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ABSTRACT

A follow-up study and evaluation were done on the effect of an annual 4-week academically intensive program for 50 St. Louis (Missouri) area high school junior and senior students. The program consists of two summers, the first offering general scientific experience and education, and the second providing students with the chance to conduct research under the direction of a mentor scientist. The study sought information through questionnaires to 64 1992 high school graduates who had attended the program. All students responded to the survey either by mail or by telephone. Results included the following: (1) all respondents enrolled in strong academic programs on returning to high school with 45 percent of their time committed to science and mathematics classes; (2) students reported final grade point averages between 3.7 and 4.6 (honors classes often resulted in grade point averages higher than 4.0); (3) all respondents planned to attend institutions of higher education in the fall of 1993; (4) 36 respondents planned to attend Research Universities I in the Carnegie classification; (5) nearly all participants were awarded significant amounts of financial aid including scholarships from major universities; (6) all respondents indicated that the summer experience helped spark and maintain their interest in science or mathematics; and (7) 90 percent indicated they would be interested in the Institute helping them find summer work in science, mathematics, health care, or engineering. Appendixes contain student comments. (JB)

THE GEORGE ENGELMANN MATHEMATICS & SCIENCE INSTITUTE
A FOLLOW UP STUDY AND EVALUATION
1992 ALUMNI

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Introduction

Established in 1988, the George Engelmann Mathematics and Science Institute's, Science Scholar Program, is an annual four-week academically intensive program for 50 St. Louis area high school rising junior and senior students. Participants in the Institute must rank in the upper 3% of their high school class and have demonstrated a strong aptitude and interest in science and mathematics. The Institute introduces these highly select students to scientific thought, research design, statistical analysis, and modern laboratory procedures, while accenting the philosophy of science, problem-solving, and the integration of science and the humanities. The faculty of the Institute consists of senior UM-St. Louis professors and staff, as well as four high school science teachers who serve as mentors. Students are named Engelmann Scholars upon completion of the program.

The second level summer science experience, the Scholar Research Program, provides those Engelmann Scholars who participated as rising juniors or students who participated in the Missouri Scholars Academy program with the opportunity to attend the Institute to work on research projects in astronomy, biology, chemistry, engineering, mathematics, optometry, physics, or psychology on the campus of St. Louis University, University of Missouri-St. Louis, and Washington University. Their activities are conducted under the supervision of a mentor scientist. Upon completion of their six-week program, students are commended National Science Foundation Young Scholars.

Questionnaire

In order to understand and assess the impact of the program on its 1992 scholars, a Scholar Alumni Questionnaire was designed by Institute staff and mailed to all 64 1992 Engelmann Scholar high school graduates. A letter was sent explaining the Questionnaire, with a request that the scholar return the instrument as soon as possible. Fifty-seven questionnaires were received. The response rate was 89%. All respondents were seniors. For those students who did not return their Questionnaire brief telephone interviews concerning critical information (i.e. high school GPA, college choice, intended major, and career pursuit) were conducted.

The questionnaire sought information in three areas: (1) the current activities and immediate plans of graduating seniors in the 1992 class; (2) the Institute's impact on the scholars regarding career choice, continuing research interest, and motivation to study science or mathematics during their final year of high school; and (3) the student's interest in working with the Institute to find science and technology related work opportunities for the 1994 summer.

To obtain information regarding the first area, the students were asked the following: (1) What was your senior class schedule? (2) What was your grade point average? (3) To what institutions of higher education did you apply, were accepted, and will attend? (4) What will be your intended major? (5) Did you receive any scholarship(s), other awards or financial assistants? (6) What specific career would you like to pursue?

To address the second area of interest the students were asked: (1) To what extent did the Engelmann experience enhance your attitude toward science, mathematics, or engineering? (2) How likely is it that you will become a scientist, mathematician, engineer, or computer scientist? (3) Did the Institute help solidify/clarify your interest in science or mathematics? (4) What impact did the Engelmann Institute have on you when you returned to your high school? and (5) Did you develop your Englemann paper into a science fair project or similar project?

To address the third area of interest questions asked included: (1) Would you be interested in working in a science/health care related job next summer? (2) What specific jobs would interest you?, and (3) What are your salary requirements?

Results

High School Academic Interests and Grade Point Average

All of the respondents enrolled in strong academic programs upon returning to their high school. In fact, 45% of their time was committed to science or mathematics classes. Other areas of study included: (1) language arts/literature (21%); foreign languages (12%); social science (11%); fine arts/humanities (7%); and religion (4%). Two hundred eighty classes (48%) were taken for either advance placement or "honors" credit. See Table I. Students reported final grade point averages between 3.7 and 4.6. A grade point of 4.00 indicates a student earned all A's. Students who take "honors" classes and receive an A can acquire a grade point average in excess of 4.00. Forty-one (72%) of the scholars had final G.P.A.s of 4.00 or higher. See Table II.

Higher Education Interest

All respondents to the questionnaire will attend an institution of higher education in fall 1993. Two hundred eleven applications were sent to eighty-five different colleges or universities. There are five institutions that received 7 or more applications. Sixty-three scholars will attend 27 different schools. The scholars will be dispersed among 8 public universities, 15 private universities, and 4 private colleges and one foreign institute. Washington University (St. Louis) and the University of Missouri-Columbia will each have 9 scholars. St. Louis University will have 6, MIT 6, Harvard University 3, and Duke University, George Washington University, University of California-Berkeley, and Yale University will have 2 each. Thirty-six scholars will attend institutions classified as Research Universities I by the Carnegie Foundation for the Advancement of Teaching and 2 will attend institutions classified as Selective Liberal Arts colleges by the same Foundation. Thirty-three Engelmann Scholars, (53%), are attending Missouri institutions of higher education. See Table III.

Intended Majors

One of the objectives of the Engelmann Institute is to introduce students to a wide variety of career opportunities in science, mathematics and technology. Specific training provided by certain college majors often provides appropriate background for entry into scientific careers. Of the 17 different intended majors mentioned, 12 are directly related to science. Eighteen students indicated they will pursue biology degrees, 8 each indicated their interest in chemistry and engineering, and 7 students will major in physics. Three majors are in the humanities and two are in the social sciences. Eleven respondents have undeclared majors. Forty-five scholars have majors that are directly related to math, science, or engineering. See Table IV.

Career Interest

Sixteen different career pursuits were mentioned by scholars. Thirteen are directly related to science, mathematics, or engineering. Fifty-two of the 55 scholar respondents will pursue one of the thirteen science careers. Most scholars who will be pursuing science careers indicated they are at least 90% likely to eventually become scientist. See Table V.

Scholarships and Financial Awards

College educations can be very expensive and students often require assistance from scholarships, awards, and other financial aid. Tuition and living expenses at some private schools can exceed twenty thousand dollars. Engelmann Scholars received significant amounts of assistance for their college educations. Almost all scholars applied for various scholarships and awards from sources such as colleges, universities, foundations, industry, civic groups, and government programs. See Table VI.

Program Effect on Students Interest in Science/Mathematics

Almost all students indicated the Engelmann Institute experience helped spark and keep their interest in science or mathematics. Of particular help were the hands-on laboratory experiences in biology. Some students indicated they better understood how science/math could be used for a variety of career opportunities. Five students indicated that science was not of interest to them at this time. See Appendix A.

Program Impact Upon Return to High School

After returning to their high schools, students felt the Institute had a positive effect on them, personally and academically. Many felt that they were more motivated and confident to pursue their academic work. Some felt they were better prepared and academically ahead of their fellow students. Other areas of impact included: (1) students taking more classes in mathematics and science, (2) career interests were more focused, (3) some students were more aware of the inadequacies of their high school, and (4) some students expanded their Engelmann research paper into science fair projects and similar projects. See Appendix B.

Research Project Follow Through

Ten students developed their Engelmann research paper into a science fair project and one student completed a new project. Six students entered their projects in the Junior Science, Engineering and Humanities Symposium. Other competitions included: Missouri Junior Academy of Science - 5, St. Louis Science Fair - 5, St. Charles Lincoln County Fair - 2, Westinghouse Science Talent Search - 2.

Future Employment Interest

Ninety percent of the students indicated they would be interested in the Institute helping them find work in science, mathematics, health care, or engineering for next summer. The two areas of interest most frequently mentioned were laboratory research and health care. Most students will need a salary of about $200/week.

Summary

A Scholar Alumni Questionnaire was designed by Institute staff and mailed to all 1992 Engelmann Institute high school graduates. Fifty-seven questionnaires were received.

- All of the respondents enrolled in strong academic programs upon returning to their high school. Forty-five percent of their time was committed to science and mathematics classes.
- Students reported final grade point averages between 3.7 and 4.6.
- Forty-one (72%) of the scholars had a final GPA of 4.00 or higher.
- All respondents to the questionnaire will attend an institution of higher education in the fall 1993. Over half will attend institutions of higher education in Missouri.
- The students will be dispersed among 8 public universities, 15 private universities, and 4 private colleges.
- Thirty-six students will attend institutions classified as Research Universities I by the Carnegie Foundation for the Advancement of Teaching.
- Of the 17 different intended majors mentioned 12 are directly related to science.
- Almost all Engelmann Scholars received significant amounts of assistance for their college educations including major scholarships (full tuition) from major universities.
- Almost all students indicated the Engelmann Institute experience helped spark and keep their interest in science or mathematics.
- After returning to their high schools, almost all students felt the Institute had a positive affect on them, personally and academically. Many felt they were more motivated and confident to pursue their course work.
- Ten students developed their Engelmann research paper into a science fair project.
- Ninety percent of the students indicated they would be interested in the Institute helping them find work in science, mathematics, health care, or engineering for next summer.

TABLE I

Senior Year Semester Course Enrollment by Area of Study

Area of Study	Enrollment	%	AP/H*	%AP/H**
Fine Arts/Humanities	39	6.68	9	23.1
Foreign Language	72	12.33	38	52.8
Language Arts/Literature	122	20.89	74	60.7
Mathematics	72	12.33	61	84.7
Religion	27	4.62		
Science	189	32.36	74	39.2
Social Science	63	10.79	24	38.1
TOTAL	**584**	**100.00**	**280**	**48.0**

* Indicates Advanced Placement or Honors courses.
** Indicates percentage of Advanced Placement or Honors courses taken in that area of study.

TABLE II

Final High School Grade Point Average

GPA	f	cf	c%
3.70-3.79	2	2	3.5
3.80-3.89	4	6	10.5
3.90-3.99	10	16	28.1
4.00-4.09	15	31	54.4
4.10-4.19	8	39	68.4
4.20-4.29	3	42	73.7
4.30-and above	15	57	100.0
TOTAL	57	57	100.0

TABLE III
Higher Education Institutions and
Number of Engelmann Scholar Enrollments

Institutions	Enrollments
Brigham Young University	1
Drury College	1
Duke University (1)	2
George Washington University	2
Goucher College (2)	1
Grinnell College (2)	1
Harvard University (1)	3
Illinois Wesleyan College	1
Israel Institute of Technology	1
MIT (1)	4
Northeast Missouri State University	3
Northwestern University (1)	1
Notre Dame University	1
Princeton University (1)	1
St. Louis University	6
Southeast Missouri State University	1
Stanford University (1)	2
University of California-Berkeley (1)	2
University of Delaware	1
University of Indiana	1
University of Miami (1)	1
University of Missouri-Columbia (1)	9
University of Missouri-Rolla	2
University of Missouri-St. Louis	1
University of Pennsylvania (1)	1
Washington University (1)	9
Webster University	1
Yale University (1)	2
TOTAL	**62**

(1) Denote Research University I
(2) Denote Selective Liberal Arts College

TABLE IV

Intended Major Area of Study and Number of Students

Intended Majors	Number of Students
Anthropology	1
Biochemistry	4
Biology	18
Biophysics	1
Chemistry	8
Computer Science	2
Environmental Science	1
Engineering:	
biomedical	1
chemical	1
electrical	2
unspecified	4
English	2
French	1
Mathematics	1
Microbiology	1
Music	1
Philosophy	1
Physics	7
Political Science	1
Pre-medicine	4
Undeclared	11
TOTAL*	73

* Indicates more then 57 majors because some students indicated a double major and some were undecided between two majors.

TABLE VI

Selected Sources for Scholarships, Awards,

Financial Aid and Amounts

Industry	**Amount**
Imcera	2,000
Johnny Londoff Chevrolet	300
Monsanto Company	2,000
Higher Education	**Amount**
Brigham Young University	full tuition
Drury College	8,500
Duke University	full tuition
Goucher College	13,000
Harvard University	full tuition
Illinois Wesleyan College	9,500
Indiana University	3,000
MIT	10,000
Northeast Missouri State University	1000
St. Louis University	8400
Southeast Missouri State University	full tuition, books and fees
University of Miami	7800
University of MO-Columbia	full tuition
University of MO-St. Louis	full tuition
Washington University	full tuition
Civic Organizations	**Amount**
Dad's Club	500
Educational Employee's Credit Union	1000
Ferguson-Florissant School District	250
Francis Howell High School	200
Junior Achievement	2000
National Merit Scholarship Corp.	2000
Foundations	**Amount**
Earl Collins	750
Charles Frees	1100
Westlake	800

TABLE V

Specific Career Interest and Number of Students

Career Interest	Number of Students
Biochemist	2
Biologist	4
Biomedical Research	3
Botanist	1
Communication	1
Computer Science	1
Engineering	
biomedical	1
chemical	2
electrical	2
unspecified	2
Mathematics	1
Microbiology	1
Military Officer	1
Physician	19
Physics	5
Political Science	1
Science Engineering Research	2
University Faculty/Researcher	5
Veterinary Science	1

APPENDIX A

Selected Comments Concerning Students
Clarification of Interest in Science and Mathematics

- Many of the biology labs gave me a chance to perform advanced techniques. These experiences helped solidify my interest.
- The role of research in science and future education was clarified.
- The Engelmann program boosted by interest in various science areas.
- It made me consider research as a career much more seriously.
- By being able to work in the laboratories, I know I wanted a career in science.
- I was already pretty "solid" in my interest. Engelmann amplified it.
- It brushed on a lot of areas and it made you curious about more.
- My experience with my mentor convinced me that I wanted to teach and do research.
- It was a unique opportunity to experience the scientific world outside the classroom.
- Engelmann gave me a much clearer picture of what the research experience entails.
- I didn't consider a career in research before last summer. Now I'm fairly sure I want to become a research scientist.
- I enjoy science and learning, but at the same time feel others (my peers at Engelmann) are better suited or motivated to be true scientists.
- It showed me that I didn't want to be an engineer.

APPENDIX B

Selected Comments Concerning Program Impact
Upon Students' Return to High School

- As seen in the four science and math classes I took, I was motivated to study and do well in these areas. I was more confident, especially in biology because of the labs and discussions I participated in at Engelmann.

- I had already planned to pursue science courses, but my experience at Engelmann prepared me for lab research courses and gave me a great science fair project.

- It did heighten my interest in lab-oriented science and gave me a higher degree of confidence. However, it also produced a certain disappointment because my classes were not as challenging or educational as Engelmann had been.

- I was more motivated to part from the traditional school structure and learn on my own. For this reason, I continued my research out of school.

- At the beginning of this year, I felt better prepared scientifically and was more confident in my interest and analytical abilities.

- The Engelmann Institute influence me an encouraged me to take more challenging math and science courses.

- I was more confident in my abilities to follow through with projects. It made me desire more science classes. Unfortunately, my school didn't offer any more than the ones I wanted.

- I was more confident when I returned to school. I received my first 4.0 that first quarter. The program made me feel as if I could do anything, if I put my mind to it.

- I was more anxious than ever to learn whatever I could in any area of science and to look toward a career in biology or chemistry.

- High School was a let-down. I enjoyed the advanced level of learning and achievement at Engelmann as was disappointed when I returned to the slow pace of high school.

- I was more confident in my approach towards independent scientific research. In science V I could make quicker decisions during research.