Real Data Makes STEM Relevant to Students

To engage students in Science, Technology, Engineering, and Mathematics (STEM) courses, leverage data from students’ own lives.

Question
How can teachers best engage all their students in STEM coursework?

Background
Science, technology, engineering, and math (STEM)-related occupations are an important and growing part of the U.S. economy. Yet student interest is lower than what it needs to be: the Department of Commerce estimates there will be more than 1.2 million unfilled STEM positions in the US by 2018. Student interest in STEM subjects is also marked by substantial gender gaps; girls report less interest in STEM than boys, and as adults, women remain vastly underrepresented in STEM-related fields. Prior research suggests that teaching styles focused on collaboration, projects inspired by real-world problems, and interdisciplinary connections can increase student engagement in STEM learning, particularly for girls.

STEMhero is a web application with accompanying curriculum materials that aims to put these insights into practice. Designed to use real-world challenges to inspire student engagement in STEM, the program follows four steps:

1) Students identify and learn how to read water, gas, and/or electric meters at their home and/or school;
2) Students record meter readings, measuring utility consumption over time;
3) Students learn about a range of efficiency behaviors and technologies that can affect utility consumption; and
4) Students implement an efficiency behavior and/or technology of their choice, measuring its effect on utility consumption.

In this study, we test whether STEMhero’s real-world classroom program, in which students act as “citizen scientists” to reduce water and energy consumption, increases interest in STEM subjects. We also test whether the program closes the gender gap in STEM interest. Finally, we consider whether such an experiential, project and problem-based approach, also increases civic engagement by making students and their communities the center of the learning process.
Intervention(s)
Thirteen schools (551 students) were recruited for the Spring 2015 impact study of STEMhero and randomly assigned to control and treatment groups. Both treatment and control schools received a pre-treatment survey to gauge baseline student interest. During the two-week study period, seven treatment schools integrated STEMhero into regular class instruction, while six control schools maintained their standard classroom activities. All students in the treatment schools were asked to use STEMhero to complete several short classroom assignments. These required approximately 50-60 minutes of total class time over the two weeks. At the end of the two-week unit, researchers administered a post-treatment survey to all students to test whether treatment schools saw increases in: (1) interest in future STEM study; (2) overall engagement in STEM coursework; and (3) civic engagement. Students in the control schools were also given the option to implement the STEMhero curriculum, but only after survey data had been collected.

Results
STEMhero had a significant impact on two of three key outcomes:

(1) Interest in taking science/math classes: Students who used STEMhero expressed more interest in taking math and science classes in the future. Additionally, STEMhero passed the “placebo test;” the program did not move interest in other (non-related) subjects like music and history. The program worked equally well for boys and girls, so there was no statistically significant evidence that the program closed the gender gap in STEM interest.

(2) Overall engagement in science/math: STEMhero did not have a discernible impact on the extent to which students found science and math useful, interesting or enjoyable; nor did the program increase students’ perceived abilities in these subjects. These null results may reflect the difficulty in moving such perceptions over a very short two-week timeframe.

(3) Civic engagement: Students who used STEMhero were more likely to agree that they can work with others to improve their communities and that their environmental efforts can make a difference.

Lessons
- Using data relevant to students’ own lives can increase students’ persistence in STEM study.
- “Citizen Science” activities can increase students’ sense of collective efficacy -- their perception that they can work with others to solve community problems, such as water scarcity.

Authors: Amber Wichowsky and Dan Matthews