Infusing Engineering into K-12 Classrooms: Broader Impacts Collaboration Program

Organizations such as the National Science Foundation (NSF) and the National Academies continue to push for research and educational initiatives in STEM (Science Technology Engineering and Mathematics) education. Much of the focus of these initiatives is in the K-12 classrooms with science, mathematics and technology teachers looking for ways to infuse engineering concepts and design procedures into elementary, middle school and high school classrooms. Examples of recent activities in this area include:

1. Development of curricular resources for teaching engineering.
    a. Engineering is Elementary (Boston Museum of Science), http://www.mos.org/eie/
    b. Engineering by Design (ITEEA) http://www.iteea.org/EbD/ebd.htm
    c. Project Lead the Way (CISCO) http://beta.pltw.org/
2. Proliferation of engineering-related student competitions such as US First and First Lego League. http://www.usfirst.org/
3. Development of the K-12 Division of the ASEE: http://www.asee.org/k12/index.cfm
4. The name change of the technology education professional organization from the International Technology Educators Association (ITEA) to the International Technology and Engineering Educators Association (ITEEA). http://www.iteaconnect.org/
5. Development of the Standards for Technological Literacy in 2000 and the inclusion of engineering-related content in these standards http://www.iteea.org/Publications/publications.htm

With a teacher preparation program (Technology and Engineering Education) situated strategically within a College of Engineering and Technology, Brigham Young University has a great opportunity to coordinate efforts between engineering, technology and teacher preparation faculty and develop a strong position of research, curriculum development and other STEM initiatives. To facilitate this opportunity, the faculty in the TEE program propose a collaboration between engineering and technology faculty that are preparing funded research proposals and the TEE program's desire to better prepare technology teachers to teach engineering-related content in the public schools. The focus therein would be the inclusion of TEE students in the broader impacts areas of research proposals. This inclusion could take many forms but would most likely involve TEE students working with engineering students in funded research projects and then develop curriculum to bring the experience from the research into k-12 classrooms. Funding for supplies, internships, travel and other costs would come from allocations made by the PI in the research proposal budget.

Potential benefits to engineering faculty include:

- Efficiency in identifying, describing and executing a broader impacts program.
- Greater assurance of an effective broader impacts program, especially to female and minority students.
- Access to the educational expertise of the TEE faculty and students
- Formal access to K-12 school classrooms.

Potential benefits to TEE students include:

- A chance to gain first-hand experience in an engineering and or technology area.
- Funding for an internship experience.
- Interaction with engineering and technology faculty and students.
- Additional opportunities for practicum teaching experiences.

Potential benefits to TEE faculty include:

- Better prepared graduates to occupy pre-technology/engineering teaching positions in high schools and junior high schools that can direct students into university engineering and technology programs.
- Consistent and applicable internship opportunities for students.
- Interaction with engineering and technology faculty.
- Funding for curricular experiences in the public schools.
- Potential funding for graduate students.
- Opportunities to publish findings for best practices in infusing engineering into K-12 classrooms.

Formal Procedures

The formal procedures for implementing and administrating this type of program will need to be discussed and formulated. Most likely they would include the following:

1. Engineering and technology faculty preparing research proposals will need to consider if collaboration with the TEE program will promote the broader impacts areas of their proposal.
2. Engineering and Technology faculty can contact a faculty member in the TEE program to discuss the possible collaboration and potential budget requirements.
3. A research component related to the broader impacts is identified (possible inclusion of graduate students).
4. TEE Faculty will disseminate information to TEE students to recruit those interested in participating.
5. If the collaboration involves a curriculum component in K-12 schools, the TEE faculty would work with district administration and teachers to identify classrooms for participation.
6. TEE faculty and students would use existing courses** or possible afterschool or summer programs to develop the curriculum and teach the materials in the public schools. Note: engineering undergraduate students might be part of this curriculum development and teaching experience.
7. Faculty and students work together to publish findings related to the broader impacts at various venues: ASEE, ITEEA

** Currently there are three courses in which TEE students interact with teachers and students in the public schools:

1. TEE 276R: (Exploration of Teaching) Students visit schools at the elementary, middle and high school levels, working in small teams, students teach a 2-3 day unit on technology and engineering related content.
2. TEE 378: (Practicum) TEE students collaborate with local teachers to develop and teach a one to two week curricular unit.
3. TEE 476R: (Student Teaching): 14 weeks of teaching technology and engineering related content (7 weeks of middle school, 7 weeks of high school).