

Effects of an Engineering and Science Intervention on the Science Achievement of Talented Elementary Students

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Background Information

STEM Starters+ “scales up” a previous U.S. Department of Education Javits demonstration project (STEM Starters) that produced science learning gains in identified gifted students, general education students, and elementary teachers. STEM Starters+ has produced gains in science achievement and engineering knowledge for grade 1 students who also report high levels of engagement.

Research Questions, Design, & Analysis

Research Question 1:

What are the differences by gender, meal subsidy status, and underrepresented minority status for identified gifted elementary students from high-poverty schools on science content achievement at the end of the year, controlling for their pretest scores?

Research Question 2:

When provided the opportunity to engage in curriculum focused on problem-solving in science, the engineering design process, and STEM biography, provided by teachers who have received professional development and coaching, do gifted students exhibit higher achievement in science content than gifted students not provided the opportunity?

Design and Participants:

- Quasi-experimental **design**
- Matched **sample** based on school demographics, pretest on outcome measure
- Total **participants** $N = 479$, 39 classes, grades 2-4
 - Cohort 1 intervention = 12 schools, $N = 355$
 - Cohort 2 comparison = 8 schools, $N = 124$

Analysis:

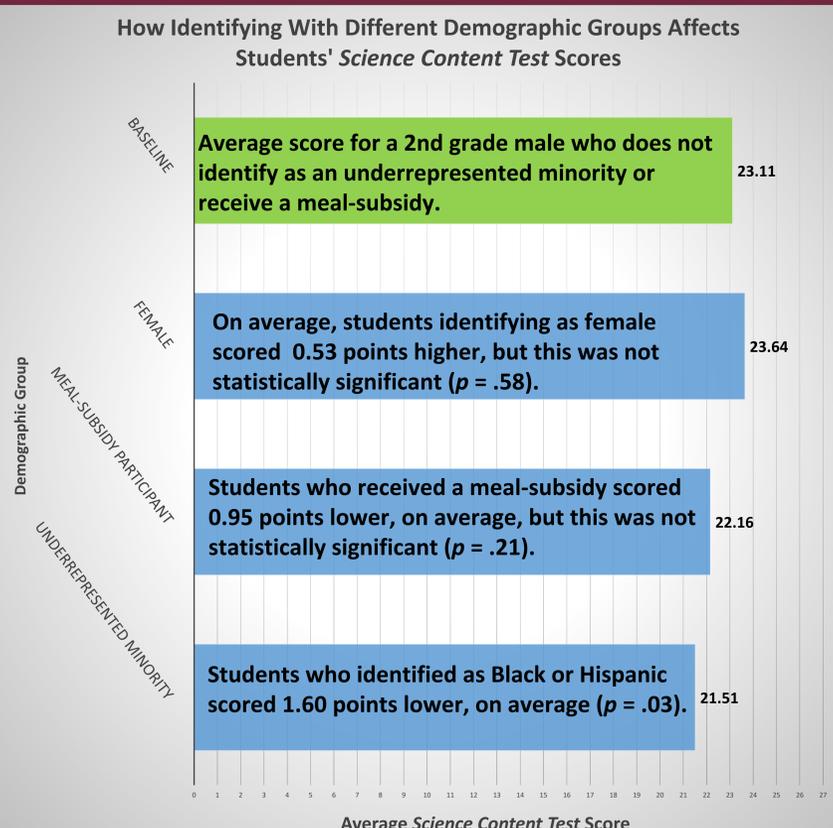
- Multilevel modeling: Level 1 = students; Level 2 = classrooms; Level 3 = schools
- Controlled for grade level and pretest scores

Instrumentation

To measure science content knowledge, we used a *Science Content Test* constructed from released items from the NAEP and TIMSS assessments.

- A science and engineering educator pulled the science objectives from the science, engineering and biography units.
- The educator and the external evaluator reviewed released items and selected the items to measure the objectives.
- To minimize ceiling effects, we included questions from grades 2-5 on one assessment and used out-of-level questions.
- *The assessment includes 34 items*, some with multiple parts and some with partial credit.
- *The total possible score was 44.5 points.*

Results Research Question 1



Results Research Question 2

- Students in the **intervention schools** scored an average of **1.92 points higher** on the achievement test ($p = .03$).
- The size of this increase was nearly as large as the difference between grade levels (2.17 points). That is, the difference between students in comparison and intervention schools was 92% as large as the difference between students in two adjacent grade levels!
- The **effect size, $d = 0.23$** , indicates that students in intervention schools scored 0.23 standard deviations higher than students in comparison schools.
- Moreover, whether a school received the intervention or not **explained 87% of the variability in average achievement scores between schools** above and beyond the control variables.

Discussion & Implications

- 2nd- 4th grade gifted students demonstrate **greater science achievement gains** when provided with the opportunity to learn science through differentiated engineering and science curricula and biography study of eminent scientists and engineers.
- Black and Hispanic students did not close the gap in either intervention or comparison condition although they did make greater gains in the intervention condition.
- Because underrepresented minority gifted students achieved at relatively lower levels, it is important for them to be exposed to enriched STEM interventions.
- Educators and policy makers should continue to press for opportunities for gifted students from high-poverty schools to develop their STEM talents in the elementary grades as part of a comprehensive suite of services.
- Although gaps in science achievement based on poverty status were found in first graders participating in STEM Starters+, **no gaps based on poverty were found in the sample of gifted 2nd-4th graders.**



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