The Institute for Engineering Education at SMU – Answering the Shortage of Tomorrow's Engineers

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Abstract

To help combat the projected shortage of engineers, the Institute for Engineering Education at SMU was founded in 2002 with funding from the national government. The Institute develops engineering curriculum for K-12 students and educators. All programs aim to increase the quality, quantity, and diversity of tomorrow's engineers by leveraging collaboration of academia, industry, and the community. Three marquee programs include Visioneering, the Infinity Project, and the Gender Parity Initiative. Visioneering, a one-day event for middle school students, introduces engineering in a high-energy, high-tech environment. The Infinity Project is a year-long engineering curriculum for high school students that provides schools with a complete turnkey solution. The Gender Parity Initiative seeks to reach gender parity in the undergraduate engineering population through institutional transformation. Filling the shortage of tomorrow's engineers requires a novel combination of educational opportunities that reach an increasingly diverse population of students.

Introduction

By 2010, the Department of Labor predicts a shortage of engineers in the U.S. High school graduates are neither prepared nor interested in pursuing degrees in engineering. Less than 15% of high school graduates have the required background in math and science to enter a freshmen engineering program.[1] Less than 2% of high school graduates earn a degree in engineering, and less than 0.5% of female high school graduates earn a degree in engineering.[2,3] Over the past decade, the number of engineering graduates in the U.S. has remained stagnant.[4] Therefore, corporations are forced to bring in engineers from overseas. Europe produces three times as many engineers as the US and Asia five times as many.[5] To remain globally competitive, the U.S. must increase the number of American born engineers.

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The Institute for Engineering Education at SMU was founded in 2002 with funding from the federal government. The mission of the Institute is:

To enhance the quality, quantity, and diversity of tomorrow's engineering workforce.

This mission is being achieved through collaboration with universities and other organizations by developing and implementing nationwide programs that enhance engineering education and preparedness in K-16. Programs teach engineering in fun, creative, compelling ways with the message that engineering touches every facet of the modern world. Upon successful implementation and comprehensive evaluation, programs are disseminated nationally to serve as models for other institutions. (The Institute for Engineering Education at SMU website[6])

Visioneering

What is Visioneering?

Visioneering is a signature National Engineers Week event that brings together middle school students, working engineers, innovators, and noted national figures from a variety of industries and businesses to celebrate the ways that engineering makes a difference in the world. It also provides an opportunity for students to have fun with engineering and play as an "engineer for the day." Visioneering is held annually as a live event on SMU's campus, and in 2003 was distributed to schools throughout the U.S. as a 30-minute tv show by Cable Channel One.

Visioneering is best described as a combination of a day at the mall, an exciting sporting event, a live concert, and the science fair – delivering substance in a MTV-type atmosphere. The day's events include high energy motivational speeches from high tech celebrities, a major real-time engineering design competition, a high tech expo showcase of the nation's latest leading technologies and companies, and an awards ceremony recognizing the top student designs.

Students are divided into teams of ten led by three adults – a team leader who is a working engineer, a SMU engineering student, and a teacher who accompanied students. Teams are assigned by Visioneering personnel to achieve maximum diversity. No two students on any given team are from the same school.

Visioneering has grown from 250 students in 2001 to a by-invitation-only audience of 500 students in 2003. The diversity of the invited schools ranges from private schools to urban schools. Each year has its own unique theme that guides the direction of the design contest and exhibits at the tech expo.

Visioneering 2001: Computers of the Future
Visioneering 2002: Transportation of the Future
Visioneering 2003: Emergency Room of the Future

Impact

Participating students, teachers, team leaders, judges, and corporate partners were surveyed on their experience at Visioneering 2003. Student evaluations were conducted at the live event, and adult volunteers, including team leaders, teachers, judges, and corporate partners, were surveyed via on-line evaluations after the live event.

Student Evaluation
94% learned how math and science are used

95% liked working with engineers

94% liked visiting the company exhibits

87% would attend Visioneering next year
(a large portion of the other 13% would be too old)

92% would tell their friends about Visioneering

Adult Evaluation
Would like to participate next year
- **86% of team leaders**
- **100% of judges**
- **73% of corporate partners**
- **100% of teachers**

Would recommend Visioneering to a colleague
- **95% of team leaders**
- **100% of judges**
- **100% of corporate partners**

The Infinity Project

In response to the low numbers of high school students pursuing degrees in engineering, the Infinity Project was developed to introduce students to engineering in a year-long high school course. Developed by a team of university professors, high school teachers, working engineers, and leading researchers, the Infinity Project puts engineering in the hands of high school students in a fun, cost-effective, hands-on curriculum that makes math and science relevant in today's high-tech world. The Infinity Project provides a complete turnkey solution including world-class

curriculum, state-of-the-art technology, and best-in-class professional development for math and science teachers.

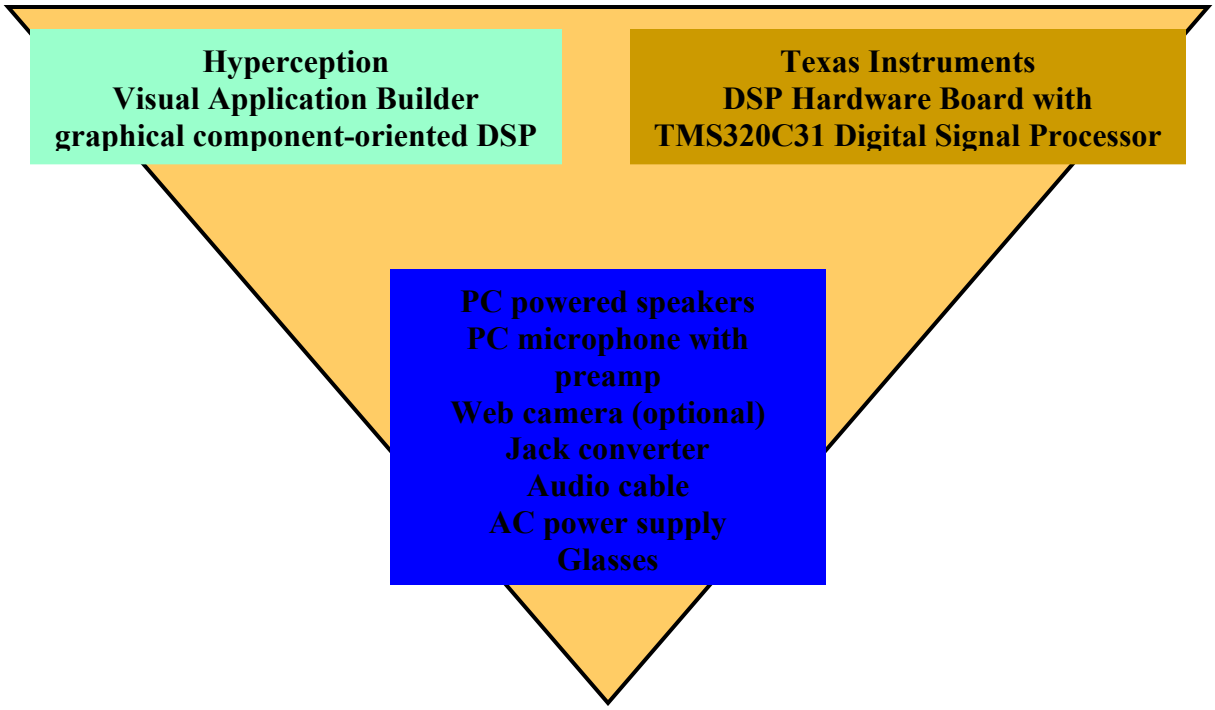
The Infinity Project curriculum teaches students firsthand how engineering touches everyday products. Students use math and science to create and design a variety of new technologies centered around topics of interest to them, such as the Internet, cell phones, music, and video. The curriculum is delivered through an intimate connection of the textbook to hands-on experiments and design projects. The year-long curriculum includes over 300 experiments and designs through which students learn to think like engineers. In addition to the printed text, additional chapters on current technologies are available on-line.

Textbook Title Chapters

The World of Modern Engineering
Creating Digital Music
Making Digital Images
Math You Can See
Digitizing the World
Improving Bits
Communicating with 1's and 0's
From the Telegraph to the Internet
Engineering the Future

The Infinity Technology Kit

The Infinity Technology Kit was developed in conjunction with Texas Instruments and Hyperception to turn ordinary PCs into easy-to-use, high-tech engineering workstations.



Professional Development

The Infinity Project professional development extends beyond the introductory teacher training to provide on-line technical support with 24-hour response, networking among Infinity teachers, and collaboration with industry. Teachers are trained in the Infinity curriculum at the week-long 40-hour Summer Professional Development Institutes held several times each summer at universities throughout the U.S. Follow-up with teachers is achieved through monthly progress reports. And, teachers remain engaged in the on-line discussion groups and technical assistance.

Teacher's Comments…

"Every student in America should be exposed to this material."

"Best training I have ever seen."

"I want to run home and show this to my own children."

"My state needs this right now."

Impact

Started in 1999, the Infinity Project has grown from 13 schools in Texas to nearly 60 schools in 16 states from Hawaii to Connecticut. Schools reach a variety of demographics from urban, inner city to private all-girls schools. Over half of the participating students have been minorities and over half have been women – two critical groups to reach in combating the shortage of engineers. Over 65% of Infinity graduates planned to study engineering in college, and nearly 100% would recommend the program to others. With Infinity's history of success, the goal is to put it in every high school in Texas by 2005.

Gender Parity Initiative

SMU is the first university to set the goal of reaching gender parity in engineering. Nationwide, only 20% of undergraduate engineering students are women, 18% of all B.S. degrees in engineering are awarded to women, and 10.6% of the country's engineers are women.[7] The Gender Parity Initiative is designed to attract women to engineering through institutional changes, rather than creating "Women in Engineering Programs." Institutional transformation involves a collaboration of industry, academia, the community, and government to effect change in education, public policy, and public image.

VISION
To achieve gender parity in graduating leaders for engineering and beyond

The Gender Parity Initiative encompasses outreach, recruitment, and retention programs targeted at but not exclusive to girls. Outreach activities aim to raise the visibility of engineering and to dispel myths about engineering through programs such as engineering exploration in schools, exposure to careers in engineering, and ensuring adequate pre-college preparation. Recruitment efforts show girls what SMU engineering has to offer in the branding "Engineering and Beyond." Retention programs deliver on outreach and recruitment promises by opening up numerous, varied opportunities in engineering to young women through service learning, study abroad, leadership opportunities, and interaction with industry.

KEY MESSAGE:
An engineering degree opens doors – to the high-tech industry, medicine, law, and much more!

The Strategic Plan for achieving Gender Parity involves growing the entire undergraduate engineering population with the female sector growing more rapidly than the male sector.

Accordingly, an increase in female faculty is necessary to provide role models for female engineering students.

Summary and Conclusions

The Institute for Engineering Education at SMU was founded in 2002 with funds from the federal government for the purpose of increasing the quantity, quality, and diversity of tomorrow's engineers. Three of the flagship programs include Visioneering, targeted at middle school students; The Infinity Project, targeted at high school students; and the Gender Parity Initiative, targeted at the pre-college and college female population. Although different in scope, the three programs seek to achieve the overall vision of the Institute through innovative, creative programs. The mark of the innovation and creativity is in the medium of the programs – each meets its target audience in their realm. Programs are fun, hands-on, and easy to implement. Upon success, programs are disseminated nationwide as is currently taking place with the Infinity Project and took place with Visioneering and its broadcast on Cable Channel One.

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