# Science Education at Week-long Residential Outdoor Schools: Results for At-Risk 6th Graders

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The American Institutes for Research conducted an evaluation to measure the impacts of week-long residential outdoor education programs for 255 sixth-grade California students. Approximately half of each school's sixth grade attended outdoor school between September and November of 2004 and served as the treatment group. The remaining sixth grade classrooms attended outdoor school after the data collection period ended, thereby serving as the control group. In this manner, the study utilized a treatment and control design without denying any child the opportunity to attend outdoor science school.

Pre- and post-survey data were collected from students, parents, and teachers. Participation in outdoor school was associated with higher ratings of conflict resolution skills, cooperation, and environmental behaviors. Participating students received significantly higher teacher ratings than children who did not participate in six of eight constructs: self-esteem, conflict resolution, relationship with peers, problem solving, motivation to learn, and behavior in class. Children who attended outdoor school significantly raised their science scores by 27 percent, as measured by a pre- and post-survey. The positive outcomes associated with students' participation in the five-day outdoor science school are impressive, especially given the relatively short timeframe of the program.

The American Institutes for Research (AIR) conducted an evaluation to measure the impacts of week-long residential outdoor education programs for at-risk sixth graders in California. As described by California Assembly Bill (AB) Number 1330, Chapter 663, the Outdoor Environmental Education Program is designed to "foster stewardship of the environment and an appreciation of the importance of the wise use of natural resources." The program serves at-risk youth and underserved demographic groups. AB 1330 called for the California Department of Education (CDE) to administer an independent evaluation of the program to be conducted by February 1, 2005 to examine the effects of outdoor experiences on students' behavior and learning.

This study focused on 255 sixth-grade students from four elementary schools who attended three outdoor education programs (also referred to as outdoor science schools) between September and November of 2004. The evaluation utilized a "delayed treatment design." Within participating elementary schools, sixth-grade children were divided, by classroom, into two groups. Approximately half of each school's sixth grade (one or more classrooms) attended outdoor school between September and November of 2004 and served as the treatment group. The remaining sixth grade classrooms were scheduled to attend outdoor school after the study's data collection period ended in December 2004, thereby serving as the control group during the study period. In this manner, the study utilized a treatment and control design without denying any child the opportunity to attend outdoor science school. The design provides a rigorous method to identify the outcomes associated with participation in the program.

## RESEARCH QUESTIONS

The specific research questions addressed in this study are as follows:

1. How does participation in outdoor education programs impact students' personal and social skills (e.g., self-esteem, cooperation, teamwork)?
2. How does participation in outdoor education programs foster students' stewardship of the environment and their appreciation of the importance of the wise use of natural resources?
3. How does the science instruction received through the outdoor education program curriculum increase students' knowledge and understanding of science concepts?

## METHODOLOGY

The CDE, in consultation with AIR, selected three resident outdoor science schools as the target programs for the study. The programs primarily serve fifth- and sixth-grade students during week-long residential programs, and use curricula that align with the California State Science Framework and the California Academic Content Standards for science. The hands-on, inquiry-based curriculum is designed to help students understand the environment and the role of humans as participants in ecosystems, as well as develop their skills, attitudes, knowledge and commitment concerning the natural world. While instructional activities vary somewhat across the outdoor education programs participating in the study, the content of the curricula is consistent, focusing primarily on ecology and earth science.

A total of 255 students from four California elementary schools participated in the study. The four schools serve mostly Hispanic children (ranging from 69 percent to 89 percent of the student population) and have a high proportion of English Learners (32 percent to 66 percent of students). Eighty-one to 100 percent of the children in each school qualify for the free and reduced price lunch program.

Data collection included the use of surveys and site visits between September and December of 2004. Students, parents, and teachers were surveyed. Three rounds of surveys were administered: before the treatment group attended outdoor school (Round 1 pre-survey), immediately after the treatment group returned from outdoor school (Round 2 first post-survey), and six to ten weeks after the treatment group returned from outdoor school (Round 3 second post-survey). Students were surveyed in all three rounds, and parents and teachers were surveyed in Round 1 and Round 3. Parents and teachers provided individual ratings on eight constructs for students in both the treatment and control groups. Student responses from Rounds 1 and 2 were used to determine the immediate impacts of participation in outdoor education, while student, parent, and teacher responses from Rounds 1 and 3 were analyzed to explore the longer-term impacts of the program. Research staff conducted one-day site visits to each of the three outdoor schools during the same week the treatment group attended each program. Staff observed instructional activities while on-site and conducted in-person interviews or focus groups with the sixth-grade teachers of participating students.

## DATA ANALYSIS

Scales for five social and personal constructs, three environmental attitude scales, and an overall science score, were developed from individual survey items. The reliability of these constructs (scales) was assessed by calculating Cronbach's alpha, which measures the extent to which the scale items are measuring a common, underlying construct. Two independent sample t-tests were used to detect statistically significant differences between various student groups and subgroups (e.g., treatment versus control groups, male versus female, Hispanic versus non-Hispanic students). Paired-sample t-tests were employed to examine significant gain scores

within groups. Similar analyses were conducted for survey data from parents and teachers. The criterion used for statistical significance was $p<.05$.

## FINDINGS

### Social and Personal Skills

Students and parents were surveyed to measure student-level changes across five related constructs: conflict resolution, self-esteem, cooperation, leadership, and their relationship with their teacher. Teachers rated each student on eight constructs: self-esteem, cooperation, conflict resolution, leadership, relationship with peers, problem solving, motivation to learn, and behavior in class. Findings included:

- According to student assessments gathered immediately after program participation, children who attended outdoor science school showed significantly higher gains in conflict resolution. However, these gains were not significantly higher than the increases shown by the control group. Six to ten weeks later, children who attended the program showed gains in cooperation and conflict resolution that were significantly higher than the control group.
- Teacher ratings provide evidence of a wide range of positive outcomes related to participation in outdoor science school. Teachers rated all children before the treatment group attended outdoor school and six to ten weeks later. According to teacher ratings of each student, those children who attended outdoor science school showed statistically significant positive gains on all eight constructs on which they were rated. In contrast, the control group showed losses on seven of the eight constructs. Children who attended outdoor science school showed significantly larger gains than the control group in six of

the eight constructs. These gains were observed in self-esteem, conflict resolution, relationship with peers, problem solving, motivation to learn, and behavior in class.

- Parent ratings of their children did not reveal any significant differences in the five social-emotional constructs between children who attended outdoor school and those who did not.

Stewardship of the Environment

- According to student assessments gathered immediately after program participation, children who attended outdoor school showed significant increases in one of the three constructs: concern about conservation. However, these increases were not significantly larger than gains by the control group.
- At the six- to ten-week point, the control group showed significant losses in two of the three constructs (attitude toward science and environmental behaviors), whereas the treatment group did not show any significant losses.
- According to parent reports, students who participated in the program had significantly larger gains in environmental behaviors, compared to children who did not attend the program. In other words, parents of children who attended outdoor school observed children engaging in positive environmental behaviors (e.g., recycling, etc.) at home, whereas a statistically significant finding was not observed for parents of the control group.

Knowledge and Understanding of Science Concepts

- Children who attended outdoor school significantly raised their science scores by 27 percent, as measured by a pre- and post-survey administered immediately upon their return to school.

- The increase in science knowledge was maintained six to ten weeks following program participation, with no significant loss in science scores.

## CONCLUSIONS

Fifty-six percent of the treatment group reported that outdoor school represented the first time they had spent time in a natural setting. Participation in outdoor school was associated with higher ratings of conflict resolution skills and cooperation (longer-term student assessments), and environmental behaviors (parent reports). Strong evidence of the benefits of outdoor school is seen in teachers' ratings of students – students who attended the program received significantly higher ratings than children who did not participate in six of eight constructs: self-esteem, conflict resolution, relationship with peers, problem solving, motivation to learn, and behavior in class. Children who attended outdoor school significantly raised their science scores by 27 percent, as measured by a pre- and post-survey administered immediately upon their return to school. The increase in science knowledge was maintained six to ten weeks following program participation, with no significant loss in science scores. The positive outcomes associated with students' participation in the five-day outdoor science school are impressive, especially given the relatively short timeframe of the program.