



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 Outdoor Science Programs (OSP) nationally, and across the field of environmental education in general.



Figure 1. BEETLES Project Timeline

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). 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.

EVALUATION DESIGN AND METHODS

MULTI-PHASE EVALUATION 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

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?

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. *Program leaders demonstrated a significant downward shift in Instructor-Centered pedagogy; and a significant upward shift in Learner-Centered pedagogy from Pre-Post Institute.*

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 (as illustrated in the table to the right.)*

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 included revising student journal prompts, providing ongoing opportunities for staff reflections, incorporating the BEETLES Learning Cycle in professional learning and field teaching opportunities, increasing awareness of teaching practices, and helping programs to prepare for and align with the Next Generation Science Standards.

| 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* |

Table 1. Program Leaders Attitudes Towards Teaching Science

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. Results are summarized in the table below, suggesting 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* |