

Future of Education for STEM Talented Adolescents

Multi-Level Outcomes of a Specialized Science High School Study Overview of Study Goals, Findings, Next Steps

Why Study Selective Science, Mathematics and Technology (SMT) Schools and Programs?

- Recognition that some students complete middle school with strong interests, skills, and knowledge in science and mathematics, and aspire to high level careers in STEM.
- Advanced students are not being sufficiently challenged in many of today's high schools and SMT schools and programs offer one way to meet their educational needs.
- Curricular and environmental components of SMT schools and Talent Search programs that appear to predict completion of STEM university degrees might be adapted more widely.

Study Research Goals

- *Overarching Research Question:* What is the impact of participation in a selective SMT school or Talent Search program on completion of a STEM major in university?
- *Sub-research question 1:* What characteristics of (a) the SMT school/TS program or (b) the participants contribute to this outcome?
- *Sub-research question 2:* Do these characteristics differentially affect male and female graduates? Those whose parents are not college graduates? Those whose parents are not in STEM related careers?

Study Description: Participants

- 2004-2007 graduates of 25 selective SMT schools (N=3,510)
- Same age peers who attended Talent Search and enrolled in mathematics or science classes in the summer (N=603)
- For the overall study population, 69% were white, 23% Asian, 4% African-American, 4% Hispanic, and 5% reported other ethnic backgrounds
- 79% reported English as their primary language
- 53% of SMT participants were female as were 55% of Talent Search respondents

SMT School Model Descriptions

- Residential: Draws from an entire state. All students reside on campus. (n=8 schools)
- Half-Time: Students attend a regional center for SMT courses daily. (n=7 schools)
- Full-Time Commuter: Whole school is SMT and draws from local metropolitan population. (n=4 schools)
- School-within-School: An academy within a regular high school. (n=6 schools)
- Talent Search: Selective invitation to enroll in advanced summer SMT courses based on high standardized test scores.

Future of Education for STEM Talented Adolescents

FINDINGS

Completion of STEM Degree

- **49.8%** percent of graduates of selective SMT schools
- **53.4%** percent of Talent Search participants
- **22.6%** of all students entering college complete a STEM undergraduate degree (source NSF)
- **26.5%** of students scoring at the 95th percentile or higher in a sample of SAT-M test results (overall sample N=87,840)
- **17.3%** of students scoring at or above the 95th percentile on the combined SAT Critical Reading, Math, and Writing tests (sample size=87,740)

Completion of STEM University Degree by Specialized SMT School Model

- School w School **58.3%**
- Residential **51.7%**
- Half-Time **48.4%**
- Full-Time Commuter **42.3%**

Percentage of Participants Completing STEM degrees by Gender

- Female
 - o Specialized SMT School **46.1%**
 - o Talent Search **50.5%**
- Degree Fields Selected by Participating Female STEM Completers
 - o Bio and BioMed **33.0%**
 - o Engineering **11.0%**
 - o Physical Science **9.0%**
 - o Mathematics **6.0%**
- Male
 - o Specialized SMT School **57.8%**
 - o Talent Search **61.9%**

Future of Education for STEM Talented Adolescents

Parent Working in a STEM Field

- Graduates of specialized SMT schools with a parent in STEM are 1.37 times more likely to complete a STEM related major than SMT graduates with no parent working in STEM related fields.
- Respondents from the Talent Search with a parent in STEM were twice as likely to complete a STEM degree.
- Looking at those without a parent in STEM, there was no difference in odds of completing a STEM degree between graduates of specialized SMT School or Talent Search.
- 20% of SMT school graduates who completed STEM degrees had parents with no education beyond high school; the same was true for 2% of the Talent Search participants.

Signature High School Factors that Predict STEM Degree Completion

- Participation in an authentic high school research experience:
 - Overall, those who participated in high school research were nearly two times more likely to complete a STEM degree.
 - Among female students, those who participated in high school research had nearly twice the odds (1.95) of completing a STEM university degree compared to females who did not.
- Feelings of belonging in the academic setting:
 - 55.8% of respondents that attended a specialized SMT high school said that their high school experiences in SMT helped them to be well prepared in their chosen major, compared to their university classmates.
 - 24.6% of Talent Search participants agreed.

Motivation and Interest

- 40% became interested in topics related to their eventual major *before* high school.
- Respondents in this group were 52.9% more likely to report that they earned a STEM related major or concentration.
- SMT school graduates motivated to attend their school by interest in STEM were 2.5 – 4 times more likely to obtain a STEM degree than fellow graduates with different motivations.
- For SMT graduates who reported other motivations for attending their SMT school, the study found:
 - Those motivated by prestige and recognition were 30% less likely to obtain a STEM degree.
 - SMT graduates whose attendance was motivated by getting into a good college were 25% less likely to obtain a STEM degree.
 - SMT graduates motivated by their academic peer group also were 30% less likely to receive a STEM degree.

Behavioral and Social Sciences (BSS) Degrees

- 28% of SMT school graduates reported earning an undergraduate degree in the behavioral or social sciences; Talent Search participants were no more likely to obtain a degree in these disciplines.
- SMT graduates with BSS undergraduate degrees, who reported that experiences in college (rather than high school) were the most important determinant of their major, were more than twice as likely to earn an undergraduate degree in BSS.
- There were no differences between college graduates in life or physical sciences and BSS in terms of self-reported intellectual capacity for mathematics and science.

Future of Education for STEM Talented Adolescents

NEXT STEPS

Follow up Survey to Study Participants

We are conducting telephone interviews with a small group of SMT graduates and Talent Search recipients to refine a survey instrument that will be sent to the 2400 study participants who agreed to participate in a follow up phase. The survey will collect additional details from them:

- Current status beyond college
- Persistence or non-persistence in STEM
- Contributions to feelings of intellectual capacity to be a scientist or engineer
- Mentors
- Parental influence
- Expectations when entering SMT
- Setbacks and reaction to them
- Research experience
- Influence of high school curricular and instructional factors

SAT predictors of STEM undergraduate degree completion

With cooperation of the College Board, the research team has obtained data on a sample of SAT test takers (N=87,740) who graduated from high school in 2006. We were interested in exploring the relationship between high performance (students scoring at the 90th and 95th percentiles) on the SAT-M and overall SAT) on their likelihood of obtaining a STEM undergraduate degree. This exploration is intended to test the notion that high ability alone may explain STEM degree attainment, without interventions such as attendance at specialized STM schools or Talent Search participation. Preliminary results reported above indicate that SAT-takers in our sample obtain STEM undergraduate degrees well below the rate for SMT school graduates and Talent Search participants. The research team has plans to expand this analysis to a full set of SAT test-takers in a new grant proposal.

Presidential Early Career Award for Scientists and Engineers (PECASE)

With cooperation from several of the sponsoring federal agencies, the research team conducted a pilot survey of 314 PECASE 2010-2012 awardees from 16 agencies and obtained a response rate of 80%. The main purpose of the survey was to understand the developmental trajectory of interest in STEM fields from the perspective of early interest, education, influence of key mentors, and parental influence. Of those who responded to the survey, 72% attended a public high school; 78 (30.8%) out of 253 respondents participated in some form of selective science program, 23 of whom attended a specialized SMT school; 41% had parents in a STEM-related profession; 29% reported that their interest in science began between kindergarten and grade 5; an additional 25% said their interest was kindled in grades 6-8; and two-thirds reported having a mentor during their high school years. More than 80% of PECASE survey respondents said they were willing to be contacted again for a more comprehensive data collection effort, which the study team is making plans for in the form of a new grant proposal.

Research Team

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