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An Evaluation of the National Cancer Institute 1998-2002 Science Enrichment Program

Executive Summary

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EXECUTIVE SUMMARY

BACKGROUND AND SEP PROGRAM GOALS

Over a decade ago, the National Cancer Institute (NCI) of the National Institutes of Health (NIH) developed the Science Enrichment Program (SEP) in response to the then widely noted under-representation of minority and underserved populations among biomedical scientists. SEP targets and serves racial/ethnic minority and medically underserved students in the summer before their tenth grade year. NCI articulated two major goals of SEP, which have remained the same since the program's inception:

1) To encourage under-represented minority and underserved students to select careers in science, mathematics, and/or research
2) To broaden and enrich students' science, research, and sociocultural backgrounds

SEP is held for five or six weeks during the summer on college campuses, where students are in residence for the duration of the program. Program activities include classes in science, math, and other subjects, as well as educational and cultural extracurricular activities (e.g., speakers, forums, field trips).

There have been three major phases of program funding and implementation of NCI's SEP: (1) a one-site pilot phase during the summers of 1990 and 1991, (2) four regional sites during the summers of 1992-1997, and (3) two regional sites during the summers of 1998-2002. In 1998, NCI awarded five-year contracts to two regional programs: the Kentucky Appalachian Science Enrichment Program (KASEP) and the San Diego State University Science Enrichment Program (SDSU SEP). From 1998 through 2002, each regional program served approximately 50 students per summer, for a total of 479 students.

EVALUATION METHODS AND RESPONSE RATES

NCI contracted Goodman Research Group, Inc. (GRG) to conduct a longitudinal study of the 1998-2002 program. The longitudinal study included the five SEP cohorts (1998-2002) and three cohorts of a control group (1999-2001). Of the 479 SEP students participating in the program between 1998 and 2002, 182 of them were randomly assigned to the program. The total randomly assigned control group sample was 245.

Each cohort of SEP and control group subjects, during their first year in the study, completed pre- and post-tests designed to assess their attitudes about and interests in both science and math and their career aspirations and expectations. Additional information collected pertained to students' backgrounds and (for SEP students only) information about their program experience. Students were then tracked and surveyed on an annual basis thereafter. A core set of questions remained the same from the pre-test questionnaire through all of the follow-up questionnaires.

The longitudinal study also included an annual SEP parent questionnaire and annual site visits to the programs. Overall, the SEP participant response rates to the longitudinal study questionnaires ranged from 63% to 97%. The control group response rates in the longitudinal study ranged from 72% to 86%. The overall response rate to the parent questionnaire was 64%.

In 2002, GRG conducted a onetime Alumni Survey of the 1990-1997 SEP participants. The survey was designed to gather information about alumni activity since leaving the SEP program, specifically science-based activity participation and educational and career trajectories, and retrospective data about perceptions of the SEP program. Just over half (58%; N=644) of the 1990-1997 alumni were contactable. Of those contactable, the response rate was 85%.

KEY FINDINGS

The following key findings from the evaluation (both longitudinal component and Alumni Survey) are organized in terms of the program's major goals: sociocultural enrichment, science enrichment, and science career selection. (NCI's stated goal is here recast, separating "science and sociocultural background" enrichment into two distinct goals.) The full report describes differences between the two regional SEPs in several areas; however, the findings presented here reflect SEP overall (i.e., the two programs combined).

Sociocultural Enrichment

Students found SEP most helpful in sociocultural areas.

Respondents to both the longitudinal and alumni studies rated SEP's sociocultural enrichment as the most helpful of the program's three objectives (mean rating of 3.75 out of 4 in the longitudinal study, 6.33 out of 7 in the alumni study), followed by academic aspects (mean=3.57/4 longitudinal, 5.72/7 alumni), and career exploration (3.24/4 longitudinal, 4.50/7 alumni).

At the end of their participation in the program, students considered SEP most helpful in sociocultural areas (77% reported benefits), followed by academic (50%). A much smaller portion (5%) cited benefits related to future pursuits. A similar pattern giving primacy to the sociocultural benefits of the program was observed over time in the longitudinal follow-up and Alumni Survey data, as students reflected on the program's benefits. Nonetheless, 19% of Alumni Survey respondents (who were older than longitudinal study subjects) indicated that SEP had influenced their future pursuits, including their choice to attend college, their choice of college major, and career pursuits.

Students held more positive opinions of the SEP culture than they did of their high school cultures.

Participants' mean ratings of SEP culture were significantly higher than were mean ratings of high school culture. Ratings indicate that SEP students felt that their peers in SEP treated each other with more respect than did their peers in high school, that students in SEP helped each other more than students in high

school, that SEP teachers gave students more choices about their work than high school teachers, and that students had more say in classroom decisions in SEP than they did in high school.

SEP creates a lasting network among its students.

Within a year of attending SEP, the majority (93%) of longitudinal study respondents reported being in contact with a SEP student, staff or faculty member, or both. While the percentage decreased somewhat over time, a majority (62%) of respondents to the fourth follow-up questionnaire were still in contact with someone from SEP. Similarly, over two-thirds (69%) of respondents to the SEP alumni study had been in contact with another SEP student since completing their program, and more than half (58%) had been in contact with a staff member from their SEP program, despite having been out of the program five to 10 years.

Science Enrichment

Science and academic enrichment were the major reasons students attended SEP.

Students in the longitudinal component attended SEP for many reasons, most commonly to learn math and science (93%) and to do better in school (85%). Two-thirds of SEP students found out about the program from either teachers or guidance counselors. One-quarter (23%) of SEP students had participated in some type of science enrichment program prior to SEP. Eleven percent had worked in a scientific research or healthcare setting prior to attending SEP.

Students found SEP science different from and more enjoyable than high school science.

The results indicate that SEP 1998-2002 students used science textbooks and discussed science news events more in ninth grade science than in SEP science. Conversely, students worked with others on science projects, gave oral or written reports in science, and did science experiments more in SEP science than in ninth grade science.

SEP 1998-2002 students enjoyed their SEP classes and found them challenging. Overall, students enjoyed SEP science and math more than high school science and math. Students' perceptions of the challenge of high school science and SEP science did not differ significantly; however, they found high school math more challenging than SEP math.

SEP resulted in improved science process skills among students.

Students' science process skills improved after SEP (pre-test score of 22.40 compared to post-test score of 24.82, out of 36), and SEP students outperformed control group students. There was no increase in SEP students' formal reasoning scores and no difference between SEP and control group scores in this area.

Students' attitudes about science were more positive after SEP.

Students' attitudes about science and math improved significantly after SEP, in three out of four areas investigated. Specifically, they considered science more useful after SEP, they were more positive about the role of women in science after SEP, and they had improved attitudes about math. SEP students' attitudes about usefulness of science improved more than control group students' attitudes in this area; no difference was observed between the two groups' improvements in other attitudes.

Students perceived themselves as more likely to persist in science – though not in math – after SEP.

Students' mean ratings of their likelihood to take advanced science in high school, take science in college, and pursue a science career increased significantly after SEP. Their likelihood of pursuing math to these extents did not increase significantly after SEP. SEP students were significantly more inclined than control group students to take science courses in college. Ninety-eight percent of SEP students were interested in attending a program similar to SEP, and 91% of them would recommend SEP to others.

Parents were enthusiastic about SEP and its science enrichment benefits.

Parents of 1998-2002 SEP students reported that their children showed improvement after SEP in sociocultural and academic areas. They indicated that their children had enjoyed the program (mean rating of 3.95 out of 4), and 86% of parents reported that they would encourage their children to pursue their science interests. Ninety-eight percent of parents would recommend the program to others.

Precursors to Science Career Selection

Reporting requirements of the five-year evaluation precluded following the 1998-2002 program participants through the point at which they would select a science career. Thus, GRG identified *precursors* to NCI's impact goal of science career selection. The precursors were identified as a series of concrete outcomes – short-term, intermediate, and longer-term – related to students' education and career trajectories. These outcomes included:

- Short-term: high school graduation, college preparation, and achievement tests
- Intermediate: college attendance, majoring in science, and college graduation
- Longer-term: graduate degrees, interest in science jobs, and experience in science jobs

In addition, the evaluation investigated less tangible aspects of the trajectory toward a science career, including intended college majors, career aspirations, and attitudes about science. Longitudinal analyses indicated no differences between treatment and control group at various time points on science attitudes, enjoyment of science and math classes, perceived challenge of science and math

classes, perceived likelihood of persisting in science and math, science career interests, and intention to major in science. The Alumni Survey contributed to an overall assessment of the program's value by providing information about the education and career paths of older alumni.

Nearly all SEP students are graduating from high school, and they are graduating at rates higher than the national average.

Virtually all (99%) SEP Alumni Survey respondents graduated from high school. SEP alumni have higher rates of graduation from high school than the national average (82%). Differences in the high school graduation rates of SEP alumni are even more striking when compared to other groups of underserved minority students; 100% of Black and Hispanic SEP alumni graduated from high school, compared to national averages of 77% and 60%, respectively.

At the end of twelfth grade, nearly all (98%) of 1998 and 1999 SEP respondents reported that they were graduating from high school. Over three-quarters (77%) were planning to attend a four-year college the following fall. Most (96%) of the respondents to the fourth follow-up survey had attended college that year; half of them had obtained a college scholarship. There were no differences between the treatment and control groups in reported graduation rates, planned college attendance, or college scholarship.

SEP students actively participate in college preparatory activities and courses.

The vast majority of respondents (from SEP 1998 and 1999 cohorts) had talked to their parents (95%) and guidance counselors (88%) about college plans and/or researched colleges (76%) and requested information from colleges (88%). Before graduating, most respondents had also researched or applied for scholarships (84%) and visited college campuses. Compared to other college prep areas, fewer respondents (45%) had participated in college recruitment activities. One significant difference between SEP and control group respondents was in how many had visited a college campus; 85% of SEP students had visited college campuses, compared to 78% of control group students.

The majority (75%) of SEP students took college prep courses. In the twelfth grade, 45% of respondents had taken advanced science classes, higher than the national average of 23%, and 57% had taken advanced math classes.

SEP students' achievement test scores are comparable to national averages.

SEP 1998-2000 respondents' average SAT math and verbal scores were 518 and 507, respectively, comparable to the national averages from the same time period. Their average ACT score of 21.94 is also comparable to the national average of 21.00. The randomly assigned SEP students' mean overall ACT score was significantly higher than that of the control group (22.43 compared to 20.63).

SEP alumni are more likely to major in science than are students nationally.

As 10th and 11th graders, about half of SEP 1998-2001 respondents (47% and 44%, respectively) intended to major in a hard science. This percentage decreased to 37% in twelfth grade, and 30% in freshman year of college.

More than one-quarter (27%) of Alumni Survey respondents had actually earned a degree in a hard sciences field. SEP alumni were significantly more likely to earn bachelor's degrees with a major in science than were students in a national sample. Significantly more Black SEP Alumni Survey respondents (32%) earned science degrees than their national counterparts (6%), and significantly more Hispanic SEP Alumni Survey respondents (21%) earned science degrees compared to a national sample (6%). Of the Alumni Survey respondents currently in the process of earning a college degree, 31% expected to earn their degree in science.

Those SEP alumni who participated in other enrichment programs in high school *and* in college (45%) were more likely to major in science than alumni for whom SEP was their only enrichment program experience (22%).

The SEP alumni college graduation rate is significantly higher than the national average. This is true for the sample overall and for Black and Hispanic alumni in particular.

At the time of the Alumni Survey, 57% of the survey respondents from the older cohorts (aged 23-29) had earned a college degree, a significantly higher percentage than the 29% of 24-29 year-olds nationally who had completed four or more years of college. College graduation rates for SEP alumni in underserved minority groups were also significantly higher than their national counterparts: 58% for Black and 66% for Hispanic SEP Alumni Survey respondents, compared to national rates of 18% and 10%, respectively.

SEP alumni earn graduate degrees, and graduate degrees in science, at rates equivalent to the national average. SEP does not appear to influence students' aspirations to obtain postgraduate degrees.

Between 1998 and 2002, about half (55%) of students overall entered and exited SEP with a desire to obtain a professional degree, Ph.D., or M.D. About one-third (30%) entered and exited anticipating some other level of education. The education aspirations of the remainder (15%) changed between SEP entry and exit, with similar percentages changing their minds in either direction (i.e., in favor of a professional degree, Ph.D., or M.D., or against it). SEP students did not differ from control group students in their education aspirations before and after SEP.

At the time of the Alumni Survey, 32 SEP alumni had actually earned graduate degrees. SEP alumni are earning graduate degrees at a similar rate to those earned by the nation's population; however, the percentage of alumni who have earned a graduate degree is likely to increase as the younger cohorts (41% of the sample) become old enough to have completed graduate degree programs. About

one-quarter (26%) of alumni graduate degrees were related to science, math, or engineering, which is comparable to the national average.

Although SEP does not appear to influence students' career aspirations in the short term, Alumni Survey results suggest that SEP alumni work in science-related fields at a rate above the national average.

Half of students overall entered and left SEP with an interest in a science, math, or engineering career; 36% entered and exited SEP with some other career interest. The career interests of the remainder of the students changed between SEP entry and exit, with similar percentages changing their minds in either direction. SEP students were no different from control group students in their stated career interests before and after SEP.

About one-quarter (26%) of the respondents to Alumni Survey aspired to a career in science by the age of 30. Half of those who aspired to a science-related career wanted to be medical doctors. About half (48%) of SEP alumni had actually been employed in science, math, research, or healthcare at some point in their lives; 13% of alumni reported that their most recent position was in a science-related field. This is significantly higher than the national average of 5%. The types of science-related jobs held by SEP alumni ranged from doctors and nurses to researchers and pharmacists.

Further analyses indicated that SEP alumni who went on to participate in another high school science enrichment program and then in a college science enrichment program were more likely to aspire to a science career and to be employed in science-related jobs than those who were attended SEP only or those who attended SEP and another high school science enrichment program only.

RECOMMENDATIONS

GRG makes several recommendations based on the results and conclusions following from the longitudinal and Alumni Survey components of the NCI SEP evaluation. We acknowledge that cost will be *one* of several considerations in NCI's decision to accept or reject our recommendations. In sum, we recommend continuation of the NCI SEP, with at least a five-year funding cycle, conditional on several modifications to the program:

- We believe that increasing the number of programs around the country in different regions would better ensure the program's availability to under-represented minority students from all parts of the country; thus, we recommend NCI consider expanding SEP to four or five sites.

- Given the program's intent to encourage science career selection and the many documented barriers to minority participation in science careers, we recommend that the program narrow its target population to students with a demonstrated interest in and aptitude for science.

- We recommend clarification and standardization of SEP operations to ensure that program sites have a unified SEP identity and presence and are not viewed as a collection of disparate projects funded by the same agency. Specifically, we recommend that NCI review prospective programs' operations to determine sufficient commitment to the SEP goals and objectives and a proven track record in implementing this type of intervention program. Special attention should be paid to the qualifications of proposed instructional staff and plans for staff orientation and ongoing staff training.

- We recommend making SEP longer (6 weeks) to increase students' cohesion as a social and academic group and to allow students to work on scientific research projects in more depth.

- We recommend that NCI consider mandating standard formats for local evaluations (those occurring at the individual site level) in tandem with national external evaluation.

- While recognizing the need for flexibility, we recommend standardizing program content across SEP sites, including courses, career exploration activities, and scientific research opportunities.

- We recommend that SEP link with other science enrichment programs for students at either a pre-SEP or post-SEP grade level. In addition to building relationships with other intervention programs, SEP should give students the opportunity to interact with science researchers, especially those with a focus on cancer. This could be accomplished through links to the NCI Special Populations Networks (SPNs). Links between SPNs and SEPs would also create opportunities for SEP students to shadow SPN researchers and learn about network activities.

- While acknowledging the difficulty of conducting follow-ups with students over time, GRG strongly recommends that SEP students receive follow-up beyond the summer they participate in the program. We suggest accomplishing this either by adding a formal academic year follow-up component to the program or by ensuring that grantees have such opportunities for students in place.

In conclusion, the evaluation demonstrates SEP's effectiveness in enriching students' science and sociocultural backgrounds, particularly compared to their high school experiences. Future SEPs that incorporate the recommendations we advance here will strengthen the link between the program's operations and activities and its intended outcome of science career selection.