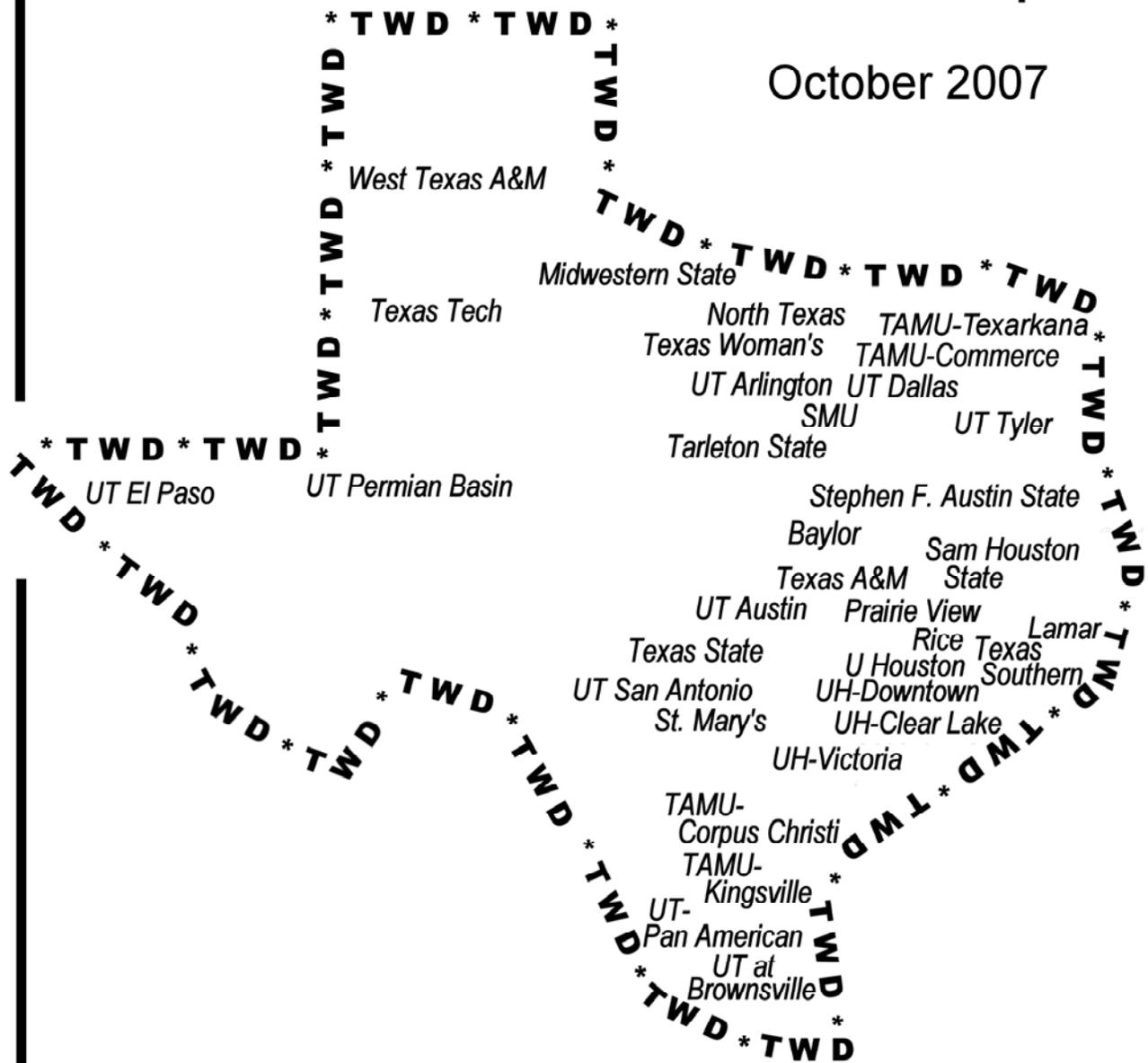


Texas Higher Education Coordinating Board
Technology Workforce Development Grants Program

6th Annual Report

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Texas Higher Education Coordinating Board

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Mission of the Coordinating Board

The Texas Higher Education Coordinating Board's mission is to work with the Legislature, Governor, governing boards, higher education institutions and other entities to help Texas meet the goals of the state's higher education plan, *Closing the Gaps by 2015*, and thereby provide the people of Texas the widest access to higher education of the highest quality in the most efficient manner.

Philosophy of the Coordinating Board

The Texas Higher Education Coordinating Board will promote access to quality higher education across the state with the conviction that access without quality is mediocrity and that quality without access is unacceptable. The Board will be open, ethical, responsive, and committed to public service. The Board will approach its work with a sense of purpose and responsibility to the people of Texas and is committed to the best use of public monies. The Coordinating Board will engage in actions that add value to Texas and to higher education. The agency will avoid efforts that do not add value or that are duplicated by other entities.

The Texas Higher Education Coordinating Board does not discriminate on the basis of race, color, national origin, gender, religion, age, or disability in employment or the provision of services.

Technology Workforce Development Grants Program

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Technology Workforce Development Grants Program

Summary of Grants Program

In response to requests by high-tech industry to increase the number of electrical engineering and computer science graduates from higher education institutions in the state, the 77th Texas Legislature passed the Technology Workforce Development Act in 2001. This legislation, Senate Bill 353, created the Texas Engineering and Technical Consortium (TETC) and the Technology Workforce Development (TWD) Grants Program.

TETC is composed of representatives of university engineering and computer science programs throughout the state, as well as representatives from high-tech industries. Current industry members are Advanced Micro Devices, Hewlett-Packard and Hewlett-Packard Foundation, Intel Corporation, Lockheed Martin Corporation, National Instruments Corporation and National Instruments Foundation, Raytheon, and Texas Instruments and Texas Instruments Foundation.

The total amount of TWD funding from the program's creation in 2001 through 2007 is \$19 million. Industry has contributed \$3.37 million in funds to the grants program and \$1.07 million through in-kind donations such as hardware, software, and sponsored internships. TETC secured two federal grants from the U.S. Department of Education for a combined total of \$3.78 million for grants. Through 2005, the state provided \$7.78 million in general revenue funds as matching for non-state contributions. In 2007 the program received \$3.0 million from the Governor's Office through the Texas Workforce Commission in U.S. Department of Labor funds.

In-kind hardware and software donations by TETC industry members allowed alignment of course curriculum, lab set-up, and best practices implementation across Texas institutions and across the different cycles of TWD grants. Eighteen institutions installed ten National Instruments ELVIS (Educational Laboratory Virtual Instrumentation Suite) hardware stations each in their laboratories, and 14 institutions combined the equipment with Texas Instruments-donations of digital signal processing hardware and software. In addition 27 departments incorporated a donated Hewlett-Packard tablet computer into their instructional activities.

Funding allowed four cycles of grants TWD 2002, TWD 2003, TWD 2005, and TWD 2006. Grants from TWD 2002 and TWD 2003 closed March 31 and August 31, 2007, respectively. The grant periods for TWD 2005 and TWD 2006 are continuing until the end of August 2008. No new funding and no new grants were added during the state fiscal year 2007.

Over the duration of the TWD grant program, a large number of projects focused efforts on curriculum development, particularly for first-year courses, and student mentoring and tutoring programs which became increasingly popular. Departments modified course material to make it more appealing to students, enhanced participatory learning in classrooms, and made laboratories more relevant to current technologies by equipping them with user-friendly hardware and software. Several departments established summer camps to recruit students and to increase the capability of enrolled students. Learning communities were established to ease the transition to college life and provide opportunities for students to connect with one another and others in the department. The University of Texas-Pan American used a work-study program to keep students on campus and engaged in the program. Annual meetings of project leaders increased the impact and dissemination of new, effective practices.

TETC and the Coordinating Board held two Best Practices Conferences – the first in January 2006 and the second in March 2007. The symposium-style meetings facilitated presentations and discussions for over 100 project leaders and industry leaders from across the state for each of the two conferences.

Successful strategies from the 2007 meeting include the cost-effective use of peer teachers; course redesign to balance depth with breadth of the curriculum; on-campus jobs and work-study opportunities; a faculty “course champion” for multi-faculty taught introductory courses; specialized “camps” as outreach to high schools, and as retention tool for enrolled students; provision of career information to high school counselors; an honors program for highly qualified students; modern instructional technologies; and opportunities for non-traditional students, such as evening courses or on-line courses.

Technology Workforce Development Grants TWD 2002

Governor Rick Perry announced the first cycle of grants for the Technology Workforce Development (TWD) Grant Competition, TWD 2002, at a press conference on April 1, 2002. Twenty-three institutions received \$8.2 million in funding for 29 departments. Twenty grants benefited departments of electrical engineering, and 13 grants benefited departments of computer science. These grants ended on March 31, 2007, as extended by the TWD Grants Program Advisory Committee on June 2, 2004.

Due to a budget shortfall at the beginning of the grant period, budgets for TWD 2002 grants were first written and approved at the 54 percent funding level and were prorated to 100 percent when full funding was achieved on October 4, 2004.

The grants received \$3,334,608.54 in state funds and \$2,649,991.48 in industry donations. Industry also contributed hardware and software with a value of \$756,000. \$2,247,492.65 came from a congressionally directed grant through the U.S. Department of Education to the Texas Engineering and Technical Consortium (TETC) and its host institution, The University of Texas at Austin.

The grant period for the funds from the Department of Education started on September 1, 2004 and ended August 31, 2006, according to a one-year time extension granted by the Department of Education on June 30, 2005. (The federal grant had award number P116Z040302 under CFDA 84.116Z.)

Federal funding also made possible the first TETC Best Practices meeting for the TWD Grant Competition. It was held on the campus of the Southern Methodist University on January 10 and 11, 2006. Project leaders presented 18 papers in a symposium setting for discussion under the topic headings of "*Best Practices for Retention*," "*Best Practices for Recruiting*," "*Best Practices for Curriculum Revision*," and "*Experiences with Statewide Implementation of the Infinity Program*."

Table 1 of this document lists a 10-point summary of ideas classified as "Best Practices" from this conference. The list is not exhaustive, but indicative of what the TWD Grant Program established in positive experiences during the first four years of its existence.

Table 1 **Ten Best Practices for Increasing Engineering and Computer Science Graduates, January 2006**

1. Use peer teachers as a cost-effective retention and recruiting tool.

Peer teachers (undergraduate teachers/mentors/assistants) have proved to be remarkably effective at increasing the success rate of beginning students. There is some indication that these programs are most successful when student organizations can run them, or if students otherwise can view them as primarily committed to student success and independent of faculty or grading.

2. Expose students to their discipline early in their academic careers.

If students are not exposed to their discipline until sometime in their second year, many of them will have moved on to other career choices. Departments should make a serious effort to expose freshman students to their discipline and integrate them into departmental programs. During first- and second-year courses, students still need to find motivation, perspective, and often need assistance. The department's best professors should teach early courses and provide students with inspiration and goals for continued work in the area. The department should provide supplementary instructional support as needed.

3. Identify a faculty "course champion" for each core course in the curriculum.

Core courses are exceedingly important because they provide prerequisites for difficult specialty courses that follow. However, they often suffer because course standardization and quality control is difficult if multiple faculty members co-teach the curriculum. This problem is especially severe when adjunct faculty or graduate students teach some sections of core courses. Each core course should have a "course champion" who is responsible for the course, even if this champion does not teach it in a given semester. This person should be given significant authority over the content of the course, teaching methods used, testing and laboratories, and other aspects of instruction, and should be responsible for maintaining the quality of all sections of the course.

4. Implement an honors program if the department is large enough.

Much of the effort to increase graduates focuses on making marginally qualified students successful or on recruiting students who might not typically pursue degrees in engineering or computer science. Programs that are large enough to justify an honors program within the regular degree program should implement activities and opportunities to ensure that highly qualified students are not lost to the discipline because they miss challenges and inspiration. An honors program can give these students the best education possible.

5. Provide on-campus jobs rather than scholarships, at least to some students.

Many students don't seriously commit to their academic program because they also hold off-campus jobs that do not support their academic goals. On-campus jobs provide opportunities to learn about the student's discipline and get to know professors, staff, and other students. They bond the student-employees with the program, whether they involve working in a research lab or providing office support. The families of many low-income students expect them to have jobs, and those students are willing to risk their academic careers by working off-campus, even if they have scholarships. On-campus jobs avoid this problem.

Table 1 (continued)

6. Use specialized “camps” as a tool for both recruiting and retention.

Specialized camps for girls, for high achievers, or for minority students can be effective recruiting tools for computer science and engineering disciplines. “Redshirt” camps, i.e., camps for students between the freshman and sophomore years, have had good records as effective retention tools.

7. Use summer camps for high school students to fill the pipeline.

The experience of a summer camp can be extremely empowering to high school students by giving them the confidence that they have the ability to succeed in engineering or computer science and helping them prepare for a college culture. Involvement by industry representatives can introduce role models and ideas for future job opportunities. The program should use the resulting close-knit group experience to facilitate continuing contact between participants through web-based communication tools after the camp.

8. Increase enrollments by providing degree programs to non-traditional students.

In some areas of the state, there are large numbers of technology company workers who do not have degrees but would like to obtain them. Departments can in some cases significantly increase enrollments by tailoring programs specifically to their needs, e.g., by offering courses in the evenings, on-site, on-line, etc. Graduate engineers and computer scientists from these same companies may supplement the department’s faculty, often at low cost.

9. Reach out to high school counselors at least as aggressively as to mathematics and science teachers.

High school students are more likely to get guidance regarding higher education institutions and majors from counselors than from teachers. There is some indication that high school counselors often do not understand the benefits of degrees in engineering and computer science and recommend that good students pursue degrees in other areas. It is important that high school counselors have accurate and meaningful information.

10. Customize best practices to address the specific needs of your program.

Based on TETC’s experience with statewide implementation of the Infinity program, it is difficult to pick up an idea from one campus and duplicate it exactly at a number of other campuses. It is often the case that ideas will need to be “tweaked” to accommodate differences in students, faculty, curriculum, facilities, or schedules.

Highlights of Reported Project Results from TWD 2002

1) *Retention programs*

- The University of Houston-Victoria established a multipurpose tutoring and lab facility which energized and vitalized their program and gave its students opportunities to discuss and share their work with others. The institution increased its retention rate to a consistent 80-85 percent.
- The University of Houston developed preparatory camps for sophomores focused on student group work and novel problem-solving techniques which are applicable to any future class, research, and work situation.
- The University of Texas-Pan American found that offering part-time employment on-campus reduces conflicts with outside work, increases contacts with faculty and staff, keeps students on campus for longer periods of time each day, and increases graduation rates.
- The University of Texas at Austin was challenged by a large, temporary student-to-faculty ratio due to a rapid increase in entering students and used the project to address that issue as well as to increase retention by hiring a large number of teaching assistants and adjunct professors.
- Texas Tech University developed Web-based software tools to help students match their interest to college majors, learn how to learn, and quickly develop a schedule to optimize academic performance.
- The Texas Engineering Experiment Station (Texas A&M University) created Peer Teachers, i.e., students who are not involved with giving grades for the course and thereby provide a non-threatening mechanism for the tutored students to seek help.

2) *Recruitment programs*

- Texas State University-San Marcos established a branch campus specifically designed to give working professionals opportunities to seek degrees after hours.
- The University of North Texas used the grant to separate the typical introductory course into two different types – depth-first courses for majors and breadth-first courses for non-majors.
- The University of Texas at Dallas found an effective way to reach high school students by connecting with high school counselors in its in-state and out-of-state recruitment target areas.

3) *Scholarship or work study programs*

- Texas Tech University established a research program starting at the freshman level as one component of a quality undergraduate education.
- The University of Texas at Arlington established a successful student-initiated and student-led peer mentoring office.
- The University of Houston-Clear Lake built an endowment, *Texas Scholars in Computer Science*, to fund scholarships for transfer students.

4) *Curriculum revision*

- Lamar University mandated a new course “Think, Speak, Write” geared to counter incorrect perceptions about the field which can lead students to drop out early.

- Texas A&M University-Kingsville added a computer engineering option to its curriculum and leveraged the grant with almost half a million dollars in NSF follow-up funding for the program.
- Prairie View A&M University used grant funds to establish its new computer engineering program which has now grown to 70 enrolled students.
- The Texas Engineering Experiment Station (Texas A&M University) addressed teaching quality issues in a research environment by using senior faculty as “faculty champions” to enhance instruction of its gateway curriculum.
- Texas Tech University developed two new introductory courses to provide clear and honest introductions to electrical engineering and to allow immediate contact with its best teaching faculty.

5) *Outreach programs*

- About 100 high school teachers from more than 40 schools in 25 school districts from San Antonio and the South Texas region participated in The University of Texas at San Antonio’s teacher training program.
- The University of Houston orchestrated, over the years, 14 summer camps that taught high school girls engineering principles and problem-solving.
- The University of Texas at Austin created a lecture series with topics of current interest specifically targeted at middle school and high school students.

6) *Efforts to attract and retain underrepresented minorities*

- Lamar University created specific programs for female students implementing the full activity spectrum including reaching out to middle and high school girls, mentoring female students, and providing research opportunities to female students.

7) *Infinity program*

- Southern Methodist University (SMU) developed the Infinity Project and spearheaded its collaborative implementation under TWD with 14 project partners. In addition, the institution integrated engineering as one design for the first-year course curricula of multiple departments in the SMU School of Engineering.
- The Infinity curriculum supported new introductory courses at Baylor University, Lamar University, Prairie View A&M University, The University of Texas at Austin, The University of Texas at El Paso, and The University of Texas at San Antonio. Using Infinity for freshmen courses frequently resulted in a retention rate above 80 percent.
- Tarleton State University used the Infinity Project, and National Instruments’ ELVIS system donated hardware to equip its laboratories for a new computer science program and used the infrastructure for math and physical science instruction in general and for summer camps for high school students in particular.
- Texas Woman’s University built an Infinity classroom as an undergraduate research laboratory.
- The University of Texas at Arlington modified the Infinity curriculum and Infinity hardware to link with other laboratory instrumentation and to provide “hands-on” experiences with circuit components.
- The University of Texas at El Paso used the Infinity program for a pre-engineering course as well as a one-week summer orientation course for students planning to enter its electrical engineering program.

- The University of Texas at Tyler used its Infinity laboratory to train teachers from two collaborating area high schools.
- The University of Texas at Arlington combined Infinity and additional concepts which allowed beginning computer science and engineering students to connect to the real world and preview topics from their future, more advanced studies.
- St. Mary's University improved recruitment and retention through a new Infinity lab that it used for freshman education and outreach to high school students and teachers.

Technology Workforce Development Grants TWD 2003 and TWD 2005

The Coordinating Board announced the second cycle of grants, TWD 2003, for the Technology Workforce Development (TWD) grant program on October 30, 2003. The grant period started January 1, 2004 and ended August 31, 2007, as extended by the TWD Grants Program Advisory Committee on January 11, 2006. Twelve institutions received \$2.4 million in funding for 15 departments. Ten grants benefited departments of electrical engineering, and five grants benefited departments of computer science.

The TWD 2003 grants received \$363,000.15 in state funds and \$1,380,285.24 in industry donations. Industry also contributed, as in-kind donations, summer internships to TWD students valued at \$314,000. A portion of funds, \$656,664.61, came from the same congressionally directed grant to TETC through the U.S. Department of Education that also funded TWD 2002 grants.

The grant period for the funds from the Department of Education started on September 1, 2004 and ended August 31, 2006, according to a one-year time-extension granted by the U.S. Department of Education on June 30, 2005. (The federal grant had award number P116Z040302 under CFDA 84.116Z.)

The Coordinating Board announced a third cycle of grants, TWD 2005, on April 21, 2005. Fifteen institutions received \$3.58 million in funding for 19 departments. Fourteen grants benefited departments of electrical engineering, and 11 grants benefited departments of computer science. These grants started May 1, 2005 and will end August 31, 2008, as extended by the TWD Grants Program Advisory Committee on January 11, 2006.

The TWD 2005 grants received \$2,425,416.00 in state funds and \$350,000.00 in industry donations. A second congressionally directed grant to TETC provided \$801,866.17 for TWD 2005 grants. The grant period for the federal funds started September 14, 2005 and ended August 31, 2007, according to a one-year time-extension granted by the U.S. Department of Education on December 26, 2006. (The federal grant had award number P116Z050418 under CFDA 84.116Z.)

The second federal grant to TETC made possible the second TETC Best Practices meeting for the TWD Grant Competition. It was held on the campus of The University of Texas at Austin on March 6 and 7, 2007. Project leaders presented 21 papers in a symposium setting for discussion under the topic headings of "*Best Practices for Transition to College*," "*Best Practices for Retention*," "*Best Practices for Course/Curriculum Re-Design*," and "*Best Practices for Consortium Building*." The conference also features presentations by representatives of the Governor's Office under the headline "*State Initiatives for Developing the Engineering and Technology and Science Workforce*."

Table 2 of this document lists a 10-point summary of ideas classified as "Best Practices" from this conference. Some of the Best Practices were re-visited from the 2006 Best Practices meeting and are listed in part A of the table. Other Best Practices were introduced for the first time and are listed in part B of the table.

Table 2 **Ten Best Practices for Increasing Engineering and Computer Science Graduates, March 2007**

Part A Best Practices Revisited from the 2006 Best Practices List

1. Use peer teachers as a cost-effective retention and recruiting tool.

Peer teachers (undergraduate teachers/mentors/assistants) have proved to be remarkably effective at increasing the success rate of beginning students. There is some indication that these programs are most successful if students view them as primarily committed to student success and the peer teachers are independent of faculty and grading.

2. Provide on-campus jobs rather than scholarships.

Many students don't seriously commit to their academic program because they also hold off-campus jobs that do not support their academic goals. On-campus jobs provide opportunities for students to learn more about the discipline and get to know professors, staff, and other students. They bond the student employees with the program, whether they involve working in a research lab or providing office support. The families of many low-income students expect them to have jobs, and those students are willing to risk their academic careers by working off-campus, even if they have scholarships.

3. Identify a faculty "course champion" for each core course in the curriculum.

Core courses are important because they provide prerequisites for difficult specialty courses that follow and because they provide students with their initial impression of the discipline. These courses often suffer because course standardization and quality control are difficult if multiple faculty members teach these courses, which is usually the case. Each core course should have a "champion" who is responsible for the course, even if this person does not teach it in a given semester. This person should be given significant authority over the content, teaching methods used, testing, laboratories, and other aspects of instruction. He or she should be responsible for maintaining the quality of all sections of the course.

4. Use specialized "camps" as a tool for both recruiting and retention.

Specialized camps for girls, for high achievers, or for minority students can be effective recruiting tools. The experience of a summer camp can be empowering to high school students by giving them the confidence that they have the ability to succeed in engineering or computer science and helping them prepare for a college culture. "Redshirt" camps (camps for students between the freshman and sophomore years) have had good records as retention tools.

5. Implement an honors program if the department is large enough.

Much of the effort to increase graduates focuses on making marginally qualified students successful or on recruiting students who might not typically pursue degrees in engineering or computer science. Programs that are large enough to justify an honors program within the regular degree program should implement activities and opportunities to ensure that highly qualified students are not lost to the discipline because they miss challenges and inspiration. An honors program can give these students the best education possible.

Table 2 (continued)

6. Increase enrollments by providing degree programs to non-traditional students.

In some areas of the state, there are large numbers of technology company workers who do not have degrees but who would like to obtain them. Departments can, in some cases, significantly increase enrollments by tailoring programs specifically to their needs, e.g., by offering courses in the evening, on-site, on-line, etc. Graduate engineers and computer scientists from these same companies may supplement the department's faculty, often at low cost.

7. Customize best practices to address the specific needs of your program.

Based on TETC's experience, it is difficult to pick an idea from one campus and duplicate it exactly at a number of other campuses. It is usually the case that ideas will need to be "tweaked" to accommodate differences in students, faculty, curriculum, facilities, or schedules.

Part B Best Practices Introduced in 2007

8. Re-design courses and the curriculum as needed.

Both individual courses and the entire curriculum should be reviewed often to ensure that they are both relevant and appropriate for the students currently and potentially enrolled in the program. The course sequencing should be appropriate to motivate students. Courses and teaching methodologies should utilize current technology. Curricula should balance depth with breadth.

9. Reach out to high school counselors.

High school students are more likely to get guidance regarding higher education institutions and majors from counselors than from teachers. There is some indication that high school counselors often do not appreciate the benefits of degrees in engineering and computer science or the job market for students with these degrees. As a result, they recommend that good students pursue degrees in other areas. Take steps to ensure that counselors have accurate and relevant information.

10. Be forward-thinking in the use of instructional technology and instructional methods.

There is good evidence to suggest that today's students learn in different ways. They are more visually-oriented, they are more comfortable with computers and communications services, and they value collaboration more than competition. Institutions should adapt by using technology in instruction and adopting collaborative learning models.

Highlights of Reported Project Results from TWD 2003 and TWD 2005

1) *Retention programs*

- The University of Texas-Pan American created mentoring and learning communities to aid its freshman students with the transition to university life.
- The University of Houston continued its Redshirt Camps for sophomores. The camps provide experience with problem-solving techniques applicable to all future class, research, and work situations.
- Texas State University-San Marcos created an online tutoring and mentoring system for its Round Rock campus program for working professionals.
- The University of Texas at Tyler continued its now established tutoring and monitoring system and increased student participation by 27 percent.
- The University of Texas at Austin used the project to support and better train its mentors for the school's Freshman Interest Groups initiative.

2) *Recruitment programs*

- Prairie View A&M University and Texas A&M University-Kingsville awarded scholarships to transfer students from community colleges.
- Baylor University, in collaboration with Mary Hardin-Baylor College, created a distance-learning freshman-year engineering curriculum for use at small private and community-based colleges that do not have a pre-engineering program of their own.
- The University of Texas at Tyler incorporated a new, project-oriented "Hobby Shop" program into its curriculum and showcased the students' projects during open houses and visits to high schools.
- The University of Houston-Clear Lake worked jointly with San Jacinto College Central and South Campuses to improve the quality and increase the number of computing majors through mentoring centers at all three campuses.
- The Texas Engineering Experiment Station (Texas A&M University) conducted annual computer science contests for high school students.

3) *Scholarship or work study programs*

- Texas A&M University-Corpus Christi and Texas Tech University awarded undergraduate research fellowships to allow students to participate in research projects of computer science faculty members.
- Texas A&M University-Kingsville incorporated robotics into its introductory course and used graduate assistants to develop new lab exercises for smaller lab sections.
- The University of Texas at Dallas organized its mentor group into six sections targeting distinct topics, allowing the group to increase the scope of the program and reach more students.
- The University of Texas-Pan American provided on-campus jobs with the purpose of increasing retention through financial support, engagement with faculty, and reduced competition for student time from outside commitments.

4) *Curriculum revision*

- The University of Texas at San Antonio introduced a new hands-on laboratory course that emphasizes development of both written and oral communication skills.
- The University of Houston developed a hybrid course system where classroom lectures are recorded and posted online and the students attend classes only for discussions, quizzes, tests, and hands-on labs.
- The University of North Texas created interdisciplinary courses for the computational life sciences in bio-computing, bioinformatics, and computational epidemiology.
- Texas Tech University improved its freshman course by adding TWD-sponsored National Instruments ELVIS systems and laptop PCs to its hardware projects.
- The University of Texas at San Antonio developed a new introductory course in collaboration with faculty of San Antonio Community College.
- Texas Tech University leveraged its grant through collaboration with The MathWorks, Inc. and incorporated MATLAB as a significant component of its summer camp curriculum.
- The University of Texas at El Paso transformed 'gatekeeper' to 'gateway' courses by introducing cooperative learning labs that gave Hispanic and first-generation students positive outlooks on their education.
- The University of Texas at Austin established a National Instruments ELVIS equipped laboratory and is continuing its course restructuring for a more coherent circuit design program from the freshman through the senior year.

5) *Outreach programs*

- Texas Tech University made it possible for a high school teacher to develop engineering course projects at its department during the summer.
- Texas A&M University-Texarkana held a robotics training workshop for K-12 teachers and offered a high school robotics camp and competition.
- The University of Texas at Arlington gave scholarships to six of its students to mentor high school students at six schools on a weekly basis.

6) *Efforts to attract and retain underrepresented minorities*

- The University of Houston, the University of North Texas, and Prairie View A&M University held summer camps for high school girls and minorities which used robots to teach engineering principles and problem-solving.
- The University of Houston created a "WELCOME" support program involving working female engineers from the Houston area to serve as mentors and studied the importance of early access to such support programs.

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Technology Workforce Development Grants TWD 2006

In spring 2006, the Governor's Office committed \$1 million in federal Department of Labor grant funds to the Texas Engineering and Technical Consortium (TETC), enabling the Texas Youth in Technology (TYT) Demonstration Project. The Texas Higher Education Coordinating Board (CB) and the Texas Workforce Commission (TWC) signed an interagency cooperation agreement on March 15, 2005. Per the agreement, the 12-month grant period started March 15, 2006. A contract amendment between TWC and the CB, approved November 10, 2006 and signed on March 7, 2007, extended the grant period to June 30, 2007.

On March 24, 2006, the CB announced the upcoming competition on its Techworkforce website (<http://www.thecb.state.tx.us/AAR/Research/Techworkforce/>) and sent email notifications to TETC liaisons, institution representatives for sponsored projects, and previous project leaders.

The Technology Workforce Development (TWD) Grants Program Advisory Committee, consisting of eleven distinguished representatives of industry and academic members of TETC, guided the competition. The committee oversaw the creation of the program announcement and recommended that a) funding be capped at \$95,000 for each *Phase I* grant; b) pending approval of follow-up funding through TWC, awards include a *Phase II* extension with double the amount of *Phase I* funding; and c) each Texas institution be allowed to submit two proposals from eligible engineering and computer science departments or colleges.

Program components were 1) internship programs; 2) scholarship or work-study programs; and 3) recruitment, retention, and mentoring best practices programs. Project leaders were encouraged to collaborate with their local workforce development boards, community colleges, and/or independent school districts for outreach and recruitment of eligible students.

The CB issued the program announcement on June 1, 2006 by web posting, and sent email notifications to all eligible institutions. By the July 1 submission deadline, the CB received 25 proposals from 16 institutions, with a total request of \$6.5 million for *Phases I* and *II* combined. One review panel of out-of-state experts from academia and in-state and out-of-state industry technology leaders involved with workforce development discussed the proposals during two teleconference meetings, using the CB-developed web tool for proposal review. The panel ranked all proposals and recommended strategy changes. At its July 20, 2006 meeting, the CB approved funding of 11 projects in rank order for a program value of \$950,000 for *Phase I* and a potential \$1,899,709 for *Phase II* of the program.

The grants started August 1, 2006 and ended June 30, 2007.

All but one institution had *Phase I* awards close to the \$95,000 limit established by the TWD Advisory Committee. By the end of the grant period, the grantee institutions had expended 90.4 percent of their funding, or \$858,603.38. The CB received and expended \$50,000 for administration of the grants. Per agreement with the TWC, the CB will distribute the unexpended *Phase I* grant funds for *Phase II* projects until December 2007.

Highlights of Reported Project Results from TWD 2006

1) *Internship programs*

- The University of Texas at El Paso organized *Phase II* summer internships for 30 middle school students by working with the joint venture company NewTec.
- The University of Houston initiated an internship program with Schlumberger LTD, as reward for its mentors to high school students.
- Texas Tech University started a small internship program poised for expansion through cooperation with the WorkSource of the South Plains Development Board.

2) *Scholarship or work study programs and mentoring best practices*

- The University of Texas at San Antonio employed 20 work-study students within a highly structured program that allowed them to work on externally funded research projects.
- The University of Texas at El Paso Computer Science Department collaborated with the school's College of Education to introduce peer-led team learning into critical introductory courses.
- Texas Tech University employed 11 peer teachers to mentor about 200 freshmen during weekly tutoring sessions.
- The University of Houston-Clear Lake faculty regularly met with instructors at two community colleges, San Jacinto College Central and South, and set up three mentoring centers at the respective campuses staffed by students.

3) *Retention best practices programs*

- Prairie View A&M University created the institution's first design competition for electrical engineering, mechanical engineering, and computer science to increase student collaboration, offer leadership opportunities, and foster social skills.
- The Texas Engineering Experiment Station (Texas A&M University) previously pioneered a peer teacher system which is now widely copied by other institutions. The institution is using this grant for a formal assessment study.
- Texas Tech University implemented a pilot for a distance education course.
- The University of Texas-Pan American used an \$8,000 grant to create an activity program personalizing the transition to college for its many first-generation students.

4) *Recruitment best practices programs*

- The University of Texas at Austin negotiated with Austin Community College to achieve better preparation for the many transfer students between the two schools.
- The University of Texas at San Antonio faculty taught two courses for college credit in pre-calculus and physics to 15 students at San Antonio High School.

5) *Outreach best practices programs*

- The University of Houston initiated "Step Forward" with 21 undergraduate mentors supporting 63 high school students in Houston's Fifth Ward community.

- Texas Tech University students served as mentors for robotics, science, and technology activities at four elementary schools in Lubbock and also involved about two dozen West Texas middle and high schools from Abilene to Amarillo.
- The University of Texas at Austin continued its highly successful Edison Lecture Series for high school and middle school students and collaborated with the Round Rock Independent School District.

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Appendix A: Project Summaries from TWD 2002 Final Reports

Project summaries are from project leaders' annual reports to the Coordinating Board.

Computer Science Departments TWD 2002

Texas State University-San Marcos: *Enhance Computing Workforce & Provide Higher Education in Computer Science to Working Professionals*

The project strategy was to bring working professionals, a very large population in the Austin area, into the B.S. degree program in computer science. The institution implemented the strategy economically in collaboration with Austin Community College (ACC). The work completed under the grant between April 1, 2002 and March 31, 2007 included creating infrastructure at the Round Rock Higher Education Center (RRHEC), establishing the B.S. degree program accredited by the Accreditation Board for Engineering and Technology (ABET), establishing articulation agreements with ACC, adopting effective recruitment methods, maintaining high quality of the program, establishing relationships with industry, establishing a web-based online mentoring system, and employing efforts to enhance retention.

The University of Texas at Austin: *Target Diversity: Increasing Graduation Rates by Recruiting and Retaining Underrepresented Populations*

The department initiated outreach, recruitment, and retention programs aimed at under-represented populations by creating a "Pre-Computer Science" program. This was an effort to establish an introductory curriculum consistent with the guidelines proposed by the Association for Computing Machinery (ACM) Curriculum Report, and to provide a mechanism for quality control over admission into the computer science major. This program proved to be a key innovation in terms of both curriculum alignment and helping students acquire the necessary mathematical and technical foundations on which to become successful computer science majors. To provide proactive assistance, the department created mentoring programs as well as special study sections which are smaller and allow focused attention on helping students strengthen their academic skills before they enter the more challenging required courses.

University of North Texas: *Retention Strategies for Computer Science*

The implementation of this program has progressed through several phases and revisions since it was first funded in the Fall semester of 2002. The initial phase was to offer separate sections of the introductory course – one for majors and a different one for non-majors. The majors section of the course provided a comprehensive introduction to program structure and design, as well as developed skills in core programming using the C++ programming language, and included a relatively large component of the course devoted to writing and testing applications. Most of the funds had been expended prior to the 2005-2006 academic year, but the momentum created by the programs which began in the Fall 2002 has continued to carry progress and change forward into the current year.

Texas Tech University: *Efficient, Cost-Effective, Seamless Advising Process to Increase CS Graduates*

A system of Web-based software tools was developed to help students match their interests to college majors, learn how to learn, quickly develop a schedule with study times provided to optimize academic performance, and discover the value of sleep management on academic performance. The career-mapping tool can be used from about 12 years of age through adulthood and can be used as a recruiting tool at high schools and junior colleges. The system

did achieve growth in several departments in the College of Engineering that also used these tools.

University of Houston-Clear Lake: *Texas Scholars in Computer Science*

The institution established an endowment scholarship fund. The computer science department then produced promotion and marketing materials for the scholarships funded through the Texas Scholars in Computer Science program and established new and strengthened previously existing connections between the University of Houston-Clear Lake and its partner institutions. The project leader and his team carried out visits to the community colleges and high schools to inform potential students about computer science studies and the availability of scholarships.

The institution collaborated with the San Jacinto College District, the College of the Mainland, the Aerospace Academy for Engineering and Teacher Education, and the Clear Creek and Pasadena Independent School Districts.

University of Houston-Victoria: *Recruitment and Retention of Computer Science Students*

The program awarded six to eight \$500 scholarships each semester to students who worked as either mentors or tutors in the institution's labs in Victoria and Sugar Land or in the area of recruiting and publicity for the computer science program. This mentoring and tutoring activity created a very positive atmosphere for the program, especially in the Sugar Land location, and was instrumental in providing valuable help to many students in need of assistance in programming and other areas. Other grant-assisted activities include the Computer Science Contest, Math-Computer Science Awareness Day, and open houses for publicity and recruitment.

University of Texas at San Antonio: *Building Strategic Pathways to the Baccalaureate Degree in Computer Science*

The TWD grant proposed five strategies for improving the number and quality of The University of Texas at San Antonio computer science graduates: outreach, recruitment, retention, curriculum and laboratory improvement, and scholarships. All of the initiatives in the proposal were successfully implemented. Midway through the program, the scholarship program was converted to a scholar/mentor program. Career path development activities were introduced which included mandatory career services laboratories, a push for student participation in internships, and workshops on the latest technologies. The initiatives significantly increased retention rates and the quality of graduates from a workforce development perspective. The grant also enabled significant long-term infrastructure and curriculum improvements.

The institution collaborated with high school teachers from more than 40 schools in 25 school districts from San Antonio and the South Texas region.

Lamar University: *Study, Research, and Achievement in Lamar University Computer Science*

Lamar University's program established a new course entitled "Think, Speak, Write," designed to expose students to the breadth of computer science and help them develop an understanding of the collaborative process that is used to advance the field. LUCSWomen++, a program designed to develop and retain women in computer science, includes mentoring for undergraduate women and outreach to middle and high school girls. The Women in Research Development (WIRED) program involves and retains women by engaging them in robotics research and outreach programs.

The Association of Women in Computing, Houston Chapter, provided guest speakers for a Career Forums initiative of LUCSWomen++. Central Middle School, Port Neches Middle

School, and Nederland High School helped organize pilot summer camps for their female students.

Texas Engineering Experiment Station: *Increasing Computer Science Retention by Developing and Deploying Self-Paced Learning Modules*

The Department developed computer learning modules for both Texas A&M University and high school students. Modules were tested in half a dozen high schools and are slated for distribution across the state. The cost per student per module was designed to be low because a large number of students are expected to use the modules. This grant also started the institution's Peer Teacher program for freshman level courses as a retention project. This developed into a very well received initiative. During the first summer of the project the department offered Java computer language programming courses as aid to teachers seeking certification. However, teachers did not find it cost effective to relocate to College Station for a two-week summer course.

Electrical Engineering Departments TWD 2002

Project summaries are from project leaders' annual reports to the Coordinating Board.

University of Houston: *Undergraduate Retention and Recruiting of Electrical and Computer Engineering (ECE) Students at the University of Houston*

The Electrical and Computer Engineering Department (ECE) has sponsored 14 engineering GRADE (Girls Reaching and Demonstrating Excellence) Camps for female high school students since 2003. The girls learned engineering principles and problem-solving. They also applied their knowledge to programming, designing, and building a Lego robot, all within one week's time, that autonomously navigated a maze.

ECE also has sponsored Redshirt camps and workshops for sophomores every semester since 2002. ECE formulated a curriculum that required a significant amount of student group work. The goal for the camps was to give the students experience using novel problem-solving techniques that they can use for any future class, research, and work situation.

The institution collaborated with Houston Community College and with numerous Houston area high school teachers and students for its GRADE Camp.

The University of Texas at Dallas: *The University of Texas at Dallas School of Engineering and Computer Science – TETC Undergraduate Expansion Program*

The University of Texas at Dallas used three primary strategies during this period: 1) adding more classes in the summer to increase the number of students graduating; 2) holding information sessions in key cities across Texas in an attempt to increase enrollment in electrical engineering and computer science; and 3) recruiting out of state (Arkansas, Louisiana, New Mexico, and Oklahoma) concentrating on high school counselors. The huge downturn in the telecommunications industry drastically reduced the institution's predicted enrollments. The grant money alleviated the situation by allowing the institution to recruit more aggressively than otherwise possible.

The institution collaborated with high schools and high school counselors all over Texas, as well as some schools and counselors in Arkansas, Louisiana, New Mexico, and Oklahoma.

The University of Texas-Pan American: *Electrical Engineering Recruitment and Retention Enhancement*

The institution offered electrical engineering students part-time employment in the electrical engineering department in an effort to reduce conflicts with outside work, increase early contacts with faculty and staff, and encourage students to spend a larger fraction of their time on campus. Despite the fact that the department did not use any screening or selection process, e.g., did not consider the grade-point average of the students, participating students had significantly higher rates of first-year retention than non-participants. The cumulative success rate over the time of the grant was 88 percent. Over this period the institution saw a three-fourths increase in graduation numbers but a 20 percent drop in recruiting new students.

The institution sent a recruitment specialist to South Texas College, McAllen and Weslaco campuses.

Texas A&M University-Kingsville: *Expansion of the Electrical Engineering Program at Texas A&M University-Kingsville with Scholarships and Tutoring*

To increase the electrical engineering undergraduate enrollment and to offer a more updated curriculum, a “computer engineering” option was added to the electrical engineering curriculum and advertised to high school and community college students in South Texas. To recruit students, the institution offered scholarships to students who would be qualified to gain admission to the electrical engineering program and register as fulltime students. This also helped recruit students from Del Mar College, which has a cooperative two-plus-two program with the institution. A student tutoring program has been used to increase the retention rate.

Prairie View A&M University: *Increasing Electrical Engineering Program Enrollment: New Program, Increased Retention and College Transfer*

By 1998 the number of graduates with electrical engineering bachelor’s degrees had fallen 50 percent compared to 1987. However, programs with computer engineering did not suffer the dramatic enrollment decline. The main strategy of this project was to create a Computer Engineering program. Other strategies for this grant were to provide mentoring and tutorials, and offer scholarships to transfer students. The Computer Engineering program admitted its first students in June 2003. There were 15 students in the program in September 2003 and 70 students in September 2006. The program is fully integrated into the College of Engineering.

The institution collaborated with Richland College, Houston Community College, and CyFair College.

Texas Engineering and Experiment Station: *Enhancing the Quality and Quantity of Electrical and Computer Engineering Graduates*

This project has contributed to enhancing the retention of students in order to produce more graduates. This has been achieved by more efficient use of resources rather than by increasing enrollment. The strategies included both curriculum modifications to make it more appealing to students as well as use of a more participatory style of instruction, such as design studios, WebCT (Course Tools), and help desk. Participation of senior faculty in the gateway courses increased. The objectives of the project have been successfully achieved, with the peak number of graduates currently 60 percent higher than at the beginning of the project

The University of Texas at Austin: *Increasing and Improving Texas Capability in Electrical Engineering*

The aim of this project was to increase both enrollments and retention. Enrollments at The University of Texas at Austin are controlled by central admissions, with input from department targets. One-year enrollments increased from 400 to 480 but dropped in later years to previous levels. The large enrollment led to the graduation of about 280 electrical engineering bachelor’s

degree recipients in 2006, which was the largest graduation of electrical engineering students in the United States that year. This project allowed the department to act quickly to rectify a resulting large student-to-faculty ratio by hiring larger numbers of teaching assistants and adjunct professors – a measure that has been very successful in improving its retention rate. The department also leveraged the award with 12 new faculty positions. Another retention initiative that the project enabled is the Freshman Interest Groups, a method that allows groups of undergraduates to study together in a cluster of classes which results in greater social cohesion. Further work was done to enhance software engineering as a mechanism to attract more women applicants, including the new hire of women faculty, but it was observed that a revamped energy program under the topic of renewable energy generated a greater level of interest.

Texas Tech University: *Electrical Engineering Workforce Development at Texas Tech*

The institution implemented three strategies to improve recruiting and retention of electrical and computer engineering students. The strategies are 1) freshman curriculum development, 2) summer undergraduate research, and 3) tutoring and peer teaching. The first strategy addresses retention of incoming students in their first year impacting the entire freshman class. The second strategy concentrates on retaining students at all levels by offering paid opportunities for undergraduate research during the summer. The third strategy is aimed at retaining freshman and sophomore students by providing tutoring and peer-teaching services to help them succeed in math, chemistry, physics, and introductory electrical engineering courses.

The University of Texas at Arlington: *Recruitment and Retention to Increase the Number of Undergraduate Students in the Electrical Engineering Program*

Three strategies were originally proposed with a fourth strategy added later. The most successful strategy by far was the added strategy – *Students Mentoring Students*. Its overwhelming success was due to the leadership of the Institute of Electrical and Electronics Engineers (IEEE) Student Branch organization which conceived the strategy, and the desire of its leadership to help lower-level undergraduate students succeed in the program. Success was measured by the number of lower-level undergraduate students who sought help with their course work from the Mentoring Office. This added strategy was classified as a retention measure and impacted students primarily in the Entering and Progressing categories.

Infinity Project Participants TWD 2002

Baylor University: *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*

The grant initiated curricular reforms, best practices implementations, and course and faculty development between 2002 and 2004 that have positively impacted the retention rates of freshman engineering students at Baylor University. Retention is approaching 85 percent. Course development in *Introduction to Engineering* impacted many more students than reported on the TWD rosters, since the course is required of all freshman engineering students. Follow-on work in 2005 concentrated on course content innovation and alternate delivery and learning formats for this course. Positive results generated by this grant were key elements for a second TWD grant in 2005.

Lamar University: *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*

The institution implemented an Infinity Project curriculum as a three-credit, single-semester, freshman introductory course with the intention of improving recruitment and retention in electrical engineering. Over time, the department customized the course to fit with its mission and vision, and it added a set of National Instrument's ELVIS units. These labs emphasize fundamental and foundational concepts in electrical engineering. Since this project addressed a new course in the curriculum, sustainability is ensured. The department saw almost a doubling in both, the entering student population and in students retained. It will be graduating almost twice as many students (30) in 2007 than in 2001. While this improvement is not based on the TWD project alone, program implementation did have a significant effect.

Prairie View A&M University: *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*

Nationally, the retention rate for freshman engineering students is close to 48 percent. The main strategy under this project was to increase the retention rate of freshman electrical engineering students by using the Infinity Project curriculum. The course *Fundamentals of Electrical and Computer Engineering* was formally introduced in fall semester 2003. The Infinity Project kits equipped the laboratory facilities supporting the freshman class. The program is a success because the retention rate of freshmen students, who take the Infinity Project course, has increased beyond 80 percent.

The institution collaborated with Hempstead and Marshall High Schools.

Southern Methodist University: *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*

The institution implemented a joint effort to integrate engineering design in the first-year courses across the curricula of multiple departments in the Southern Methodist University School of Engineering. A modular design approach allows for student interaction and teaming across two different design exercises, and early exposure of students from each engineering discipline is emphasized. Survey results indicate that the intervention is helpful in promoting engineering design and inter-discipline awareness for the students.

St. Mary's University of San Antonio: *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*

This grant enabled the electrical engineering department at St. Mary's University to establish a modern, 16-station classroom/laboratory equipped with Infinity Project kits. As a result, the department was able to address the retention issue by introducing two one-hour courses entitled '*Introduction to Electrical Engineering/Computer Engineering*' to its freshman curriculum. These courses helped the freshmen become better prepared for the rigor of the degree plan. The grant also allowed the department to establish fun and interesting summer workshops for high school students and teachers to help attract and educate more students about the science and engineering fields. This grant provided tools to improve both recruitment and retention.

The institution collaborated with several high schools in San Antonio and with the Pre-Engineering Program (PREP) offered in San Antonio.

Tarleton State University: *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*

Tarleton's computer science program is relatively new. Part of the challenge involved in recruiting students to any technology field at Tarleton is the rural nature of the university and lack of exposure in the region to engineering and computer science professions. This sets the stage for a two-part problem: getting students and keeping them more than a year. The solution

that evolved as a result of Tarleton's participation in the TWD program was the use of summer camps as an outreach tool and the use of modern lab facilities, including the Infinity hardware and the National Instruments ELVIS systems.

Texas Engineering Experiment Station: *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*

The project allowed procurement of equipment for the department's Infinity laboratory and helped with additional installations of more advanced digital signal processing equipment. This laboratory was integrated into the electrical engineering curriculum, and students are extremely responsive to the high-stimulus activities. The department also uses the laboratory for public showcasing of senior students' design projects.

Texas Woman's University: *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*

The institution's Infinity classroom, equipped with 22 Infinity kits and software, provides high-end computers, printers, scanners, projection system, and sound system for use by department faculty and as an undergraduate research lab. Subsequent activities focused on curriculum development and revision to existing computer courses to attract and retain students. One summer class utilizing the classroom and curriculum was held for high school students, and future offerings are planned.

The institution collaborated with the Denton Independent School District and Texas Instruments.

The University of Texas at Arlington: *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*

The TWD grant money funded an additional lab component for the computer science and engineering departments' freshman sequence. This lab component is composed of the Infinity Project equipment and interface. The departments' implementation adds additional computer science and engineering-focused concepts for teaching software concepts. The combined lab allows beginning computer science and engineering students to connect to the real world and to glimpse topics from their future advanced studies.

The University of Texas at Arlington: *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*

The emphasis during years one and two involved implementation of the Infinity Curriculum for freshman- and sophomore-level "hands-on" training (in the Introduction to Electrical Engineering and Circuits 1 courses), demonstrations at various outreach days at the University of Texas at Arlington, and promotion of the Infinity curriculum at local high schools. Due to perceived shortcomings in the Infinity curriculum, such as no exposure to basic circuit components and standard laboratory instrumentation, the curriculum never became widely used. As a result, efforts in the third year and following years shifted to modifying the Infinity curriculum and hardware to provide improved "hands-on" experiences.

The institution collaborated with the Arlington and Mansfield Independent School Districts.

The University of Texas at Austin: *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*

The project helped the department introduce advanced topics into the undergraduate curriculum of the freshmen and sophomore years, making it more interesting and increasing retention. Curriculum changes also increased the number of hands-on exercises in laboratories. Students may check-out and use off campus a wide range of new kits and components. The department tried a number of such kits, some with more success than others.

In order to increase interest in applying to computer engineering programs, the department created the Edison Lecture Series and targeted it to middle and high school students. The aim of this program is to excite the students with the possibilities of careers in computer engineering. The program has exposed this material to about 15,000 students.

The institution collaborated with high schools and middle schools in the Round Rock and Austin Independent School Districts.

The University of Texas at El Paso: *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*

This project employed three strategies to increase electrical engineering majors: 1) high school assistance; 2) a pre-engineering course and one-week summer orientation course for students planning to enter the electrical engineering program; and 3) modification of the coursework for the introduction to electrical engineering class. Each strategy used Infinity Project curriculum materials developed at the Southern Methodist University. As a result of the first effort, two to three area high schools adopted an Infinity curriculum for their courses, and several others considered its adoption. The pre-engineering course was taught several times during the first years. This grant enhanced and funded the summer orientation for several years. The introduction to electrical engineering course and its associated lab were modified to include some Infinity materials. There was an increase in electrical engineering majors from 360 in fall 2001, to 445 in fall 2006.

The project leaders collaborated with Southern Methodist University, Dallas, TX, and Bowie and Riverside High Schools in El Paso.

The University of Texas at San Antonio: *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*

The main objectives of this grant were to offer the Infinity Project curriculum to freshman as part of an existing course as a means to 1) increase the freshman retention rate, 2) establish local expertise in the curriculum and technology, and 3) build the necessary laboratory facility to support the curriculum. The curriculum was introduced as a two-course sequence (one one-credit-hour course followed by one two-credit-hour course) at the beginning. Through the experience and feedback, the curriculum is now incorporated as a freshman-level, three-credit-hour course in the Electrical Engineering program, with more than 60 students during fall and spring semesters. A laboratory with 25 personal computers and National Instruments Speedy-33 digital signal processing hardware kits has been established, and about 10 projects are being conducted during the semester.

Project leaders visited with Judson High School and Health Careers High School.

The University of Texas at Tyler: *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*

The Infinity Project Laboratory was established with 16 workstations in the computer science department as a professional development center. It provided technical support and training for teachers from two regional high schools that offered the Infinity Project curriculum: John Tyler High School and Chapel Hill High School. A total of about 70 students benefited.

The Infinity Project curriculum was included as a section in the freshman seminar course that was taught for four semesters. One hundred and four students enrolled in these sections. The results of the Infinity Project were published at the professional meeting.

Appendix B: Project Summaries from TWD 2003 and TWD 2005 **Annual Reports**

Project summaries are from project leaders' annual reports to the Coordinating Board.

Computer Science Departments TWD 2003

Texas A&M University-Corpus Christi: *More Attention for Retention and Recruitment*

The major activities completed during this final year of the TETC grant include undergraduate research fellowships, recruiting, and retention. Thirty-seven undergraduate research fellowships were awarded to students conducting research with computer science faculty mentors in various areas ranging from networking to graphics. Successful retention and recruiting strategies were implemented.

The recruiting team visited the following high schools: Sinton, Tuloso-Midway, Miller, Gregory-Portland, Carroll, Moody, King, Ray, Mathis, Calallen, and Flour Bluff.

Texas Engineering Experiment Station: *Increasing Computer Science Retention with Peer Teachers and Learning Modules*

The Peer Teachers program at the Department of Computer Science at Texas A&M University had excellent success. The program entails having students, who recently took a course and earned a grade of A, participate as Peer Teachers to help with lab instruction and course assignments. The Peer Teachers are not involved in the grades for the course, thereby providing a non-threatening mechanism for students to ask any questions. This program was widened to include all of the computer science and math undergraduate courses. The institution extended the development of learning modules to additional courses.

Texas Tech University: *Integrated, Seamless, Education System to Recruit and Retain Students*

Work on this project was essentially completed during the previous year. The software for the SLEEP Model, a student time management tool, received a new interface and the variable light was additionally included. The institution is still evaluating the software tool Course Select for adoption as a tool across the college, pending completion of a software switch for its student records.

The University of Texas at Austin: *Recruiting and Retaining Computer Science Students (Turing Scholars Program)*

The Turing Scholars program was initiated as a new Honors Program for the Computer Science Department for about 40 to 50 competitively selected students from Texas per year. These students represent the best academically prepared students. The program had a profound and positive change on the department, its curriculum, and its faculty. The program's purpose is to compete with the nation's top computer science programs in attracting students. Its members graduate early, go on to top graduate schools or gain select employment offers, and include both the top academic graduate of the institution's College of Natural Science and its commencement speaker.

The University of Texas-Pan American: *Increasing Computer Science Graduates and Enrollment through Learning Communities and Outreach*

The Mentoring and Learning Communities program implemented a number of widely used techniques focusing on peer-led, small-group activities that address the challenges of building a

student community and providing student support. These techniques were tuned to the unique needs of students at The University of Texas-Pan American. The program's academically-focused elements supplement, coordinate, and refine existing university structures and programs with an emphasis on the needs of students entering computer science. Its social elements provided an important aspect in the often difficult transition to university life that is not supplied by existing programs. The program's techniques are applicable across a broad range of university populations.

Contacts were made throughout the year with high school teachers and counselors to describe the Mentoring and Learning Communities project for incoming students as they attended various university events, e.g., Computer Science Student Research Day, Hispanic Engineering Science and Technology Week, and the Computer Science Hands-On Programming Contest.

Electrical Engineering Departments TWD 2003

Prairie View A&M University: *Increasing the Quantity and Diversity of Students Pursuing Degrees in Electrical and Computer Engineering*

The objective of this project is to increase the electrical and computer engineering enrollment through 1) increasing the retention rate, 2) recruiting additional high school students, and 3) increasing the number of community college transfers. About 109 students participated in the Infinity Project course during the 2006-2007 academic year. The retention rate of the students who participated in the Infinity Project program was 75 percent during the 2005-2006 academic year. Ten scholarships were awarded to students who transferred from community colleges or four-year institutions into both the undergraduate electrical and computer engineering programs. The institution saw a record number of graduates during this academic year.

The institution worked with Hempstead High School on the Infinity Project course for its high school students. In addition, a teacher at the Hempstead High School served as one of the instructors for the department's Electrical and Computer Engineering Summer Institute.

The Project Leader visited Richland Community College twice during the academic year to recruit students from its Associate Degree in Engineering track.

Southern Methodist University: *SHinE: Strengthening Hispanics in Engineering*

The objectives for the project during fall 2006 and spring 2007 primarily involved tutoring at-risk students in calculus and signals and systems, as well as mentoring by peers. Though student leaders from the Society of Hispanic Professional Engineers were initially excited about tutoring and mentoring other students, the interest ultimately did not culminate in a mentoring and tutoring program.

Texas A&M University-Kingsville: *Expansion of the Electrical Engineering Program at TAMUK with Scholarships and Tutoring*

The institution continued to work on recruiting and retention to increase electrical engineering undergraduate enrollment. To recruit students, scholarships were offered to qualified student from the Del Mar College students registered full time. Del Mar College has a two-plus-two program with Texas A&M University-Kingsville. To increase the retention rate, the institution continued its student tutoring program.

The institution collaborated with Del Mar College and Texas A&M University-Corpus Christi.

Texas Engineering and Experiment Station: *Improving the Quality, Quantity, and Diversity of Electrical and Computer Engineering Graduates*

Curriculum and quality of instruction enhancement were adopted as a core strategy that resulted in more intensive involvement of research-active faculty, investment from the department and the college, and an increased emphasis on undergraduate education. This produced an increased number of graduates. Design and implementation of the strategy required, at least in the beginning, release time for faculty and graduate assistant support. Curriculum redesign took into consideration the talent spread of students and feedback from the Accreditation Board for Engineering and Technology (ABET) process loop. The philosophy of “understand and apply” rather than “memorize and reproduce” was central to the effective curriculum redesign.

Texas Tech University: *Electrical Engineering Recruitment and Retention at Texas Tech*

The institution used three strategies to increase its recruitment and retention of students: outreach to high schools through pre-engineering course development, undergraduate research, and freshman curriculum improvement. During the past year, a high school teacher was selected to spend summer 2007 with the department learning about engineering course projects that could be suitable for high school students. Texas Tech expanded this project’s summer undergraduate research program and now also supports students during the academic year. In addition, the school improved its freshman course by adding TWD-sponsored National Instruments ELVIS systems and laptop computers to its hardware projects. The project supported graduate student assistants who led discussion sessions.

University of Houston: *Undergraduate Retention and Recruiting of Electrical and Computer Engineering Students at the University of Houston*

The department has sponsored 16 engineering GRADE (Girls Reaching and Demonstrating Excellence) camps for more than 400 female high school students since 2003. The girls learned engineering principles and problem solving. They also applied their knowledge to programming, designing, and building a Lego robot, all within one week’s time, that was able to autonomously navigate a maze.

The Electrical and Computer Engineering department has sponsored Redshirt Camps and workshops for sophomores every semester since 2002. The department formulated a curriculum that requires a significant amount of student group work. These camps give sophomores experience using novel problem-solving techniques that they can use for any future class, research, and work situation.

The institution collaborated with Houston Community College and numerous Houston area high schools for its GRADE Camps.

The University of Texas at Arlington: *Recruitment and Retention to Increase the Number of Undergraduate Students in the Electrical Engineering Program*

The department followed through with three strategies. To improve recruiting, the project leaders partnered with local high schools to conduct electrical engineering demonstrations and information booths during College Days. The institution also coordinated curriculum content with its feeder community colleges. To improve retention, the institution paid hourly wages to mentors in its student-managed mentoring office. Student mentors averaged 270 contact hours per semester aiding students taking 21 different courses, including three critical non-major courses. Mentors conducted reviews for mid-term and final exams for 11 courses. Most of this effort was directed at the freshman and sophomore level courses where students are most academically vulnerable.

The University of Texas at El Paso: *Creating Learning Communities at UTEP to Increase Throughput*

This project developed a learning community environment that supported active learning for sophomore students enrolled in two required gatekeeper courses, *Digital System Design I* and *Electric Circuits I*. The project affected a majority of the Hispanic and first-generation students. Active and cooperative learning approaches involved students in newly created two-hour-long weekly laboratories focused on peer learning. Peer facilitators assigned to each laboratory reported on the effectiveness of each session and suggested any improvements needed for future sessions. This project transformed these 'gatekeeper' courses to 'gateway' courses allowing numerous benefits: students earned higher grades by adopting better learning strategies, and they developed positive outlooks on their education as well as their future careers as engineers.

The department collaborated with its institution's Department of Education.

The University of Texas-Pan American: *On-Campus Jobs for Electrical Engineering Retention*

During the 2006-2007 academic year, the institution completed its on-campus job program, which provided part-time electrical engineering related employment to current students, in order to improve retention through financial support, engagement with faculty, and reduced competition for student time from outside commitments. Since this was the final phase of the project, participants were primarily students who had been supported during the previous year. The one-year retention numbers for the program continued to exceed 90 percent and the long-term retention for electrical engineering majors over the three-year period was approximately 85 percent.

The University of Texas at San Antonio: *Improving Retention in Electrical Engineering Using Programmable Logic Devices*

The department introduced a new course, Logic Design Laboratory, starting in fall 2006. This new course consists of eight laboratory assignments, a mid-term project, and a final project. It provides hands-on experience with state-of-the-art tools for building digital circuits using discrete integrated circuits (IC) chips and programmable logic devices-based development kits. Students are required to write reports and formally present their final project, cultivating both written and oral communication skills. Forty-four students have taken the course during the first academic year. Students enrolled in fall 2006 were able to perform better in a subsequent class.

Computer Science Departments TWD 2005 Best Practices Projects

University of Houston-Clear Lake: *Minority Oriented Recruitment Effort in Computer Science – MORE-CS*

University of Houston-Clear Lake worked on three strategies: 1) creation of a summer experience for high school juniors, 2) development of a rapid prototype software development course with teaching modules and lesson plans for middle schools, and 3) development of a teacher training summer program for the software development course. The institution completed the course materials and will offer teacher training in summer 2008. The summer experience for high school students also will be offered in summer 2008.

The institution collaborated with the Clear Creek Independent School District and the Westbrook Intermediate School. It also worked with the College of William and Mary, the University of Wisconsin-Madison, and the University of Michigan-Ann Arbor.

Texas A&M University-Texarkana: *Operation Bootstrap*

In summer 2006, Texas A&M University-Texarkana offered the second annual Robotics Training Workshop for K-12 teachers. These teachers were exposed to new ideas about teaching math, science, and engineering concepts and how robotics can provide a student-friendly teaching tool. Also, the department offered its second annual Robotics Camp on July 10-21, 2006, culminating in a robotics competition that generated public interest. The department continued to offer scholarships to qualified computer and information system students.

The institution collaborated with Texarkana, Pleasant Grove, and Liberty-Eylau Independent School Districts and with Texarkana College for recruitment into its Operation Bootstrap Scholarship program.

Texas State University-San Marcos: *Enhance Computing Workforce & Provide Higher Education in Computer Science to Working Professionals*

The institution's strategy is to bring working professionals, a very large population in the Austin area, into their computer science baccalaureate program. It implemented the strategy economically in collaboration with Austin Community College. The work completed under the grant during fall 2006 and spring 2007 focused on retention, recruitment, and establishment of relationships with industry. With the support of industry professionals, the institution established both a web-based online tutoring system and a web-based online mentoring system. The institution also prepared a new brochure for promotion of this program for working professionals.

The institution collaborated with Austin Community College.

University of North Texas: *Recruiting and Retention Strategies for Computer Science at UNT*

The department offered a second round of its successful Robocamp series for 9th- to 11th-grade young women in North Texas during summer 2006. It completed two five-day camps, one each at the University of North Texas Denton and Dallas campuses. Twenty young women attended each camp. The institution also continued its Computer Science Eagle (CSEagle) Ambassador/Mentor program, with 12 students serving and receiving scholarships. The students attended more than 15 recruiting and visitation activities, and each student mentored from one to three freshman women in computer science and computer engineering.

The institution worked with Girl Scout councils in Denton and Dallas Counties, as well as with staff at the University of North Texas Dallas campus. It is currently discussing camps with several area school districts for next year.

The University of Texas at Arlington: *Expansion of CSE @ UTA Robot Programming Contest to Increase Computer Science and Engineering Recruitment*

This project used robotics in a way that motivates students, that is affordable and easy for high school teachers to implement, and with projects that increase students' interest in engineering and computer science. The project emphasized largely minority schools and provided incentives to minority and women teams by providing additional robot kits to schools that field such teams. During the 2006-2007 academic year, the school awarded over \$8,000 in scholarships to participants, created the Robot Programming (RoPro) College Challenge Camp for summer 2007, and held its seventh annual RoPro Contest with 20 registered teams from 11 participating high schools competing in three different robot contests. The project leader was pleased and amazed at the high quality work the participating high school students produced.

The University of Texas at San Antonio: *Developing Computer Science Career Paths*

The department successfully implemented five strategies for improving the number and quality of its computer science graduates. These include outreach to high school teachers, student recruitment from local high schools, tutoring in the introductory computer science

courses, advising and career path development, and mentoring. The outreach and recruitment efforts did not increase the number of incoming computer science students, but the decline in numbers for this program was much lower than the nationwide decline. The tutoring and mentoring strategies improved retention and graduation rates in computer science relative to total enrollments. Advising and career path development prepared computer science students for successful careers in the high tech industry.

The institution collaborated with Madison, La Hoya, and Churchill High Schools.

Computer Science Departments TWD 2005 Innovative Projects

Texas Engineering Experiment Station: *Innovative Programs to Increase the Enrollment in Computer Science*

The Department of Computer Science at Texas A&M has implemented two strategies to address recruitment and retention: 1) development of an annual computer science contest for high school students, and 2) a new one-credit seminar course that includes speakers from industry and academia talking about how computer science concepts are used in end products and research. Both initiatives aim to demonstrate that the computer science curriculum is not limited to programming; but that it includes a solid foundation in algorithms, computer systems, and software. The initiatives showcase topics such as robotics, artificial intelligence, and human-computer interfaces. Topics change every year. The department added a recruiting video for its outreach to high schools.

University of Houston: *Online/Classroom Hybrid Computer Science Program: A Pilot Project*

The project centered on *Hybrid Courses*, where classroom lectures recorded on tablet computers are made available online, and students attend class only for discussions, quizzes, tests, and other hands-on aspects of learning. The goal is to increase flexibility. This year, the department focused on detailed assessment and improvement of the technology, establishment of best practices, and dissemination to a wider audience. The approach proved to be successful and appealing to students. The feature with the maximum potential impact turned out to be good indexing of lecture videos, and that is the focus for current development.

Project leaders are in discussions with the University of Houston-Downtown, Texas Southern University, and Houston Community College about the possibility of using the technology developed in this project in those institutions' beginning computer science courses.

University of North Texas: *Improving Student Recruiting and Retention through an Interdisciplinary Computer Science Curriculum*

The department offered for the second time its "Introduction to Computational Sciences" course in spring 2007 and also will continue to offer the course "Bio-Computing." In addition, interest in the interdisciplinary areas in the computational life sciences spawned one graduate class in "Bioinformatics" and another in "Advanced Computational Epidemiology." The department established a scientific visualization lab to provide a facility for students interested in this area as well as to complement work in the computational epidemiology research lab. Finally, project leaders presented a paper discussing the results at the TWD Best Practices conference in 2007.

Several area school districts showed interest in these courses, and the Governor's Office is considering possible inclusion of these topics in the Texas Science, Technology, Engineering, and Mathematics (T-STEM) Academy projects. The work also generated interest and contacts with several Public Health departments throughout Texas, and this contributes to increased research opportunities for students.

The University of Texas at Arlington: *Webtronics Competition for Recruitment and Retention in Software Engineering*

The institution provided retention scholarships to three continuing undergraduate students and three additional scholarships to minority students to enroll in the fall of 2007. The department organized a “Webtronic” competition event in Dallas at the end of which the project leaders communicated with minority students, teachers, and parents.

The University of Texas at Austin: *The Science of Computing Recruiting Road Shows*

The department developed a number of “road show” presentations oriented towards middle and high school students to encourage their interest in computer science. The project allowed the design of several “props” for the demonstrations, such as the “suitcase computer” that is a disassembled personal computer with all internal components visible, the “dissected iPod” mini audio player, or the robotic “soccer dog” programmed to play soccer with a pink ball on a blue matt. The department took the show to Austin area middle and high schools as well as to McAllen, Port Aransas, San Antonio, El Paso, and Houston.

Electrical Engineering Departments TWD 2005 Best Practices Projects

Prairie View A&M University: *Increasing the Graduating Rates of Electrical and Computer Engineering Students: Integrated Recruitment and Retention Approaches*

The objective of this project is to increase the electrical and computer engineering enrollment through: 1) increasing the retention rate, 2) offering summer camps for high school students, and 3) awarding scholarships to transfer students. To keep the retention rate high, the department offered the Infinity Project course to its freshman engineering students. To recruit, it offered scholarships to transfer students. Furthermore, the institution conducted an engineering camp, and 19 high school students participated with more female students than in previous years.

The institution worked with Hempstead High School on an Infinity Project course for its high school students. In addition, a teacher at Hempstead High School served as one of the instructors for the department’s Electrical and Computer Engineering Summer Institute.

The Project Leader visited Richland Community College twice during the academic year to recruit students from its Associate Degree in Engineering track. In addition, the school is in discussions with administrators of Cy Fair College, about 25 miles west of Prairie View, to establish a pre-engineering program at this community college.

University of Houston: *Undergraduate Retention and Recruiting of Electrical and Computer Engineering Students at the University of Houston: Best Practices*

The Electrical and Computer Engineering department has sponsored Redshirt Camps and workshops for sophomores every semester since 2002. The department formulated a curriculum that requires a significant amount of student group work. These camps give sophomores experience using novel problem-solving techniques that they can use for any future class, research, and work situation. The department also restructured its Introduction to Computing and Problem-Solving freshman course with TWD best practices techniques.

Texas A&M University-Kingsville: *Expansion of the Electrical Engineering Program at TAMUK with Curriculum Reformation, Scholarships and Tutoring*

The department’s faculty continued to recruit at regional high school events. They continued to show and distribute to high school students the promotional CD designed last year by the department with support from this project. In addition, they further revised and updated

the department web page to increase student interest and aid recruitment. The project leader is implementing changes to the *Introduction to Electrical Engineering* course as a result of best practices studied during the TETC Best Practices conference in Austin and the American Society for Engineering Education Gulf Southwest Section annual conference at South Padre Island. Changes include special software tools for basic programming and Lego Mindstorm NXTs systems. The project leaders modified the course structure to allow smaller lab sections for enhanced student learning, and graduate assistants developed new lab sessions and exercises. Incoming electrical engineering freshman continued to receive scholarships under the project, and the project's support for tutoring undergraduate electrical students also continued.

Texas Tech University: *Recruiting and Retention Efforts to Increase Electrical and Computer Engineering Graduates*

The department pursued three strategies with its project: scholarships, peer tutoring, and undergraduate research. The undergraduate research program which was first established with funding from previous TWD awards is continuing. Fourteen undergraduate students participated in undergraduate research during the past year. The institution offered nine scholarships funded with this grant to new students, and they joined the department in fall 2006. In spring 2007, the department's scholarship committee awarded 16 scholarships to high school and community college students with offers to join the department in fall 2007. The department set up a dedicated tutoring office to help students in calculus, physics, chemistry, and all core courses in electrical engineering.

The University of Texas at Austin: *Use of Freshman Interest Groups to Improve Student Graduation at UT Austin*

Freshman Interest Groups are a proven way to enhance retention of undergraduates, and they are well established in the institution's school of engineering. However, given its size, the project leader states that not nearly enough students are exposed to this facility. This project improved upon this initiative. It allowed better support and training for the school's Freshman Interest Groups-mentors so they that they provide better support to the students.

The University of Texas at Dallas: *UTD School of Engineering and Computer Science – TETC Undergraduate Expansion Program*

The school continued the two main aspects of its proposed program, mentorships and scholarships. Mentors worked up to 10 hours per week and received up to \$1,000 per semester or up to \$750 for the summer. The program organized mentors into six groups with designated meeting places and times in order to increase the scope of the program and reach more students. The six groups' topics were calculus, discrete math, advanced math, programming, upper-level computer science, and upper-level electrical engineering. The grant also allowed the funding of 12 scholarships.

The University of Texas at San Antonio: *A Repeatable and Reproducible Approach for Improving Retention and Graduation Rates of Underrepresented Minorities and Women in Electrical Engineering*

The project sought to increase recruitment and retention and to better the preparation of underrepresented Hispanic students through pedagogical best practices such as the "key and gatekeeper" course concept. The department redesigned the curricula for its *"Introduction to Engineering"* and *"Random Processes"* courses and is evaluating the effects longitudinally. *Introduction to Engineering* was developed together with San Antonio Community College and evaluated by the entire faculty. The new course includes field trips to companies that hire the institution's electrical engineering students. The department added a summer math workshop

for high school teachers and counselors from economically depressed school districts in San Antonio. The institution leveraged the TWD grant with industry equipment donations and used it as matching support for a U.S. Department of Education grant.

The University of Texas at San Antonio created an articulation agreement with San Antonio College for course and evaluation alignment between the institutions.

The University of Texas at Tyler: *Back-to-Basics: A Student-Tutor Matching Scheme*

The Back-To-Basics tutoring/mentoring program functioned smoothly through its second academic year. Tutoring sessions were held in the following subjects: Introduction to Engineering; Calculus I and II; Differential Equations; Physics I and II; Chemistry I; Programming; MATLAB; Digital systems; Linear Circuits; and Statistics. The institution made no major changes except to replace tutors who graduated. Eight tutors worked up to 20 hours per week in the 2006-2007 academic year supporting freshmen and sophomores in the specified subject areas. Participation in the program was 27 percent higher than in the 2005-2006 academic year, even though the electrical engineering enrollment at The University of Texas at Tyler did not change from one year to the next.

Electrical Engineering Departments TWD 2005 Innovative Projects

Baylor University: *Attracting Engineering Majors from Community and Small Private Colleges*

The project team has created two distance-learning courses, *Introduction to Engineering* and *Introduction to Engineering Analysis*, that cover freshman-year introductory engineering materials and target students enrolled at small private and community-based colleges. Most of these institutions have no pre-engineering curricula. Without a curriculum that attracts students and enables them to investigate the correlations between their interests and the engineering disciplines, many capable students are lost to the engineering profession.

In 2006 and early 2007, the team completed initial development and beta-testing of these courses at the University of Mary Hardin-Baylor, in cooperation with that university's computer science faculty.

University of Houston: *Retention of Female Undergraduate Electrical and Computer Engineering Students at the University of Houston*

The WELCOME (Women in Engineering Learning Community for Maximizing Excellence) program funded by this grant continues to attract new participants. The most successful new initiative was the addition of two retreats for students and mentors, an idea which came from the student advisory board. The mentoring programs continued to grow, and the school invited additional working female engineers from the Houston area to serve as mentors. The school also leveraged the grant to obtain additional funding to study female engineering students' experiences and how various factors influence their persistence. The study found that the WELCOME program has a positive impact on the participants' sense of belonging, and also that early access to this support program is important to their success.

Texas Tech University: *WE CAN: Women in Engineering: Curriculum, Applications, and Networking*

During June 2006, the school held its first WE CAN Summer Camp at Texas Tech University for female high school juniors with nine participants from Houston, Dallas, and West Texas. In the fall, results from the camp were presented at conferences, additional funding to cover food expenses was acquired, and arrangements for the 2007 WE CAN Summer Camp were made. Preparations included advertising the camp, an effort that continued during the spring. Due to

lack of enrollment, the department had to cancel the 2007 camp. The project also provided a teacher training workshop which was attended by two math teachers.

The department leveraged the grant in collaboration with The MathWorks, Inc. and incorporated MATLAB as a significant component for the summer camp curriculum.

The University of Texas at Arlington: *Innovative Strategies to Establish a Pipeline with Local School Districts*

The project provided scholarships to six university students to participate in Project Lead the Way. The students worked as mentors/instructor assistants at six high school campuses within the Arlington Independent School District for at least two hours per week per student. Their work involved assisting high school students one-on-one with projects in their sophomore- and junior-level “*Digital Electronics*” class or giving presentations on engineering. Student mentors also gave course lectures on occasion. The project leader lectured and critiqued student presentations. High school students visited the College of Engineering on tours and for discussions. Over 150 high school students participated.

The primary collaboration was with the Arlington Independent School District Career and Technology Education Office and with the six targeted high schools.

The University of Texas at Austin: *Development of Course Modules to Enhance Retention and Graduation Rates*

It is clear that retention of students is at least partly associated with the provision of interesting and educational laboratory exercises. Too much emphasis on theoretical vs. hands-on work had led to dwindling interest in the engineering curriculum. The project allowed the installation of a National Instruments ELVIS-equipped laboratory that is accessible around the clock. The equipment is extremely useful as a prototyping platform for use in undergraduate classes and will allow, through continuing course restructuring, a more coherent circuit design program from the freshman through senior years.

The University of Texas at Tyler: *Introducing the Design and Development Lab “The Hobby Shop” to Increase Retention of Electrical Engineering Students*

The 2006 academic year was the first year the Hobby Shop was integrated into the electrical engineering curriculum, i.e., into “*Electrical Engineering I*” and “*Electrical Engineering 1201*,” as planned in the original proposal. The Hobby Shop initiative provided semester-long projects. Hands-on experience included workshops on electronic circuits soldering, design and fabrication, circuits testing, and troubleshooting. The Hobby Shop was the center of the department’s open house to high schools, and Hobby Shop students also held a successful one-day exhibit of their projects in December 2006 at the only math and science magnet school in the area, Moore Magnet Middle School.

The institution is currently working on an expanded proposal for a project that would include several community colleges and one other state institution.

Appendix C: Project Summaries from TWD 2006 Phase I Reports

Project summaries are from project leaders' annual reports to the Coordinating Board.

Prairie View A&M University: *Recruitment and Retention Programs for the Department of Electrical and Computer Engineering*

The project had two objectives: 1) offer mentoring work study positions to provide role models within the department of electrical engineering; and 2) promote interaction between freshmen, sophomore, junior, and senior students through a design competition. The first objective was addressed with the First Year Initiative (FYI) that helped transitioning high school and transfer students through their first year and the Year Two (Y2) program that helped students to continue with engineering through their major-specific course options. The grant supported these programs with \$500 scholarships and undergraduate teaching assistant positions for tutors and mentors. The program formed a collaborating cohort of students that met regularly and frequently. The second objective was the Electrical and Computer Engineering Design Competition (ECEDC) which was intended to increase retention through increasing communication, team collaboration, social skills, and leadership opportunities. Three teams participated in the institution's first design competition.

The department collaborated with the mechanical engineering and computer science departments on the design competition.

University of Houston: *Step Forward: Preparing Low-income High School Students for Academic Success in Electrical and Computer Engineering at the University of Houston*

The "Step Forward" program was initiated in the fall 2006 semester. The program was designed to provide low-income high school students with 1) mentoring; 2) activities that promote math, science and engineering; and 3) internships. Step Forward Scholars from the institution's Cullen College of Engineering are majors in electrical and computer engineering and serve as mentors to high school students throughout the academic year. During the initial semester, the program supported 63 students in Houston's Fifth Ward community with 19 student mentors. Twenty-one mentors were working with the high school participants during spring 2007, the second semester. In addition, Step Forward Scholars mentored the students of the Wheatley High School FIRST Robotics team. As part of the program, Schlumberger provided one of the mentors with an internship.

The institution collaborated with the Houston Independent School District (Phillis Wheatley High School) and Schlumberger LTD.

University of Houston-Clear Lake: *Computer Science Scholars: Recruiting, Retention, and Mentoring*

The institution focused on recruiting and mentoring. For recruiting, the project participants prepared informative visuals, visited targeted classes of area high schools, and participated in high school recruiting events. For mentoring, the project created a mentoring center at the grantee institution staffed by five student mentors, and one center each at two San Jacinto College campuses. Each of these two-year institutions employed two mentors for their center. Students and faculty at all three campuses enthusiastically embraced the mentoring program. This and previous TWD projects at these institutions led to regular joint meetings by the three groups of faculty members to discuss progress, brainstorm, and initiate a variety of innovative ideas.

The institution collaborated with two community colleges, San Jacinto College Central and South.

Texas Tech University: *Integrated Outreach, Mentoring, and Placement of Texas Youth in Engineering Careers*

The institution started filling the pipeline of future engineering students through three major outreach activities: 1) Get Excited About Robotics (GEAR); 2) Boosting Engineering, Science, and Technology (BEST); and 3) For Inspiration and Recognition of Science and Technology (FIRST). The project involved both Texas Tech engineering students and high school graduates as mentors for these programs. The department teamed up with numerous institutions and individuals that helped facilitate these efforts. Also, the program started a modest internship program that now has opportunities to expand through a cooperative program with WorkSource of the South Plains.

The institution collaborated with Lubbock elementary schools Roscoe Wilson, Harwell, Ramirez, and Lubbock Cooper and also with approximately 25 West Texas junior high and high schools from Abilene to Amarillo. It collaborated with the Maxey Community Center and the Texas Tech University Center for Engineering Outreach, the Texas Tech University Institute for the Development and Enrichment of Advanced Learners (IDEAL), and with WorkSource of the South Plains Development Board.

Texas Tech University: *Curricular Development, Multidisciplinary Team Internship, and Undergraduate Peer-Mentors for West Texas Students*

This project supported the employment of 11 undergraduates as peer tutors and three more as student assistants. About 200 freshmen received weekly peer-tutoring for the course Introduction to Electrical and Computer Engineering. The department also secured equipment to support freshman course curriculum development and implemented a distance education course pilot study. The project laid the groundwork for its summer internship activities in recruiting students and industrial mentors for *Phase II* of the grant.

The institutions collaborated with South Plains College and Midland College.

Texas Engineering Experiment Station: *Assessment of Computer Science at Texas A&M University Peer Teachers Program*

The institution coordinated and began a formal assessment process of the Peer Teachers program in the department of computer science. The process entails assigning Peer Teachers to only a limited number of sections in given courses. This allowed project leaders to compare the grades of the students in the sections with Peer Teachers to those in sections without Peer Teachers. This assessment procedure began during fall 2006 with 10 Peer Teachers for three freshman courses. Each peer teacher was assigned to only half of the total number of sections in each course. The assessment will be completed during Phase II of the project, taking into account all computer science courses and for all freshman, sophomore, junior, and senior level courses.

The University of Texas at Austin: *Increasing the Applicant Pool and Retention in Computer Engineering*

The institution engaged a large number of undergraduate tutors to support mentoring and retention issues for its undergraduate students. The department also negotiated with Austin Community College to determine how to best prepare their students for transition to The University of Texas at Austin. The project allowed organization and management of the department's third Edison Lecture Series. The emphasis of the series was renewable energy, and it was aimed at stimulating enthusiasm for careers in engineering in middle and high school students.

The institution collaborated with Austin Community College and with the Austin and Round Rock Independent School Districts.

The University of Texas at Dallas: *Jonsson School Undergraduate Scholars Program*

The project awarded stipends for students who participated in a variety of activities such as outreach, mentoring, and research. Outreach activities were reserved for freshman students, mentoring activities for sophomores, and research activities with the department's faculty for juniors.

The University of Texas at El Paso: *Reaching Out Across Disciplines: Learning from Each Other to Produce More Graduates in Computer Science*

The institution put in place two strategies: 1) a peer-led team learning component for its introductory course sequence for computer science majors, and 2) a comprehensive internship experience program. For the first objective, the project trained student peer leaders, followed by weekly peer leader work sessions, to provide timely assistance to students learning difficult topics. The department is working on posting publicly a repository of the peer learning workshops on its website. For the second objective, the department made preparations for its *Phase II* summer internship program involving undergraduate peer facilitators and 30 middle school students.

The Computer Science Department together with the grant's co-lead, the College of Education of The University of Texas at El Paso, collaborated with NewTec, a joint venture company that includes members Computer Science Corporation, Lockheed Martin, Northrop Grumman, and Trax International.

The University of Texas-Pan American: *Increasing Engineering and Computer Science Retention through Mentoring and Learning Communities*

The University of Texas-Pan American Mentoring and Learning Communities program provided activities that: 1) introduced participants to the university's culture and processes; 2) provided ongoing tutorial support; 3) created opportunities for one-to-one interactions with faculty and successful upper class students; 4) supplied less formal structures for social interaction; and 5) introduced students to university resources, such as financial aid and career placement. The program continues to attract highly qualified and dedicated student mentors. A key element of the program is the personalized experience of its peer and mentor support.

The University of Texas at San Antonio: *An Engineering Pipeline for High School to Undergraduate through a Structured Research and Mentoring Experience*

The institution began a work-study program for entering and progressing students in externally funded research programs in fall 2006. The department recruited and selected 20 TETC-TYT participants to work as members of a research team with clearly delineated tasks and expectations, and also facilitated workshops to enhance the research experience and to complement the academic learning experience. A structured year-long, pyramid-type mentoring program put emphasis on formal study groups that ensured the progress and success of the participants. The success of recruiting the right students was predicated on the relationships with local high school math and science teachers and counselors established through a prior TWD Best Practices grant.

The department collaborated with San Antonio High School by teaching one course for each semester of the grant. Approximately 15 students earned college credit for pre-calculus and physics. During the summer they will have the opportunity for additional credit by testing out of college Calculus I.

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