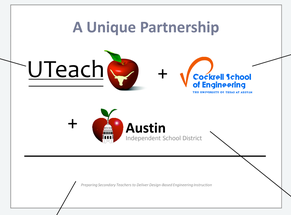
UTeach*Engineering*

Training Secondary Teachers to Deliver Design-Based Engineering Instruction

The University of Texas at Austin

Project Partners

The successful UTeach Natural Sciences program currently enrolls more than 400 University of Texas math and science undergraduates in a teacher preparation program that is being replicated at universities nationwide. UTeach Natural Sciences provides the core curriculum for the emerging UTeachEngineering teacher training programs.



The Cockrell School of Engineering is the leading College of Engineering in Texas and among the top engineering programs in the United States. The Cockrell School provides specialized courses to prepare high school teachers to deliver design-based engineering courses.

The Austin Independent School District (AISD), a school district serving a diverse population of over 82,000, is the core K-12 partner in the UTeachEngineering MSP. The AISD will deploy high school engineering courses in a variety of settings, providing rich opportunities for program research and evaluation.

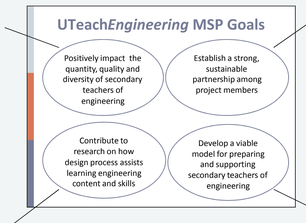
UTeachEngineering is leveraging the strengths of core MSP project partners in expanding the successful UTeach Natural Sciences model to develop a national model for preparing and supporting secondary teachers of engineering.

Project Goals and Progress To Date

In the project's first year, UTeachEngineering worked with 54 in-service teachers, including:

- 26 women (48%)
- 24 members of underrepresented minorities (44%)

Early indicators of improved teacher quality are outlined in the "Early Results" section of this poster.



Papers have been presented or accepted for presentation at 2009 and 2010 conferences including Frontiers in Education and the American Society for Engineering Education.

All project partners participate actively in project management and decision-making processes. Engineering and Education faculty collaborate with K-12 teachers and curriculum experts on course development for both high school- and university-level courses.

UTeachEngineering is in the early stages of developing a well-rounded, design-based, year-long high school engineering course that can be exported, with low implementation cost, to virtually any high school setting. This course will serve to make young men and women aware of what engineering is, what engineers do, and the role that engineering plays in shaping their world.

In-Service Teacher Programs

Professional Development Program

Engineering Summer Institute for Teachers (ESIT)

- Teachers experience engineering first-hand in six-week, hands-on courses
  - *Fundamentals of Engineering and Design*
  - *Project-Based Lesson Design in Engineering*
- Competitive application process
- $3000 teacher stipend
- Eventual dissemination at five Texas universities
- 460 teachers trained over five years

Graduate Degree Program

Master of Arts in Science and Engineering Education (MASEE)

- Teachers develop in-depth understanding of engineering and engineering pedagogy
  - Three summers at UT Austin (nine weeks each)
  - Two academic years of online study
- Competitive application process
- $10,000 annual fellowship
- Leads to a graduate degree (MA) from UT Austin
- 50 teachers over five years

In-Service Teacher Recruitment

	Year 1 (Actual)	Year 2 (Goal)	Year 3 (Goal)	Year 4 (Goal)	Year 5 (Goal)	MSP 5-Year Total
MASEE	10	10	10	10	10	50
ESIT	13*	24	24	24	24	109
ESIT (Dissemination Sites)	31*	40	80	100	100	351
Total	**54**	**74**	**114**	**134**	**134**	**510**

Recruitment goals beyond the MSP project life remain to be determined.

* Year One recruitment did not allow for attrition of participants after reaching the recruitment goal in December 2008. Future recruitment efforts will allow for some attrition between admission and matriculation.

Ongoing Interaction with Teachers

- Online collaboration Tool: MSPnet
- Lesson Planning and Classroom Support
- Online Academic Year Course for MASEE students
- Still To Come:
  - Establish a project working group devoted to teacher support and community building
  - Quarterly Events (*e.g.*, Spring Conference)
  - Selected ESIT alumni serve as Master Teachers at Dissemination Sites

Pre-Service Teacher Programs

Pre-Service Teacher Program

- Defining pathways for engineering/science students to teach high school engineering
  - Degree plans for science students
  - Certificates and/or degree plans for engineering students
- Designing a scholarship/internship program to attract top students
- Employing peer Learning Assistants in freshman engineering physics to improve retention (based on model developed at UTeach Natural Sciences replication site University of Colorado - Boulder)

Pre-Service Enrollment Statistics

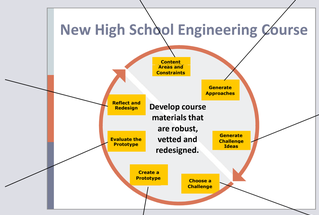
Due to record enrollment in the first UTeach course in Fall 2009, two additional sections of the course were added; this increased UTeach program capacity by 50 percent over Fall 2008 levels.

14 percent of Fall 2009 enrollees are physics or engineering majors, up from 10 percent in Fall 2008.

Curriculum Development: High School Course

- Engineers at UT with K-12 experience
- Grand Challenges
- Texas State Course Standards
- Fundamentals of Engineering

- PBL orientation
- Teacher focus group
- 5E / Inquiry-Based lessons
- Understanding by Design
- Survey of existing national curriculum
- "Changing the Conservation"
- "Engineering in K-12 Education"



- Revisions (planned for 2011-12)
- District-wide implementation in Austin ISD (planned for 2010-11)

- "Grand Challenges"
- "Changing the Conservation"
- "Engineering in K-12 Education"

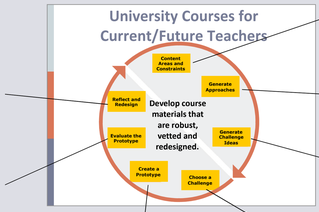
- Teacher focus group
- "Grand Challenges"

- Teacher lesson plan working group (underway)

Curriculum Development: University Courses

- Revisions underway (rollout planned for 2010 ESIT and MASEE programs)

- All engineering disciplines
- Engineering at UT
- Grand Challenges



- Faculty buy-in

- 2009 ESIT
- 2009 MASEE

- "Grand Challenges"
- UT Engineering content areas

- UT Professors and UTeachEngineering Master Teacher

- "Grand Challenges"
- UT professor expertise
- UT Engineering research

Project Challenges

Some of the challenges faced by UTeachEngineering are common among teacher development programs, while others are unique results of the project's focus on the relatively new area of secondary engineering education. As a young project, we are still grappling with many of these questions.

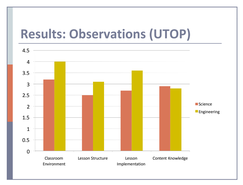
•How do we effectively engage engineering faculty at a research university in engineering education reform?

UTeachEngineering has developed a tiered system that allows for faculty engagement at multiple levels, from sponsoring teacher MA candidates to becoming departmental champions.

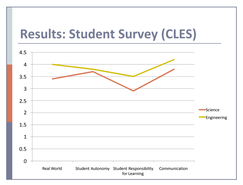
•In a large state, how do we effectively build a community among geographically dispersed teachers? (This is particularly important for our teachers who, because they are the only ones teaching engineering in their schools or districts, have no immediately obvious and local professional peer group.) Can regional communities suffice, or is a larger statewide community preferable? Beyond online collaboration, what can we do to build this community (e.g., statewide teacher conference)?

•What are the critical elements in developing a new course in largely uncharted territory (i.e., high school engineering)?

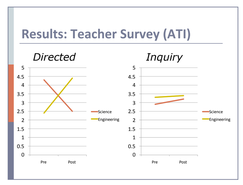
Early Results



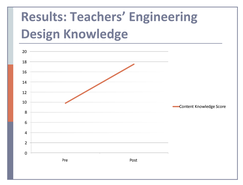
UTeach Observational Protocol (UTOP) indicators lean toward a student-centered classroom. Differences in the first three categories here indicate a possible trend toward greater focus on the student and on student ownership in engineering classrooms.



Students rated their engineering courses as significantly more constructivist than their science courses on all subscales. These data confirm the UTOP observation data.



Prior to intervention, teachers reported using inquiry practices significantly more often than directed ones only in their engineering courses. Posttest results showed a significant shift toward inquiry practices across the board and particularly in their science and math classes.



Teachers participating in UTeachEngineering showed a statistically significant increase in engineering design knowledge after intervention.

What We Hope to Learn From Other MSPs

Our project team members look forward to gleaning insight into how other MSPs have addressed challenges, particularly in these areas:

•After summer professional development activities have concluded, how do you continue to engage, support, and interact with teacher participants? What types of support are provided by the IHE? By the K-12 district partner? What have teachers found useful?

•If you received interest in your programs from prospective partners before you were ready to expand, how did you keep those partners engaged until full collaboration became possible?

•How have you utilized your Advisory Boards? What lessons have you learned? What recommendations do you have for an MSP that is just convening its Advisory Board?