Putting the “E” in STEM: A Model for K-12 Teacher Training

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In advance of the release of the Next Generation Science Standards and to support conversion to the Common Core, K-12 teacher training in engineering concepts has received much attention. Developing authentic engineering activities and lessons for K-12 STEM (science, technology, engineering, and math) classrooms is a daunting task for many educators. With underwriting from the US Department of Education Math-Science Partnership (MSP) and the Vermont Department of Education, the Southwest Vermont Curriculum Coordinators Collaborative (SVCCC) enlisted engineering professors at Norwich University to launch a summer STEM institute to train K-12 teachers to develop engineering activities for all grade levels.

The institute involved eight intensive days of engineering content training in residence at Norwich. Four two-day modules were developed to provide instruction in

- General engineering and physics,
- Civil engineering structures,
- Mechanical engineering materials, and
- Electrical and computer engineering.

Seventeen teachers from elementary school (3rd grade) through Advanced Placement Physics participated in the program, and all developed classroom lessons to introduce engineering design concepts to their students. As a follow-up to the summer training, the participants met to review successes and share experiences with one another. A final Engineering Showcase provided a venue for the K-12 students to demonstrate their solutions to design challenges created by their teachers.

During the planning phase for the institute, SVCCC organizers enlisted the assistance of an experienced high school science teacher with an engineering background to serve as a coordinator and teaching partner for the program. The teaching partner provided continuity for the participant teachers between the engineering modules and worked with the engineering professors to develop instruction at an appropriate level for the wide range of teacher participants.

Longitudinal, anonymous assessment of the participants was conducted at the beginning and end of the summer residence, and on the follow-up day three months later. Participants showed measurable improvements in their understanding of the engineering design process and individual engineering disciplines following the residence portion. In addition, most of these improvements were retained on the follow-up assessment.

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To gauge development of engineering ideas among their K-12 students, the teacher participants administered the “Draw an Engineer Test” before beginning engineering instruction in their classrooms and after completing engineering lessons. Longitudinal review of the student assessments showed 98% of elementary students, 49% of middle school students, and 56% of high school students improved their understanding of engineering activities following their engineering lessons. A total of 1400 Vermont students were introduced to engineering lessons by the institute’s participants during the 2012-2013 school year.

In anticipation of additional MSP funding, the next steps for the Norwich STEM institute will involve development of two one-week summer institutes. The first will target science, technology, and math teachers in grades 7-12. During a one-week residency at Norwich, this institute will provide instruction in general engineering concepts and then allow teachers to specialize in one discipline such as environmental engineering or civil engineering structures. This will permit participant teachers to concentrate their lessons on content more closely aligned to their math and science classes. The second program will be geared towards K-6 teachers and will emphasize methods for modifying existing activities and lessons to teach engineering ideas at the elementary level.

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**References**