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Abstract

This article reports on an alumni study of middle school participants in a university-based science camp; at the time of the study the youth were completing their junior or senior year of high school. The science- and technology-intensive program was set in an intentionally designed positive youth development context. The camp was free to youth who were members of populations underrepresented in science and technology careers or were from underserved areas of the state. The alumni fulfilled the camp goal that they plan to attend college after high school. The majority reported planning to get a professional or advanced degree.

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Introduction

This article reports on a study of summer science camp participants who were in grades 7 and 8 in 2007 and 2008. At the time of the study these youth were completing either their junior or senior year of high school. The purpose of the research was to investigate the impact the science camp program had on alumni aspirations to attend college through participation in Advanced Placement (AP) courses and SAT and/or ACT tests. Participation in these courses and tests was correlated to aspirations to attend college, because youth who do not plan to attend college do not generally take AP courses or college placement tests.

From 2007 to 2011 the Oregon State University (OSU) 4-H Youth Development Education Department provided a 2 weeklong residential summer science camp on the OSU campus supported each year by an $80,000 grant. The grant provided the program free of charge to youth entering grades 6, 7, and 8, who were members of populations underrepresented in science and technology careers, were from low-income families, or who lived in underserved areas of the state. Between 48-

64 campers were selected from over 350 applicants annually based primarily on their application essay and their science and mathematics teachers' recommendations. Over the 5-year program participants' ethnicity was 36% white, 30% Hispanic, 8% Black, 9% Native American, 12% Asian/East Indian, 5% multi-ethnic. Approximately 50% of the camp population, and the majority of white participants, came from low-income families who self-identified as qualifying for free or reduced cost school lunches.

Science Camp Program Goals and Design

Research shows that participation in out-of-school time programs focused on science, including camps, help youth to develop science skills and knowledge through practical, hands-on experience (Luehmann, 2009; Nicholson, Weiss, & Campbell, 1994; Rahm, Martel-Reny, & Moore, 2005). Youth in out-of-school time programs also gain a more positive view of science (Luehmann, 2009; Rahm, Martel-Reny, & Moore, 2005). In addition, many studies highlight the importance of out-of-school programs in contributing to the development of personal and social skills (Balsaon, Phelps, Theokas, Lerner, & Lerner, 2009; Durlak, Weissberg, & Pacha, 2010; Yohalem & Wilson-Ahistrom, 2010).

One of the National Academy of Sciences' eighteen conclusions in *Learning Science in Informal Environments: People, Places and Pursuits* (2009) is that, "Learning experiences across informal environments may positively influence children's…attitudes toward science, and the likelihood that they will consider science-related occupations or engage in lifelong science learning through hobbies and other everyday pursuits."

The science camp's program logic model gave equal weight to youth gaining science knowledge, using science skills, and providing a positive youth development context. The goals of the science camp were to:

- Be student centered.
- Provide hands-on, real-world learning experiences.
- Provide team-oriented, collaborative learning.
- Develop science process skills.
- Enhance positive youth development (PYD).
- Increase student interest in science and taking science and math in high school (including AP courses).
- Increase the number of youth from underrepresented populations completing high school, entering college, and majoring in science or technology based fields of study.

A 10-person resident camp staff was hired to supervise youth approximately 12 hours per day. The staff training was intentionally designed to provide staff with skills to create an atmosphere of equality and safety (Garst, 2010). Staff supervised campers in their engineering classes, at meal

times, and recreation, and coordinated free choice activities, journaling, and camper planning meetings. By integrating with campers in their classes, meetings, meals in an institutional dining hall, and playtime, resident camp staff built strong relationships that helped young campers be successful in a challenging university campus environment.

Campers participated in a total of 60 educational program hours in 2 weeks. The educational program was delivered by a partnership of three OSU colleges. This included 4-H faculty in the Department of Youth Development Education, the College of Science's Department of Science and Mathematics Education, the College of Engineering, and the College of Education's Science and Mathematics Investigative Learning Experiences (SMILE) program.

A cohort of between 20- 25 pre-service teachers enrolled in the College of Science's Department of Science and Mathematics Education M.S. program taught 18 hours of experiential class and field science activities. There was one pre-service teacher for each two-three campers, providing a high level of adult engagement with youth and assisting to meet the PYD goal.

The pre-service teachers were trained by the 4-H faculty to use a Mission to Mars-themed curriculum that integrated the 4-H Inquiry in Action Model flowchart (Bourdeau, 2004) into the lesson plans to teach the use of science inquiry skills. The annual camper pre-camp and post- camp evaluation used the Science Process Skills Inventory (Arnold & Bourdeau, 2009) to measure youth's ability to use inquiry skills before and after camp. Tests for reliability of the Science Process Skills Inventory revealed a Cronbach's alpha coefficient of .84 for the pre-test scale and .93 for the post-test scale (Arnold, Bourdeau, & Nott, 2013).

Senior leadership staff continued to engage science camp alumni and their families after camp throughout each successive school year with emails, a blog, and Web-based educational activities. Science camp alumni were encouraged to stay in school, take advanced science and math classes in high school, and plan to attend a college after graduation. Sustaining the peer network over the lifetime of the youth's participation in 4-H STEM activities was designed to foster ongoing participation of the program's non-dominate groups (National Research Council, 2009).

A Web page called "College—You CAN Go!" provided families with resources on choosing high school classes, tests needed for college admittance, and information on applying for financial aid. These on-line programs supported both alumni and their parents in developing competence to use digital technologies, a critical skill to successfully accomplishing tasks distributed across contexts that include home, school, the workplace, and social networks (National Academy of Science, 2012).

Methods

Subjects

During the 2012 summer, 49 summer science camp alumni were asked to participate in a short survey about their plans for the future and their involvement in science. These alumni had completed either their junior or senior year of high school; this included the 7th and 8th graders from the 2007 camp and the 8th graders from the 2008 camp.

Twenty alumni completed the questionnaire, resulting in a 41% response rate. Fourteen youth (70%) who originally attended the 2007 camp responded and six youth (30%) who attended the 2008 camp responded. Out of the 20 participants, 11 (55%) were female, and 9 (45%) were male. Four of the participants were Caucasian, six were Hispanic, three were Black, one was American Indian, and six were Asian/East Indian.

Instrument

The questionnaire consisted of 20 questions. After basic demographic questions, questions asked about youth's SAT and ACT participation and scores. Next, youth were asked about their involvement with AP science and math courses. Finally, the youth were asked about their future education plans.

Results

Results of SAT and ACT Tests Needed to Enter College

One hundred percent of respondents indicated they had taken or planned to take the SAT and/or ACT. Seven youth took only the SAT, three youth took only the ACT, and seven youth took both the ACT and SAT. In Oregon, only 38% of all students take the ACT, yet in this study's sample, 59% of the youth took the ACT (Knowlton, 2012).

Scores on the three subsections of the SAT can range from 200-800, with a total score range from 600-2400. The national average total score on the SAT for 2012 graduating seniors was a 1500. The average score for all Oregon test-takers was a 1540 (The College Board, 2012a). Only two respondents scored below the national average, and four respondents scored below the Oregon average. Three respondents said they planned to take the tests in the future, so they did not indicate scores.

Scores on the ACT can range from 1 to 36. The national average score on the ACT for the graduating class of 2012 was a 21.1. The Oregon average score for the graduating class of 2012 was a 21.4. (ACT, Inc., 2012). All but one respondent who reported their ACT scores received a score above the national and Oregon averages.

AP Courses

A little over half of the respondents (52.6%) indicated they had taken AP science courses in high school. Youth were also given the option to mark whether they intended to take an AP science course if they had not already. Three youth indicated plans to take AP science courses in the future.

AP exam scores range from 1 – 5, with 5 indicating extremely well qualified in the subject matter. Only five respondents reported their scores on the AP science exams, but all scores reported were above the national and Oregon averages of 2.9 on AP science exams (The College Board, 2012b). One youth scored 5's on AP chemistry and physics C mechanics; one youth scored a 5 on AP physics; one youth scored 5's on AP chemistry, AP physics, and AP computer science; one youth scored 4's on AP biology and chemistry; and one youth scored a 3 on AP biology. Examples of other

AP science courses students took include environmental science and anatomy and physiology.

More than half of the respondents (57.9%) indicated they had taken AP math courses in high school. Youth were also given the option to mark whether they intended to take an AP math course if they had not already. Two respondents indicated plans to take AP math courses in the future. Four respondents reported their scores, and these youth all received 5's on their AP math exams. This is well above the national average of a 3.3 and the Oregon average of a 3.5 on AP math courses (The College Board, 2012b). Examples of AP math courses respondents took included Calculus AB & Calculus BC.

Science Inquiry

Respondents were asked whether or not they had used any science inquiry skills since attending the camp, because learning these skills was a primary focus of the camp. Seventy-one percent of youth said they had continued to use these skills. Youth were also given the opportunity to comment on how they had used these skills since camp.

- Used them all in not just my science courses, but in building sets and stunts for film production.
- Scientific Process and Lab Write up.
- Going into high school, I had a better understanding of the scientific method and an understanding of how to properly handle materials that are used in a lab or outdoor study setting.
- Setting up procedures during a lab in class.
- Experiments and thought experiments (logic and critical reasoning?) observation and analysis.
- Attending this camp sharpened my observation skills and allowed me to gain more interest in the field of science.
- Every science class I have taken has used science inquiry and the scientific method.
- Problem definition and focus to systematically find answers. Winner of good science fair 2011.
- Often during school labs.
- Yes, 1 - Science fair at North West Science Expo. 2 - Science internship at OSU. 3 - Science camp - SSP.

Future Plans

One hundred percent of the respondents indicated they planned to attend college after high school. Also, when asked about what type of post-high school education they desired, all of the respondents (100%) indicated they planned to attend a 4-year college or university.

Additionally, respondents indicated their interest in college or university starting majors. The majors respondents were interested in are listed below.

- Pre-medicine, minors in Spanish and film production
- Political Science
- Zoology
- Philosophy and Pre-Law
- Nursing
- Biology, Microbiology, Biomedical Engineer
- Zoology
- Chemical Engineering
- Pre-medicine or Biomedical
- Aerospace engineering or mechanical engineering
- Unknown
- Music education

Finally, alumni were asked about their highest aspirations related to degree completion after high school. The majority of respondents (85%) reported they would like to get a professional or advanced degree, and 15% indicated they would like to finish college as their highest educational aspiration.

Conclusions and Recommendations

The study determined that science camp alumni took the ACT at a higher rate (59%) than the overall Oregon student population (38%). Science camp alumni reported ACT score at or above the Oregon and National averages on this test.

Of the science camp alumni reporting AP science exam scores, all were above the Oregon and national averages. Science camp alumni reporting AP Math scores all received 5s, which is well above the national average of 3.3 and the Oregon average of 4.5 on this test.

In addition, all of the alumni who participated in the study fulfilled the camp's goals that they plan to attend college after completing high school.

While acknowledging that the study reported here is a one-time measure of alumni's self-reported achievements and aspirations, it can provide guidance to future program design. The camp's main

educational focus and context components are replicable in other Extension programs. These included (1) clearly stated goals that were supported by intentional experiential science and technology classes; (2) positive experiences in university classrooms, labs, research facilities, and living areas; (3) resident staff trained to provide a positive youth development program environment; (4) a high number of adult teachers and counselors; and (5) senior leadership staff who used the Internet in a variety of ways to engaged science camp alumni throughout each successive school year, reminding them to focus on the goal of achieving a higher education degree.

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