

The Infinity Project – Engineering for the High School Classroom

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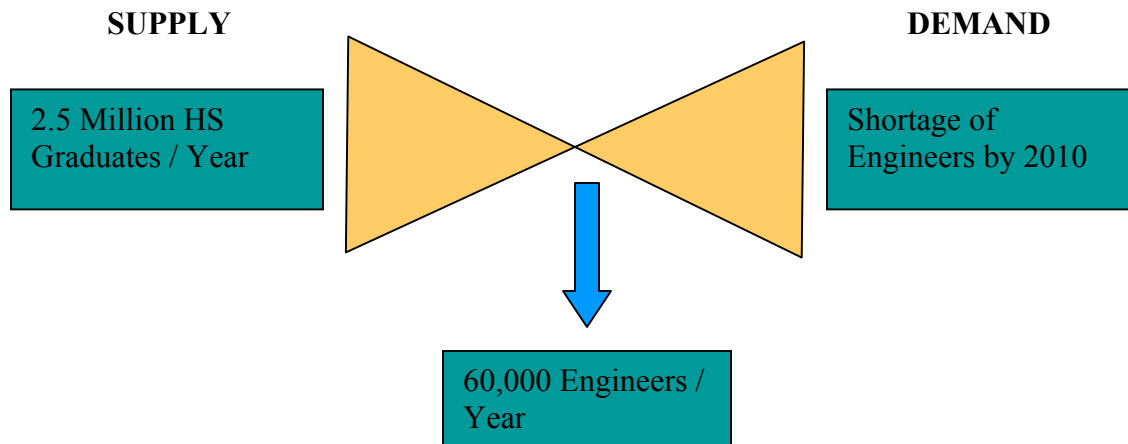
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Abstract

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 high school. The Infinity Project makes math and science relevant in today's high-tech world. 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. 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. A business model was adopted that requires schools to make time and monetary investments, thereby helping to insure rigorous assessment. The curriculum is currently taught in high schools across the nation and is making a big impact – nearly 100% of participating students would recommend the course to a friend, over 50% of participants have been women and minorities, and 65% plan to pursue engineering in college.

Introduction

By 2010, the Department of Labor predicts a shortage of engineers in the U.S. This shortage may be attributed to a large group of engineers who will be retiring and a lack of fresh engineering talent. Less than 15% of all high school graduates in the U.S. have the math and science background necessary to enter an undergraduate engineering curriculum.¹ Only 2% of high school graduates pursue engineering degrees in college, and only 0.5% of women and minority high school graduates pursue engineering degrees in college.^{2,3}



Response

In response to this critical shortage of students interested in engineering, The Infinity Project was born.

VISION:

Lead the nation in developing and supporting the implementation of engineering and technology education in K-13.

MISSION:

To increase the quantity, quality, and diversity of engineers by delivering innovative curricula, advanced technology, and outstanding professional development for K-13 teachers.

OBJECTIVES:

- Increase the number of students pursuing technical degrees at the college level
- Expand the pool of engineering talent by increasing women and minority participation
- Make math, science, technology, and engineering relevant and exciting

Development Strategy

The Infinity development strategy centered around expertise in engineering and education from across the nation through the collaboration of universities, corporations, and K-12 educators. The Infinity development team included five presidents of professional technical societies, three founders of technology companies, four deans and chairs of engineering schools and departments, two current or past university presidents who are members of the NAE, university professors, leading high school math and science teachers, school districts, industry partners, and the National Science Foundation.

The key to success lies in the ease of implementation and a great impact. The Infinity Project provides a complete turnkey solution including curriculum, teacher training, and technology.

Target Audience

“When am I ever going to use this?” - a question posed all-to-often by students to their math and science teachers. The Infinity Project provides the answer to this question for both teachers and students. The prerequisites for the Infinity Project are Algebra II and one laboratory science class. The Infinity Project is not only for the super-smart students, but rather is designed to introduce students to engineering by taking math and science concepts and applying them to familiar entities – the Internet, music, video, and more. In college, the course is positioned as an introductory course to electrical or computer engineering.

To attract students and teachers, the Infinity Project focuses on providing a fun, exciting, challenging engineering curriculum. Using basic math and science, students explore the world of high-tech engineering through hands-on lab experiments and design projects.

Business Model

The Infinity Project comes at a cost of time and money, yet offers a great reward in terms of impact. Schools must apply to the program and go through an interview process before being accepted into the program. Teachers and schools are screened for commitment and vested interest. Upon acceptance, schools must purchase textbooks, technology kits, and professional development for two teachers. Efforts have been made to keep costs to a minimum, and grants are available where cost is a barrier. Requiring schools to pay for the program makes schools take the program more seriously and helps ensure a rigorous assessment of effectiveness.

The biggest bottleneck in expansion of the program is the teacher training. To help facilitate expansion, universities throughout the country are being trained to run the professional development sessions and serve as resource centers for area teachers.

Nuts and Bolts

Curriculum

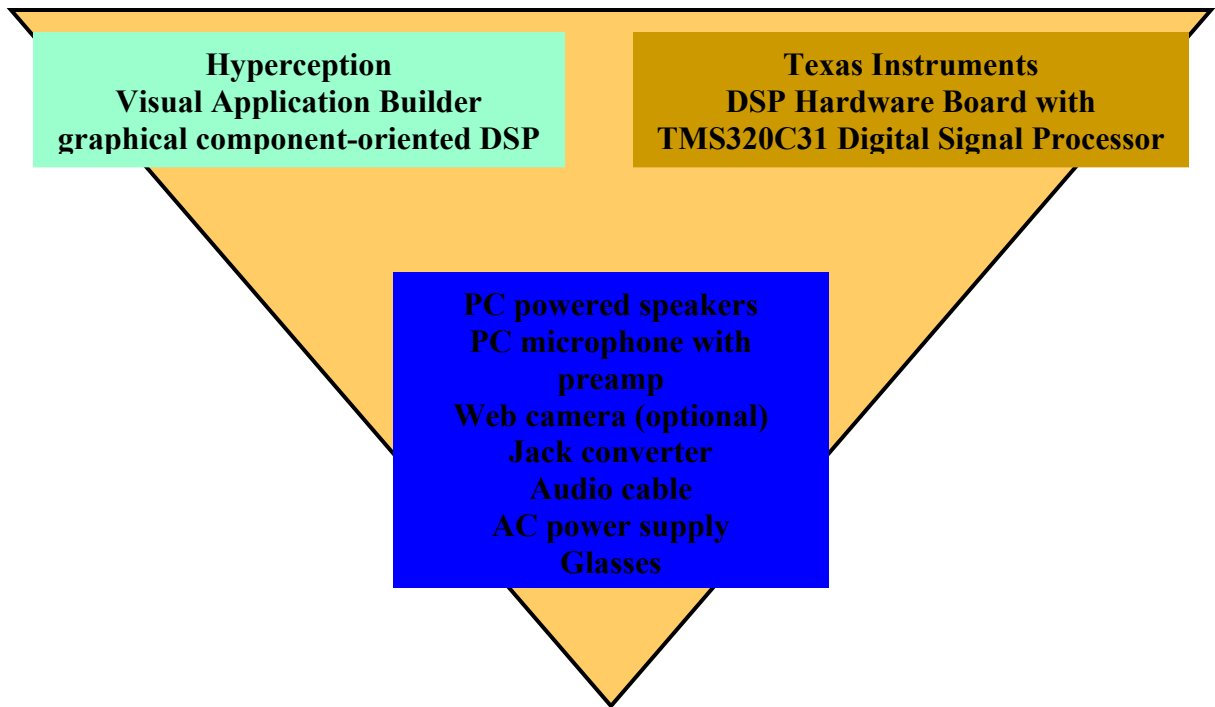
The Infinity Project curriculum teaches students firsthand how engineering touches everyday products. Students use math and science to create and design a variety of new technologies centered around topics of interest to them, such as the Internet, cell phones, music, and video. The curriculum is delivered 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. The Technology Kit makes ordinary PCs state-of-the-art engineering workstations. The minimum requirements are a 486/66 MHz PC compatible or greater and Windows 95 or greater with a sound card. Installation is simple and requires minimal time.



Professional Development

The Infinity Project professional development includes introductory teacher training, 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 ongoing refresher training and 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 and increasing the quality of engineering. 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.

Conclusion

Based on a fun, innovative, hands-on curriculum created by a collaboration of academia and industry, the Infinity Project has undergone significant growth and increasing demand. A diverse population of students has been exposed to engineering, which has had a significant effect on the number of those students pursuing engineering degrees. The Infinity Project provides a complete turnkey solution for schools including curriculum, technology, and teacher training. Using a business model, schools must invest time and money upon acceptance into the program. The keys to Infinity's success lie in its ease of implementation and fun curriculum.

References

1. U.S. Department of Education, National Center for Education Statistics, "The 1998 High School Transcript Study Tabulations: Comparative Data on Credits Earned and Demographics for 1998, 1994, 1990, 1987, and 1982 High School Graduates," NCES 2001-498, by Stephen Roey, Nancy Caldwell, Keith Rust, Eyal Blumstein, Tom Krenzke, Stan Legum, Judy Kuhn, Mark Waksberg, and Jacqueline Haynes. Project Officer, Janis Brown. Washington D.C. 2001.
2. U.S. Department of Education, National Center for Education Statistics, 2002, "Early Estimates of Public Elementary and Secondary Education Statistics: 2001-02," NCES 2002-311, by Lena McDowell and Frank Johnson. Washington, DC.
3. U.S. Department of Education, National Center for Education Statistics, [E.D. Tabs] "Degrees and Other Awards Conferred by Title IV Participating, Degree-granting Institutions: 1997-98," NCES 2001-177, By Frank B. Morgan, Washington, DC: 2000.

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Dr. Orsak is the Director of the Infinity Project. Additionally, he serves as the Executive Director of the Institute for Engineering Education at SMU and Associate Dean for Research for the SMU School of Engineering. His research interests include wireless communications, signal processing, information theory, and engineering education.

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