

Understanding Interventions That Promote Recruitment Into the Sciences: The Role of Experiential Science Programs for Youth

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What are some specific indicators for success in enhancing youth awareness of science, science process and science careers? In particular, what is the role of experiential science programs as an entry point to the science education and career pipeline? There is a growing body of evidence suggesting that hands-on experiential science programs positively impact science students at all levels of education, and help create a personal connection to and understanding of science as an active process. Moreover, many college students currently studying science indicate the importance of experiences such as science camps and other adventure/experiential based activities in their decision to pursue science as a career. Nonetheless, there are very few experiential science opportunities at public middle and high school institutions. As such, many students' access to these important opportunities may be limited due to socio-economic and other barriers.

Our study investigates changes in students' cognitive and affective development as a result of attending a multi-day residential science program aimed at enhancing their understanding of science as an active process (www.campsealab.org). We also examined changes in students' preference for future science careers, and the importance of science to their everyday lives. We utilized existing 'pipeline' models to develop a framework for testing the role of experiential science programs as major indicators to enhance entry into the science pipeline for middle school youth, and in particular underrepresented youth.

We analyzed results from 650 middle school youth who attended the program in grades 5-8 from public school in the Monterey Bay region of Central California in the years 2002, 2004, 2005 and 2006. Quantitative (SPSS and SAS) and qualitative (based in grounded theory) methods were used and data were analyzed for overall effects (pre-post) and interactions among grade, gender, and ethnicity on student responses in the affective domain (self efficacy, confidence, motivation), the cognitive domain (what and how learning occurred) and on their answers to questions about future career and college choice. Results of our study show an overall positive change within participants, and indicate the importance of these kinds of programs in enhancing recruitment into the sciences. However the nature and specificity of those changes reveal an interesting story about how they are 'changed' and which groups of students are more likely to be affected.

In the questions about college (will you go to college) and science classes (will you take them in High School), there was a fairly strong gender effect: Girls were more sure that

they would go to college and that they would take science classes in High School. In 2005, there was a significant (.0031) change in boys in their responses about community college: they were more likely to say they would consider a community college as a college option after attending the program than before. However, in both years all participants responded favorably to these questions: they would go to college and they would study science in high school. It is interesting that we know that many of these youth will not pursue college, even though they seem to identify that they will. This is an opportunity to investigate what happens that deters them from college. It is also an opportunity to disseminate information about community colleges, since community college is the most viable option for many of these youth (or will be). Other data strongly suggest this.

Science careers and college:

One of the program's goals is to make participants more aware of science careers. We asked the question "did (the program) help you think about a career?" There were strong gender, ethnicity and grade effects in the quantitative analysis. Girls, underrepresented youth and 4th and 5th graders were the groups that showed significantly higher positive response rates to this question.

Qualitative Results indicate that there was a significant interaction ($p < .018$) between grade level such that 5th, 7th and 8th graders increased their proportion of science specific responses but 6th graders did not. Qualitative Results also indicate a significant 3-way interaction ($p < .05$) among gender and ethnicity such that underrepresented boys increased their proportion of science related careers but 'white' boys did not.

One explanation for the difference in these findings is that the qualitative questions focused on science careers whereas the quantitative did not. When asked for more detail, girls were more likely to list more education and conservation careers post camp ($P < .05$) and it may be that intervention should focus specifically on engendering cognitive self-efficacy for girls with regards to science careers.

Affective and cognitive development:

Overall, our data demonstrate the importance of the 'affective' domain in conjunction with developing an understanding of science as activity and process. More participants were able to articulate the importance of science, how fun and exciting it was, and how much they 'liked' it in post camp surveys than they were in pre-camp surveys. These personal connections can be a powerful force to motivate individuals to stay connected. Qualitative Results indicate that there was a significant trend ($p < .018$) between grade level and the mean proportion of students expressing an affective component to their learning such that younger kids (4th and 5th graders) were more likely to say that science is fun and "I am good at science", and underrepresented boys showed the greatest positive change pre-post camp.

Results also showed a positive change in some aspects of the cognitive domain, including a better understanding of science as activities and process (e.g. doing rather than memorizing), an enhanced ability to articulate higher-level concepts such as interconnectivity and ecosystem interactions, and more specificity in their answers to questions about what they learned. There was a significant interaction ($p < .05$) between underrepresented youth and the mean proportion of students indicating an enhanced understanding of science process. When asked to discuss what they learned about the ocean and science pre and post program, post program responses included fewer fact-based answers, and more process/activity based information.

“I am good at science” – a self- efficacy question to look at the impact of the program on participants’ view of their competence in science. Underrepresented youth were more likely to answer favorably after attending the program– in other words they seemed to show more of a positive change. ‘Whites’ were more likely to think they were good at science both before and after the program. There was a significant difference in responses before the start of the program (especially in 2005 data). Gender had a strong effect, with boys in general and 6th graders in particular being more likely to think they were good at it before starting. Both boys and ‘whites’ were also more likely (though not significant) to think they were good at science before the start of the program (they rated themselves slightly higher) than girls and underrepresented participants.

Discussion:

Our results suggest that for many younger students, experiential science programs could help them develop a connection to and understanding of science careers and science process which could help them to remain in the science ‘pipeline’. These opportunities may be particularly important for underrepresented youth, many of whom may experience barriers to access these programs. Although results from this study agree with the larger body of evidence suggesting the importance of hands-on and experiential learning, the general findings suggest implications for students at different learning levels and ethnicities. For younger students, experiential learning might be key in attracting them to a field of study such as science, as well as help them grasp important concepts they will need to succeed. Since we know many underrepresented youth are at risk for not attending college, middle school interventions that emphasize personal connections to science and to science as a process while increasing understanding of available careers may be an excellent method for enhancing recruitment and retention efforts.

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