Hofstra's Center for Technology Education
A Model for Engineering Involvement in K-12 Education

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Abstract

Hofstra's Center for Technology Education was created 7 years ago to help improve the technological literacy of school children on Long Island. It has been successful in promoting change in K-12 education at the school level and the university level, and currently has four collaborative grants involved with K-12 education. The development of the Center and an overview of its activities will be discussed. Importantly, lessons in pedagogy have enhanced the engineering program at Hofstra.

The Center for Technology Education

The Center for Technology Education (CTE) was created in 1989 with the goal of improving the technological literacy of public and private school students on Long Island. It interacts with school districts and provides support services in a variety of ways--through sabbatical leaves in industry for teachers, outreach programs, special seminars for teachers, administrators and guidance counselors. The CTE involves local industry and professional societies in support of these activities and integrates university, school, industry and professional society cooperation.

An advisory board was created to translate these goals into specific objectives, such as summer programs for students and teachers that are consistent with improving technology education in the context of integrated mathematics, science and technology (MST). This is consistent with the National Council of Teachers of Mathematics (NCTM) standards, Project 2061 and the AAAS science standards and with forthcoming standards on technology education. The advisory board assists the CTE in funding and supporting these activities for teachers and students. The advisory board draws upon all the constituencies involved in education, recognizing that perspectives are needed from classroom teachers, school administrators, the state education department, industry and the university.

The CTE, while created in the Engineering Department, administratively reports to the Dean of the School of Education at Hofstra. There have been other initiatives that engineering schools have had in interfacing with primary and secondary schools, but to create systemic change one must tap into the existing connections that all schools of education have with the public educational community. One must become cognizant of the myriad number of variables facing teachers and school administrators, technology education being but one. This organizational structure also gives additional support and credibility to a Center. This may require some flexibility on the part of administrators and faculty, as both maybe suspicious of the intentions. The CTE has been successful in this regard, in part, by asking for little and providing service that did not

previously exist . The building of credibility takes time, but does occur when the K-12 community is supportive.

Technology Education

Very often the question is raised, what is technology education? It is the study of the human-made world and develops technological literacy through activity-based study of past, present and future technological systems; their resources and processes and impacts on society. Not only do students look at technological systems from a systems view, they design and construct devices using the engineering design process. Learning about optimum solutions, criteria used to evaluate same and the imbedded mathematics and science necessary to understanding how the devices function is the essence of a technology activity. The above description certainly resonates with goals of engineering and engineering education. Very often technology education is confused with instructional technology, such as computers, videos, CD-ROMS. These are used in technology education as well as in other educational areas.

Factors Contributing to the Center's Success

Good fortune, good timing. There is a concern in New York State and the nation that school children are not performing well in science and mathematics. There are many causes for this, but one is the lack of connection to science and mathematics their daily lives. Technology education, through its activity-based, hands-on approach, has the potential to create this connection. The combination of all three disciplines is MST education. In New York State there are newly created MST Frameworks that outline standards of performance for children at various stages in their K-12 education. The Center's philosophy and activities put it at the forefront of the MST movement in New York.

A second factor is gaining credibility with the MST teachers and their administrators. Gaining this credibility requires that one be a good listener, find out what they perceive are their problems and determine whether or not you can generate activities that will ameliorate them. One of the CTE's goals is to infuse more mathematics and science in the technology activities. The infusion works best when it is based in an activity that the technology teachers have asked assistance on.

For example, the teachers wanted to have an activity that would be exciting to school children and have high visibility, showing technology education in a very positive light. From this the middle school magnetic levitation (maglev) contest was born. In this contest students design vehicles with permanent magnets on their bottom surface, magnets of the same polarity are on a track, so the vehicles float, they are magnetically levitated. Propulsion systems, such as a small dc motor with a propeller attached and powered by a battery or an electrified track, drive the vehicle down a 16 foot track in two to three seconds.

The contest does not stop here. Students must submit a design portfolio which includes a sketch of the vehicle and a discussion of their design and the mathematics and science they used. The final winners are selected on the basis of vehicle time and portfolio quality. The contest has a high visibility. There is local media coverage, press and television, and representatives from the engineering community (drawn from companies on the CTE's advisory board) act as judges. The contest has proven so popular that it is being replicated in other parts of New York State. Engineering schools are teaming up with local technology teacher associations to offer the contest to middle school students in their regions. A modest grant from the Department of Energy, administered by the CTE, provides finding for initiating the contest.

A third factor is that the CTE always looks for collaborative relationships before entering into an activity. Not only is there strength in numbers, but credibility as well. The maglev contest is run in conjunction with three technology teacher organizations and Brookhaven National Laboratory (a member of the CTE's advisory board); some teacher workshops have been run with the support of local industry and the CTE, and the CTE runs one in conjunction with another engineering school. In this instance, SUNY Stony Brook and the NYS Education Department with grant support from the National Science Foundation developed a high school course in technology education called Principles of Engineering (POE), similar in many ways to a freshman engineering course. During the school year, Hofstra's CTE held follow-on workshops for POE teachers in its region.

A fourth factor is the support that the CTE received from Hofstra from its inception; the President wrote letters to industrial leaders asking them to serve on the advisory board. The maglev contest brings over 300 children to Hofstra from at least 20 different schools. Hofstra supports one-half the cost of providing lunch. lt also supports incidental office and mailing expenses associated with the CTE's operation. Even though the $1000 for the contest is not a large portion of the University's budget, it is a large portion of the CTE's budget of approximately $5000 that is raised annually.

Initiatives with the School of Education

The Center worked with Brookhaven National Laboratory to develop an elementary teacher education enhancement project in MST that BNL runs in the summer with joint Department of Energy and NSF support. Participating teachers may elect to concurrently enroll in a graduate course at Hofstra during this time period. Not only are they enfranchised and learn science, mathematics and technology and witness same in the Laboratory's research facilities, they create MST activities for their students as part of the course.

This experience has been so rewarding and groundbreaking that the School of Education has received a NYS grant to create a MA degree in MST for elementary school teachers. Of course, the CTE is actively involved in this. The MST component of the MA degree focuses on creating methods courses in mathematics, science and technology education, an integrated course in MST as well as a course in computer technology. In addition, there are complementary courses required in science, mathematics and technology (offered in the Engineering Department's program in Technology and Public Policy) as well as courses on educational policy.

Creating the First MST Network in New York State

The Center for Technology Education received a $1.6 million grant from the National Science Foundation along with industrial matching finds of $2.7 million to establish a New York State Technology Education Network (NY STEN). This teacher enhancement grant focuses on engineering problem solving, integrated mathematics, science and technology, in the context of new pedagogical practices in cooperative learning, enfranchising women and minorities, and authentic assessment. Over a period of three years, ending in August 1996, the NYSTEN Project is preparing 94 MST teacher-mentors with enhanced pedagogical, technical and leadership skills. Twenty regional teams have been assembled to serve all areas of the state. Each team includes on average two-three technology teachers (middle and high school), one mathematics teacher, one science teacher and one school/community partner. The teams are conducting staff and community development workshops within their geographic regions. The majority of the workshops are directed towards middle and high school MST teachers, though the activities are most appropriate for technology teachers, providing hands-on

integrated pedagogical and technical enhancement. The teams will also present hands-on awareness workshops to other members of the school and local community to broaden the base of support for improvement of teaching and learning in technology education.

Pedagogical Enhancement of Hofstra's Engineering Program

Learning educational pedagogy is not typically part of an engineering faculty member's background. It certainly was not part of mine. As part of the NYSTEN project, experts in pedagogy in a technical environment were consultants, running workshops for the mentors; workshops I could participate in. The results of the workshops in cooperative learning and authentic assessment, and design and problem solving have direct application in engineering courses. The Introduction to Engineering course at Hofstra has a significant design component; two design projects are required. This design component has been greatly improved using authentic assessment techniques in the evaluation phase and the creation of the design portfolio that provides documentation. Cooperative learning groups are being used in several engineering courses; this would have not been possible without workshop participation. Other faculty in engineering are becoming interested in these pedagogues and are incorporating some aspects of authentic assessment in design and laboratory courses.

Conclusion

The Center has found that technology education is the natural K-12 link to engineering, particularly so in the MST environment. Design creativity and understanding and using science and mathematics in design analysis are important elements of technology education. These same elements characterize engineering. Many engineering schools have developed "pipeline" activities to increase engineering enrollment and interest in engineering, however this does not address the larger issue of technological and scientific illiteracy of students. Support of technology education offers an opportunity to address this issue in a modest yet significant manner. Technology education offers a way for students to understand the abstract laws of science and principles of mathematics through devices and processes they design and construct. It is time to think beyond pipeline issues, the pipeline will be fuller when more students' curiosity and interest are aroused by technology education.

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