Work in Progress – National Center for Engineering and Technology Education: Supporting Teacher Professional Development and Renewing K-12 Schooling

Kurt Becker¹, Rod Custer ²,

Abstract - The National Center for Engineering and Technology Education (NCETE) links technology educators with engineering educators in a symbiotic alliance to build capacity for research, nurture a cadre of talented, diverse leaders in engineering and technology education and infuse engineering design and analytical skills into K-12 schools. The NSF-funded center (ESI-0426421) links four research universities with five technology teacher education institutions, fifteen K-12 school districts and three education-related societies. In 2005 the Center has been involved in on-going delivery of professional development for technology teachers in the partner K-12 schools. Professional development focuses on assessment-driven open-ended problem solving applied to engineering design utilizing mathematics and science concepts. Evaluation survey instruments are used to collect data from students and teachers to determine if the project met the objectives and if the content was effective for technology education students.

Index Terms – Professional Development, Design and Analytical Skills, Engineering and Technology Education, K-12 Schools.

INTRODUCTION

William Wulf [1] noted, in his summary remarks at the IEEE Engineering and Education Deans’ Summit Conference I, that encouraging engineers and educators to work together to address issues of technological literacy is a brilliant idea. The dialog between engineering educators and technology educators shows great potential for a symbiotic alliance to benefit both. The dialog has been facilitated by the publication of the Standards for Technological Literacy (STL) [2] that are national content standards for technology education similar to, and aligned with, the national standards for mathematics education and for science education. The STL were developed by the International Technology Education Association (ITEA) with funding from NSF and NASA. The STL were reviewed and endorsed by the National Academy of Engineering (NAE) and William Wulf wrote the forward to the document [3].

The collaboration between engineering and technology educators is an important initiative that has tremendous potential for benefiting both. Therefore, the National Center for Engineering and Technology Education (NCETE) has been established.

GOALS AND APPROACH

The ultimate goal of National Center for Engineering and Technology Education is to infuse engineering design, problem solving and analytical skills into technology education to increase the quality, quantity, and diversity of engineering and technology educators. This is being accomplished by teaming engineering faculty and technology educators to build capacity and infrastructure including collaborative technology teacher pre-service and professional development, funding for doctoral studies, and research.

NCETE PARTNERS

NCETE is a collaborative partnership between universities and school districts in regional teams located in the West, the Upper Midwest, the Central Midwest, and the Southeast. Regional teams engage in collaborative research, professional development, capacity building, and dissemination of research findings and model practices. NCETE also facilitates collaboration between teacher education programs and K-12 partners to build capacity and to share effective strategies and practices. Center partners have strengths in engineering and in technology education. A list of the NCETE partners is included in Table I.

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<thead>
<tr>
<th>PhD Granting Partners</th>
<th>Technology Teacher Education Partners</th>
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<tbody>
<tr>
<td>Utah State University</td>
<td>Brigham Young University</td>
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<tr>
<td>University of Georgia</td>
<td>California State University, LA</td>
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<td>University of Illinois</td>
<td>Illinois State University</td>
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<td>University of Minnesota</td>
<td>North Carolina A&amp;T State University</td>
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<td>University of Wisconsin-Stout</td>
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<tr>
<th>School District Partners</th>
<th>Professional Society Partners</th>
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<tbody>
<tr>
<td>Teacher education partners team with school districts in their geographical area</td>
<td>International Technology Education Association</td>
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<td></td>
<td>Council on Technology Teacher Education</td>
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<td></td>
<td>American Society for Engineering Education</td>
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One focus of the Center is to deliver professional development to technology teachers in the partner 9-12 schools. An important emphasis of the professional development component of the Center is on assessment-driven, open-ended problem solving applied to engineering design utilizing mathematics and science concepts.

The main objective of the professional development is to prepare technology teachers to incorporate engineering concepts into classroom and laboratory activities. During 2004-05, implementing a concentrated series of professional development experiences, NCETE faculty and graduate students used a set of activity-based engineering design challenges, intensive discussion, field trips and other activities to prepare teachers to incorporate engineering concepts into their courses. The technology education teachers assumed two distinct roles during the professional development: 1) learning as students would learn, and 2) developing the knowledge and skills needed to deliver engineering-oriented technology education.

As a first step toward establishing best practices for delivering engineering design and content through professional development, engineers and technology teacher educators from each of the technology teacher education (TTE) partner institutions have conceptualized, developed, and delivered a series of workshops. While the format and specific content varied across the five professional development sites, a balance between theoretical content and activity-based experiences has been maintained. At the conclusion of each workshop, participating high school teachers complete similar surveys, which were designed to facilitate analysis and reflection. Building on lessons learned during the initial year of the Center, the TTE institutions will move toward a more common professional development experience during year two of the project.

Rod Custer, PI for the NCETE TTE institutions observed that for participants in the workshops “the engineering design challenges clearly shifted the focus from trial and error problem solving to a more predictive process using mathematics and science tools. This is new to technology education and is an important key to aligning the profession more closely with engineering.”

The engineering design challenges, which were developed and used during the professional development workshops, will be implemented in secondary level technology education classrooms during Fall 2005 and will consist of learning activities that require three to five weeks to deliver. The key aspect of these activities will be on the predictive, analytical aspects of engineering design and problem solving.

PROFESSIONAL DEVELOPMENT ACTIVITIES

The project goals include the following activities related to professional development:

- Conduct teacher professional development experiences to help teachers infuse engineering content and design into their instruction.
- Evaluate current pre-service programs and begin to refocus them to infuse engineering analysis and design content into the curriculum.
- Develop teachers’ instructional decision-making so that it focuses on the analytical nature of design and problem solving needed to deliver technological as well as engineering concepts.
- Facilitate teacher initiated change into program design, curricular choices, programmatic and student assessment, and other areas that will impact learning related to technology and engineering.
- Develop teachers’ capabilities as learners so they assume leadership and responsibility for their professional development activities, including recruiting and mentoring colleagues.
- Develop engineering analysis and design skills in technology teachers, including strengthening their mathematics, science, and engineering knowledge and skills.

OUTCOMES

The specified outcomes of professional development component of NCETE include: 1) technology education teachers will be successfully prepared to deliver engineering design content, 2) technology education students will engage in and reflect on open-ended engineering design challenges, 3) develop effective communication with Center participants. These outcomes guide the professional development experiences as well as assist with refocusing the pre-service technology education programs. Teacher professional development workshops are being conducted in school districts across the country, providing over 120 hours of professional development education to more than 150 teachers.

At the time of the FIE 2005 conference, the project will have collected data from 25 technology teachers designed to assess the value and focus of the professional development workshops. Evaluation survey instruments, designed by the Center’s external evaluator in collaboration with the Center’s leadership, were used to collect data from students and teachers to assess the extent to which the project met the objectives and whether the content and delivery mechanisms were effective for technology education students.

REFERENCES

