others. One way to overcome this concern is to expressly encourage collaboration between students.

Yoon, S. A., Elinich, K., Wang, J., Van Schooneveld, J. B., & Anderson, E. (2013). Scaffolding informal learning in science museums: How much is too much? *Science Education*, 97(6), 848–877.

COLLABORATIVELY CREATING A CITIZEN SCIENCE WEBSITE

In 2012, the National Park Service (NPS) partnered with researchers at Colorado State University (CSU) to create the first citizen science repeat photography website. Repeat photography is where photographs are taken from the same location over time, documenting the changes that occur. These photographs provide compelling evidence of the changes taking place on our planet, such as the disappearing glaciers of Glacier National Park. The website accompanying the photographs in this intervention provides a platform for NPS visitors to learn about climate change while also contributing to a scientific database by sharing their photographs. After developing the website, the project leader conducted a reflective study with the project team and created an instructive resource for future teams working on similar websites. Although the focus of this study was to investigate effective practices for collaboratively creating a citizen science website, the insights the authors discuss about teamwork could be applied to any number of projects.

The goal of the NPS and CSU collaboration was to provide a web platform for sharing the results of a citizen science project in Southwest Alaska, where NPS visitors have been invited to collect repeat photographs, or “before and after” photography, of the landscape. Repeat photography has been used in California to communicate the seriousness of the current drought by comparing photographs of reservoirs before the drought to photographs of what those reservoirs look like today. In Southwest Alaska, historical photographs can be compared to new photographs taken by park visitors and used to track changes in the landscape. The website created by CSU and NPS provides the coordinates of historic photographs and invites citizen scientists to post their

comparison photographs. Citizen scientists, virtual visitors to the NPS website, and researchers are all encouraged to post their analysis of the repeat photographs, sparking discussions of how fast glaciers are receding; what kind of plants start to grow after a landslide or volcanic eruption, where soil erosion is occurring; and other changes in the landscape.

The core web development team was comprised of two CSU researchers and three NPS staff from Alaska. At the end of the development phase, which primarily took place through email and conference calls, the project leader initiated a reflective study of the collaborative process used to create the website. The researchers interviewed the five core team members about the collaborative process, asking questions such as, “What do you think [your team] did really well?” “What could [your team] have done differently?” “What were your goals coming into the project?” The team members’ reflections were then analyzed to draw out common themes in their responses.

The results of this reflective study include advice for future teams working on similar citizen science web projects. The study suggests that the web development team should prioritize in-person meetings, especially early in the project when developing cross-institutional working relationships. Also, at the beginning of the project, the team should make an effort to clarify and streamline personal goals to define the overall goal of the project. Throughout the web development process, it would be beneficial to organize tasks in a central document that can be accessed by everyone on the team and edited as progress is made. One of these tasks should include creating a detailed marketing plan to get users interested in the site once it is launched. Finally, the researchers conclude that reflection and evaluation should be incorporated into the development process, rather than left until the end of the project. By using iterative reflection and evaluation, issues and discrepancies can be identified and addressed at an early stage.

THE BOTTOM LINE:

Creating an effective educational tool with team members from different institutions, states, and academic backgrounds can be challenging. Key recommendations to facilitate productive collaboration include defining goals, talking face-to-face, and creating a central system for organizing tasks. In addition, group members should periodically reflect on the teamwork process by thinking about what is going well and what could be changed to improve the functionality of the team, and then integrate these insights throughout the project lifespan.

Mullen, K. C., Newman, G., & Thompson, J. L. (2013). Facilitating the development and evaluation of a citizen science web site: A case study of repeat photography and climate change in Southwest Alaska’s national parks. *Applied Environmental Education & Communication*, 12(4), 261–271.