An Evaluation Study of an Informal Environmental Education Program

THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

Bernadette Chi, Ph.D., Valeria Romero, M.A., & Joo Chung, M.S.

University of California, Berkeley

CONTEXT

Outdoor science programs (OSPs) have a tremendous but largely unrecognized capacity to play a pivotal role in science education reform by providing informal science learning experiences that engage youth with the natural world in ways that cannot be replicated in formal science settings. Outdoor science programs typically conduct two to five-day programs (often residential) that are centered on learning science outdoors by engaging youth with the natural world. Youth participants take part in field experiences such as hikes, data collection, and other nature studies, specifically intended to improve science and environmental literacy.

Research on professional learning and development for OSP educators is limited so the design of BEETLES professional learning opportunities primarily drew from research on informal and formal science educators (e.g. Darling-Hammond et al., 2009; Gess-Newsome et al., 2003; Tran et al., 2009).

PROGRAM DESCRIPTION

Funded by the Stephen D. Bechtel, Jr. Foundation, **Better Environmental Education, Teaching, Learning, Expertise and Sharing (BEETLES)** project is managed by the Lawrence Hall of Science at UC Berkeley. The BEETLES project team creates and implements professional development experiences for outdoor/environmental education program leaders to deliver to their staff teacher-naturalists, who then implement BEETLES activities and instructional practices with their students. The project aims to improve the quality of instruction and learning in Residential Outdoor Science (ROS) programs nationally, and across the field of environmental education in general.

The BEETLES Professional Learning Model includes a variety of resources and materials that help leaders facilitate reflection on practice through ongoing follow-up with staff and the incorporation of teaching observations as part of instructional improvement at their site (i.e., 11 professional learning sessions; 27 student activities; 16 “how-to” videos; 2 instructional observation protocols). BEETLES has also developed an implementation guides and other guides to support program leaders and field instructors put these strategies in practice. The four primary design elements of the BEETLES model are learning cycle-based instruction, learner-centered discussion practices, scientific habits of mind, and nature-centered science instruction.

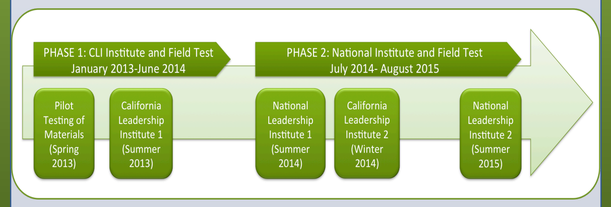

Figure 2. BEETLES Project Timeline

EVALUATION QUESTIONS

1. How did participation in the BEETLES project influence program leaders’ attitudes, interests and strategies for implementing professional development about teaching and learning science outdoors?
2. In what ways, if any, did the implementation of BEETLES influence the pedagogical approach at OSP sites (e.g., instructional strategies, curriculum, professional development for staff)?
3. To what extent did OSP sites using BEETLES influence youth participants’ fascination with science, competency beliefs and environmental literacy?

KEY FINDINGS[1]

IMPACT ON PROGRAM LEADERS

Institutes are effective in changing program leaders’ attitudes. Pre/Post surveys indicate a shift from an instructor-centered approach to one that is more learner-centered, encouraging learners to ask questions, and explore and discuss ideas.

A repeated measures of ANOVA was conducted to detect changes in participant attitudinal items from pre-Institute and post-Institute for two scales: Instructor-Centered pedagogy and Learner-Centered pedagogy.

- *CLI and NLI program leaders demonstrated a significant downward shift in Instructor-Centered pedagogy.*
- *NLI program leaders demonstrated a greater decrease in Instructor-Centered pedagogy than the CLI program leaders.*
- *CLI and NLI program leaders demonstrated a significant upward shift in Learner-Centered pedagogy from Pre-Post Institute. There were no differences between CLI and NLI program leaders.*

An individual pre-post t-test was conducted on several items related to program leaders’ perceived level of preparation and comfort in teaching science.

- *Five of the items were significant in the upward direction including program leaders’ enjoyment learning science, preparedness to teach field instructors about science, making observations, asking questions and offering evidence-based explanations.*
- *Program leaders demonstrated a significant decrease in their enjoyment and perceived level of comfort to lead a discussion with field instructors.*

Scale	N	Mean Difference	t-value	Sig. (2-tailed)
I enjoy learning science.	87	-.092	-1.470	.145
I enjoy teaching science to field instructors.	85	.165	1.974	.052*
I feel very comfortable leading a discussion with field instructors.	86	.209	2.525	.013*
I feel well prepared to teach field instructors about science.	84	-.226	-1.921	.058*
I feel well prepared to teach field instructors about how to make observations about the natural world.	86	-.663	-5.578	.000*
I feel well prepared to teach field instructors about asking questions about the natural world.	86	-.907	-8.208	.000*
I feel well prepared to teach field instructors about evidence-based explanations.	84	-.964	-7.512	.000*

Field tests were effective in reinforcing program leaders’ attitudes towards a learner-centered pedagogical approach.

A repeated measures of ANOVA was conducted to detect changes in participant attitudes from Pre-Institute, Post-Institute, and End of Field of Test.

- *There was no significant change in Instructor-Centered Pedagogy by the end of the field test.*
- *CLI and NLI program leaders demonstrated an upward shift in Learner-Centered pedagogy*

IMPACT ON PROGRAMS

There is a strong track record of program leaders and field instructors using the materials and implementing the practices supported by BEETLES over multiple years with promising evidence of program sites realigning their goals, curriculum and practices to support deeper engagement with learner-centered practices in science.

According to program leader interviews, for many programs, participating in BEETLES provided the opportunity for programs to reflect on their overarching objectives and goals for participants, to rethink their curriculum, and to think about overarching teaching practices and how to support students, as exemplified by the program leader quote below:

> *I also feel like it’s definitely pushed our program so that it’s more student-centered…More of the learning comes from the students, and the students are articulating it, and students creating their own conceptual understanding as opposed to us, “okay, did you learn these three facts by the end of the class?” I think is more effective learning, but also provided the tools and kind of resources to make that transition easier.*

Other examples of program influence reported by program leaders in interviews and confirmed during site visits included revising student journal prompts, providing ongoing opportunities for staff reflections, incorporating the BEETLES Learning Cycle in professional learning and field teaching opportunities, integrating the “I notice, I wonder, It reminds me of” instructional routine throughout programming, fostering staff inquiry, increasing awareness of teaching practices, and helping programs to prepare for and align with the Next Generation Science Standards. Overall, all sites reported being prepared to continue using BEETLES in some capacity though it was unclear at the time of the interviews what this would look like moving forward.

IMPACT ON YOUTH

Youth attending residential OSP at participating BEETLES sites demonstrated statistically significant gains on surveys measuring their fascination with science, competency beliefs in science, and their environmental literacy. Youth data were collected in 2014 from four OSP sites using BEETLES materials that operated three to five day residential programs.

Each site collected data before and after the residential programs from a minimum of 50 youth per site. Results are summarized in the table to the right, suggesting that the instruments are sensitive enough to detect the measured outcomes; the outcomes measured by the instruments are appropriate to examine in the proposed study for youth engaged in OSP; and that OSP have an impact on youth science learning outcomes.

Scale	N	Mean Difference	t-value	Sig. (2-tailed)
Fascination	278	-.04831	-2.971	.003*
Values Science	271	-.02408	-1.086	.278
Competency Beliefs	251	-.07957	-4.339	.000*
Sensemaking	199	.03304	1.192	.235
Environmental Literacy	198	-.07196	-4.027	.000*

[1] Data analysis is still ongoing

EVALUATION DESIGN & METHODS

MULTI-PHASE EVALUATON DESIGN

Developmental evaluation (Patton, 1994, 2010) – Contributes to the project development, pre-formative evaluation, through documenting, monitoring, and providing rapid, real-time feedback to emerging ideas and visionary hopes in a period of exploration to shape them into a potential model that is more fully conceptualized, potentially scalable innovation. Identify benchmarks and indicators for pilot efforts and formative evaluation.

Outcomes-based evaluation – Ensures attention to the impacts and efficacy of project goals objectives, and products with primary focus on outcomes in relation to the mission of developing innovative resources and their contribution to the EE field.

KEY EVALUATION ACTIVITIES

- Pre-/Post-Institute Surveys of program leaders
- End of Field Test Survey and Interviews of program leaders
- Field Instructor Surveys
- Four Case Site Visits (CLI 1 and NLI1): observations of activities; focus groups with field instructors; and interviews with program leaders.
- Pre-/Post Youth Participation (science activation) Surveys

SAMPLE

1. Program Leaders at Outdoor Science Programs across 71 sites throughout the United States
2. Field instructors at Outdoor Science Programs of CLI1 and NLI1
3. Youth at participating Outdoor Science programs with 50 or more youth in attendance

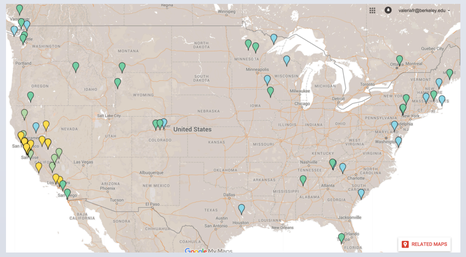

Figure 1. BEETLES Outdoor Science Program Participant Sites

NEXT STEPS

Since OSP’s have typically struggled to convince district administrators, teachers, and parents of the value of sending classes of students to a residential program for 3-5 days (Ernst, 2012; Gruenwald & Manteaw, 2007), these findings may help to advance the quality of OSP, the quality of professional learning opportunities available to OSP professionals; and increased youth and school participation in OSPs.

FOR MORE INFORMATION

QUESTIONS ABOUT THE PROJECT?Contact: Jedda Foreman
BEETLES Program Manager
beetles@berkeley.edu
www.BEETLESPROJECT.org

QUESTIONS ABOUT THE EVALUATION?
Contact: Valeria Romero
The Research Group
valeriafr@berkeley.edu