Evaluating the Impact of Engineering is Elementary
Years 3 - 4 of Implementation in Minneapolis and Hopkins Public Schools

Executive Summary

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"Continuing concerns about the nation’s innovation capacity... have brought renewed attention to the importance of student engagement with STEM subjects.... We simply must provide girls and boys in elementary school, the drivers of the economic engine of tomorrow, opportunities to develop interest and skills in these subjects. If we do not, we may not be able to sustain our quality of life or address the grand challenges of our times."

—Charles M. Vest, President Emeritus, National Academy of Engineering

America’s future depends on a STEM-literate citizenry. According to the Bureau of Labor Statistics, the nation will need 1.75 million engineers by 2018, an 11 percent increase; meanwhile some fields of engineering will see 30 to 70 percent growth. A recent report from the National Academy of Engineering (NAE) and the National Research Council (NRC) finds that exposure to engineering education at an early age has the potential to increase students’ awareness about what engineers do, their openness to engineering as a future career, and their technological and engineering literacy--while also improving student learning and achievement in science and mathematics.

Despite this encouraging finding, many elementary school districts fail to make integrated STEM instruction a priority, and according to the 2012 National Survey of Science and Mathematics Instruction, few elementary teachers feel well prepared to teach engineering—which they will be expected to do, since it’s a key element of the new Next Generation Science Standards.

With these issues in mind, the Cargill Foundation has supported a study to help define best practices in STEM instruction for American schools. Through a partnership headed by the Science Museum of Minnesota (SMM) and including the Museum of Science, Boston (MOS) along with two Minnesota school districts, a ground-breaking, research-tested curriculum has been introduced and evaluated in schools in Minneapolis (the state’s largest city) and the neighboring community of Hopkins.

The curriculum is “Engineering is Elementary” (EiE), a multidisciplinary, inquiry-based curriculum developed by MOS to interface with elementary-school science curricula and national science standards. The study asks three questions:

1. Do students learn more science, engineering, and technology content with the EiE approach than they do with traditional lessons containing science content only?

2. Is EiE effective for all student populations? Can it help to close the “achievement gap” between mainstream students and other demographic groups?

3. Does student performance in science, technology, and engineering improve when elementary teachers receive in-classroom training on how to use the EiE curriculum from an experienced science specialist?

In the first year of the study, EiE was implemented in third-grade classrooms in both districts. In the second year, some fourth-grade as well as all third-grade classrooms used the curriculum; fourth-grade teachers received summer training in curriculum implementation, then co-taught an EiE unit with support from an SMM science specialist during the school year.

This report covers the third year and fourth years of the study. Year three featured district wide rollouts of EiE in 4th grade classrooms. District wide rollouts in 5th grade classrooms were implemented in year four.
To assess the impact of the EiE curriculum, students completed surveys both before and after experiencing the EiE curriculum. These surveys showed **EiE has a positive impact on learning:**

The proportion of students with misconceptions about what constitutes a technology decreased significantly after exposure to EiE.

Students’ attitudes toward science and engineering as relevant, practical, and helpful to the public became significantly more positive after exposure to EiE.

Significant positive growth was also observed in students’ attitudes toward pursuing a career in engineering.

Students were also more likely, after engaging with EiE, to say that they had a good understanding of what scientists and engineers do in their jobs.

Students rated a series of questions on a scale from “Strongly Disagree” to “Strongly Agree.”
Pre- and post-assessments also show significant improvements in student knowledge across gender and underrepresented groups.

- Students’ knowledge of both science content and engineering content significantly improved after exposure to EiE.
- Despite having lower scores than mainstream students both before and after exposure to EiE, underrepresented minority students showed a significant increase in their understanding of science and engineering concepts after exposure to EiE. Their attitudes toward science and engineering also improved.
- No significant differences were found between male and female students.

There is some evidence that teachers trained by a Science Museum of Minnesota science specialist were better able to integrate science and engineering content than teachers who did not receive this training.

- In some EiE units—and for some science topics—student groups whose teachers had been trained by an SMM science specialist showed significantly greater improvement in their knowledge of science content than students of teachers who received only workshop training in teaching EiE.

Multiple years of EiE lead to even higher scores.

- While most students in the study received EiE for only one year, some fourth and fifth grade students received EiE for two or three consecutive years. These students scored significantly higher on pre- and post-assessment scores than students who experienced EiE for only one year.

This analysis concludes the evaluation of EiE in the Minneapolis and Hopkins Public Schools. The key points illustrated in this executive summary provide a foundation with which to build an understanding of the EiE curriculum and its impacts on learners across classrooms, districts, and demographics.

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