Texas Higher Education Coordinating Board
Technology Workforce Development Grants Program

5th Annual Report

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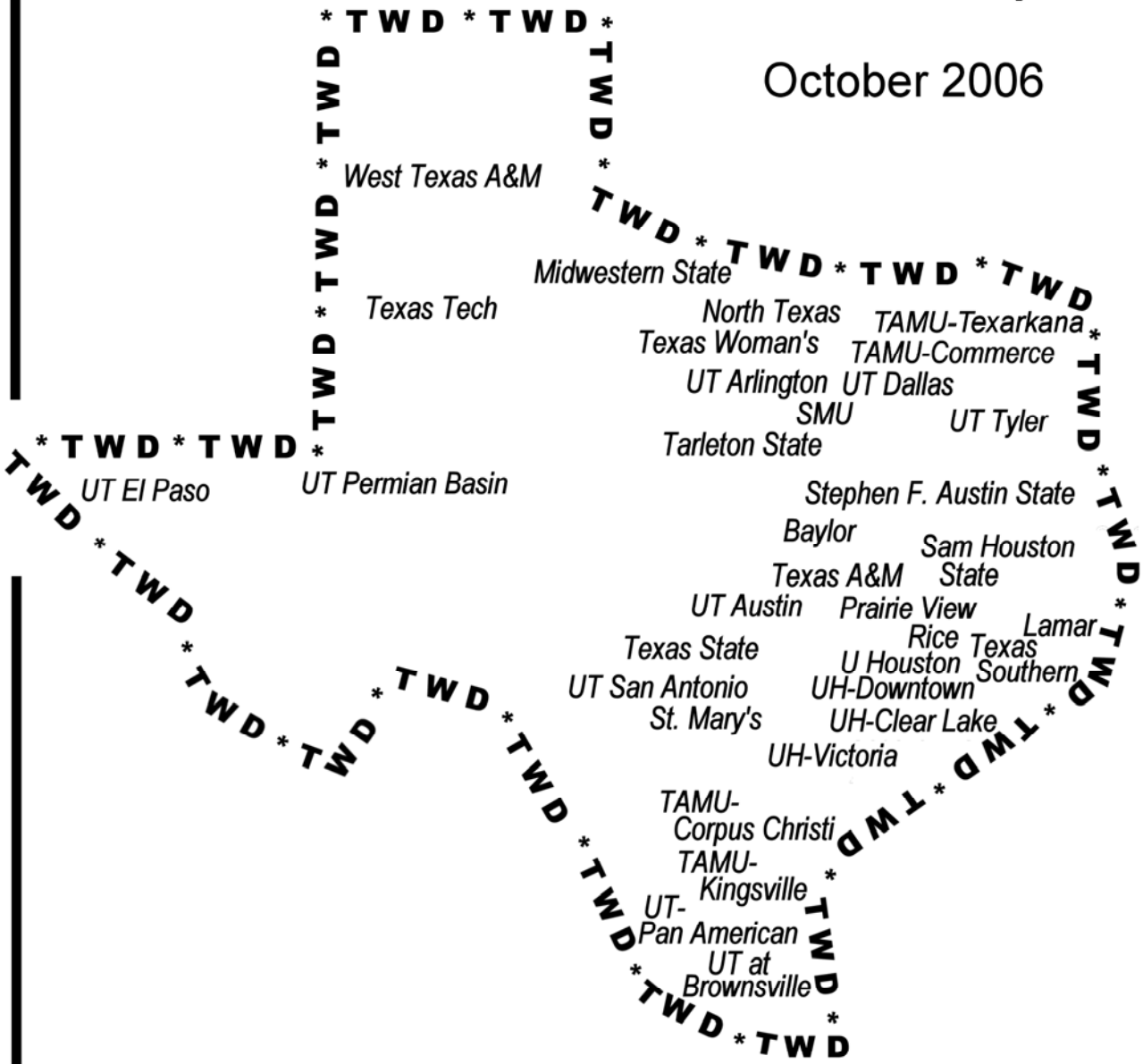

http://www.tetc.us/

http://www.thecb.state.tx.us/AAR/Research/Techworkforce/

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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

Executive Summary

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. Industry members contribute annual membership fees to TETC of $100,000. Current industry members are Advanced Micro Devices, Hewlett-Packard and Hewlett-Packard Foundation, Intel Corporation, Lockheed Martin Corporation, Freescale, National Instruments Corporation and National Instruments Foundation, 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.

No general revenue was appropriated for the 2006-2007 biennium and, consequently, the industry did not provide matching funds in Fiscal Year 2006. However the Coordinating Board (CB) received $1 million from the Governor's Office through an interagency agreement with the Texas Workforce Commission in U.S. Department of Labor funds for Fiscal Year 2006, as well as a promise of $2 million in follow-up funding for Fiscal Year 2007. During the life of the program, several institutions have secured additional funding by leveraging TWD grants as the basis for successful proposals to the National Science Foundation.

The CB awarded the 2006-2007 U.S. Department of Labor funding in 11 grants for a new TETC-Texas Youth in Technology (TYT) Demonstration Project. The new project conforms to the terms of the U.S. Department of Labor Grant with a focus on youth age 14 to 21.

Experiences by TWD project leaders have resulted in a "Ten Best Practices" list for increasing the numbers of educated electrical engineers and computer scientists. TETC sees potential for these experiences in working toward the wider and more difficult challenges facing the state in addressing K-12 education.

The TETC Best Practices Conference this year provided insights about the value of work-study projects over scholarship support for minority and first-generation students, the necessity to create a fostering engineering education philosophy, the need to rectify a troubling misconception about the nature and purpose of engineering in the general population as well as among education leaders such as high school counselors, and the benefit of summer camps to address confidence and perception issues.

Technology Workforce Development Grants Program

Background

The 77th Texas Legislature passed the Technology Workforce Development Act (Texas Education Code, Chapter 51, Section 51.853) in 2001 following the April 2000 higher education planning paper by the industry/university Task Force on Development of the Technology Workforce. The task force determined that Texas' economy had made a fundamental shift into technology industries, requiring a large technology workforce and increased collaborations between universities and private companies.

The purpose of the 2001 legislation was to:

- provide seed money that would enable institutions to expand enrollments in engineering and computer science programs,
- increase both the quantity and quality of baccalaureate-level engineers and computer scientists, and
- foster cooperative relationships and activities between technology companies and universities that offer engineering and computer science degrees.

This act created the Texas Engineering and Technical Consortium (TETC) and the Technology Workforce Development (TWD) Grants Program, and charged the Texas Higher Education Coordinating Board (CB) with administration of the grant program.

Appropriation History

When the legislature created the consortium in 2001, it appropriated $5.078 million per year to the Coordinating Board to match external contribution to the program from TETC members. Of this, slightly more than $2.8 million was matched in Fiscal Years 2002-2003. An additional matching appropriation of $4.177 million per year was made for the 2004-2005 biennium but, due to an error in the appropriation process, it was not available to the program. Subsequently, the CB received $4.9 million for two years from the Governor's Office through a Memorandum of Understanding. Of this, slightly over $4.6 million was matched in Fiscal Years 2004-2005. A total of $7.779 million in state general revenue has been provided to the program. All state money was a match to both industry donations and federal grants received as a result of industry lobbying efforts. See Table 1 for a budget overview.

There was no state general revenue appropriation for TWD for the 2006-2007 biennium. Without the prospect of a state match, industry submitted no contributions in Fiscal Year 2006 to the Comptroller's account for TWD. However the Coordinating Board (CB) received $1 million from the Governor's Office through an interagency agreement with the Texas Workforce Commission in U.S. Department of Labor funds for Fiscal Year 2006, as well as a promise of $2 million in follow-up funding for Fiscal Year 2007.

Table 1 TWD budget overview.

Sources: [1]

	FY 2002-2006	FY 2007
State Cash:	*$7,779,000*	
Industry Cash: [2]	*$3,366,000*	
Federal Cash (Department of Education):	*$3,778,000*	
Federal Cash (Department of Labor): [3]		*$3,000,000*
Industry In-Kind (hardware/software):	*$756,000*	
Industry In-Kind (AAT internships 2004): [4]	*$145,000*	
Industry In-Kind (AAT internships 2005): [4]	*$169,000*	
Total:	**$15,993,000**	**$3,000,000**

Uses: [1]

	FY 2002-2005	FY 2006
Grants TWD 2002, 2003, and 2005: [5]	*$14,127,000*	
Grants TWD 2006 (TETC-TYT): [3]		*$2,850,000*
Administration, Coordinating Board:	*$357,000*	*$50,000*
Best Practices Session:	*$8,000*	
Industry In-kind (total):	*$1,070,000*	
State Cash Balance (grant funds):	*$291,000*	
Industry Cash Balance (grants funds):	*$12,000*	
Federal Balance (Department of Education):	*$128,000*	
Federal Balance (Department of Labor):		*$100,000*
Total:	**$15,993,000**	**$3,000,000**

(1) This overview lists all sources and uses over the life of the grant program, from Fiscal Year 2001 though the end of TETC-TYT. This tabulation is based on award distribution tables and in-kind donation or administration expenses summary tables, and all numbers are rounded to the nearest thousand dollars.
(2) TETC deposits to the Comptroller's account for the grants program not including TETC expenses for program development.
(3) $1 million received in Fiscal Year 2006 and $2 million anticipated in Fiscal Year 2007. Both awarded in July 2006 with Fiscal Year 2007 funds contingent upon availability.
(4) To foster collaborations, TETC set up a program called "All Across Texas" (AAT) that provides a data base of qualified applicants from all member institutions. This eases industries' recruiting efforts to find qualified workers including those from smaller schools in a cost-effective way. One-half of the cost for additional interns over the summer of 2003 are counted as in-kind match in accordance with provisions of the TWD Act Section 51.855 and 51.856(b)(2), and TETC bylaws 6.4.1.3.
(5) Grant awards minus unexpended returns ($90,000).

New Cycle of Grants Awarded in 2006

The U.S. Department of Labor funds were used to create a new grants program, the TETC-Texas Youth in Technology (TETC-TYT) Demonstration Project. The TETC-TYT grant cycle is the fourth cycle for TWD. Awarded by the Coordinating Board in July 2006, it began August 1, 2006 and has two phases, based on availability of funding. Phase I, funded with $1 million in federal money, will run through March 14, 2007 with the option for no-cost extensions. The grant period for Phase II, with $2 million in funding, will begin after this portion of the funding for TETC-TYT is received in Fiscal

Year 2007. Special conditions of the federal grant opened the competition for the first time to all engineering programs and limited submissions to projects involving students between the ages of 14 and 21.

To initiate the TETC-TYT grant cycle, the Coordinating Board signed an interagency agreement with the Texas Workforce Commission to receive $1 million in U.S. Department of Labor funds according to instructions from the Governor's Office in March 2006. The Coordinating Board conducted a peer-reviewed grants competition and new awards were announced in July. As a result of the grant period duration and the time it took to conduct the competition, a majority of the U.S. Department of Labor funds will be spent during fall 2006 and the first half of the spring semester 2007. When funding for Phase II of TETC-TYT becomes available, project leaders can launch their planned second phase of the projects without delay.

Older TWD grants (TWD 2002, 2003, and 2005) continued operations using unspent state and industry funds from the prior biennium. In addition, they continued to spend federal money from two U.S. Department of Education grants to TETC's former host institution, The University of Texas at Austin.

Program Impact

Total TWD funding through FY 2007 will be approximately $19 million or just over $3.1 million per year (Table 1). This $3.1 million is approximately equivalent to a 3 percent supplement to the formula funding for public undergraduate engineering programs. With this 3 percent supplement and the leverage of industry involvement, the program is attempting to increase significantly the number and quality of undergraduate degree recipients in engineering and computer science.

While reports from the "Best Practices" conference described below show promise for significant impact from this relatively small program, the actual impact is still several years away. None of the students who were targets of this program are expected to graduate before spring 2007, and the 14-year-old student targeted in 2007 will not graduate before 2015. Over the 15-year period from enactment of the legislation until graduation of the prospective students reached by the latest grant, market and other powerful forces are creating significant fluctuations in the number of graduates. Thus, the direct impact of the TWD program upon number of graduates is not likely ever to be measurable. However, project leaders estimate that the grants awarded through FY 2005 have reached about 65,800 students and teachers at an average cost of about $150 each (Table 2). The effects of those contacts will be highly varied.

Organization

The Texas Engineering and Technical Consortium (TETC) is a consortium of industry and academic members. The 34 member universities either have computer science departments (29 members, public universities) or accredited electrical engineering departments (15 members from public universities; four members from independent universities). The initial legislative intent was to focus the program on computer science

Table 2 Estimate of students benefiting from TWD.

	Total	Computer Science	Electrical Engineering
Number of Grants	72	25	47
Total Award Amount (TWD 2002, 2003, and 2005)	$14,100,000	$5,260,000	$8,790,000
total spent	$9,900,000	$4,070,000	$5,780,000
percent spent	70%	77%	66%
High school students/teachers involved	18,200	9,190	8,980
Entering students involved	16,600	7,800	8,790
Progressing students involved	19,000	3,960	15,030
Advanced students involved	9,000	3,530	5,460
Graduated students involved	3,100	950	2,100
total number of students involved	**65,800**	**25,400**	**40,300**
cost per student involved	$150	$160	$140

and electrical engineering. All engineering programs were allowed to participate for the first time in the 2006 TETC-TYT grants competition.

Fiscal Year 2006 industry members for TETC were Advanced Micro Devices, Hewlett-Packard and Hewlett-Packard Foundation, Intel Corporation, Lockheed Martin Corporation, Freescale, National Instruments Corporation and National Instruments Foundation, and Texas Instruments and Texas Instruments Foundation. Other companies that have been involved include Applied Materials, Motorola, National Semiconductor, Sabre, Sematech, and the SBC Foundation. The organizational structure of TETC includes:

- *TETC Advisory Committee*: The committee meets once or twice a year for discussions, presentations, or "best practices-sharing" forums.

- *TETC Executive Committee*: An operating committee with 11 voting members – six industry and five education members – selected by industry members from the TETC Advisory Committee. Inaugural chair was Ms. Tegwin Pulley, Vice President of Texas Instruments. Mr. Ray Almgren, Vice President for Product Marketing and Academic Relations at National Instruments, has chaired this committee since January 2006.

- *Host Institution*: Southern Methodist University in Dallas has served as host institution during Fiscal Years 2005 and 2006. The inaugural host institution for TETC was The University of Texas at Dallas and The University of Texas at Austin was host for Fiscal Years 2003 and 2004. TETC's website is at http://www.tetc.us/.

The primary mission for TETC is to support the TWD grants program directly through cash and in-kind donations. TETC is also committed to program development, such as managing the All Across Texas internship program, grant-writing workshops, membership drives, and securing federal dollars to support TWD grants. TETC spent about half a million dollars on such indirect support from 2002 through 2006.

Grants History

The CB administers the TWD grants program and uses appropriations from state funds to match an equal amount raised by consortium members from external (private and federal) sources. From Fiscal Year 2002 through Fiscal Year 2006, the CB conducted four grant competitions. Awards totaled $8,243,804 for the first round in 2002, $2,399,949 for the second round in 2003, and $3,578,282 for the third round in 2005.

Table 3. Statistics for Technology Workforce Development grants.

	TWD 2002	***TWD 2003***	**TWD *2005***	**TWD *2006***
Submissions:				
Number of institutions participating:	***29***	***20***	***19***	***16***
Computer science departments	23	16	13	11
Electrical engineering departments	17	15	12	10
Other engineering departments (1)				6
Number of proposals submitted: (2)	***55***	***42***	***40***	***25***
Total grant monies requested (million):	***$13.5***	***$13.8***	***$7.6***	***$6.5***
Funding:				
Number of institutions funded:	***23***	***12***	***15***	***10***
Electrical engineering departments	16	10	10	5
Computer science departments	13	5	9	5
Other engineering departments (3)				2
Number of proposals funded:	***33***	***15***	***25***	***11***
Funding Success Rate (percent): (4)	***60***	***36***	***49***	***44***
Total grant funding awarded (million):	***$8.2***	***$2.4***	***$3.6***	***$2.8***
Average funding per institution	$358k	$200k	$239k	$285k
Average funding per grant (5)	$401k	$160k	$143k	$259k

(1) Other engineering departments included one chemical engineering, two mechanical engineering, one manufacturing engineering, and two general engineering departments.
(2) For this statistic, each department's contribution in a joint proposal counts as a separate proposal.
(3) Other engineering departments included one mechanical engineering and one manufacturing engineering department.
(4) Funding success rate is ratio of proposals submitted to proposals funded.
(5) For TWD 2002, the average does not include the many small budgets making up the "Infinity Project" joint proposal.

On July 20, 2006, the CB announced grants totaling $2,849,709 for TWD 2006 (TETC-TYT). This latest cycle of grants is called the TETC Texas Youth in Technology (TETC-TYT) Demonstration Project. Funding for TETC-TYT came exclusively from U.S. Department of Labor funds through the Texas Workforce Commission. Special grants conditions allowed participation of all of engineering disciplines for the first time and limited TETC-TYT to students between the ages of 14 and 21, meeting federal restrictions on the funds.

See Appendix A for lists of grants and Table 3 for grant statistics. The CB's website offers general information, reports, and information on reporting requirements at http://www.thecb.state.tx.us/AAR/Research/TechWorkforce/.

The Technology Workforce Development Grants Program (TWD) Grant Program Advisory Committee is an 11-member committee of six industry representatives and five academic representatives appointed by the chair of the CB. The committee meets four times a year to make recommendations concerning the grant program. The current chair is Ms. Judy Shaw, Process Engineering Manager at Texas Instruments. The first chair was Mr. Torrence Robinson, Director of Public Affairs, Texas Instruments, who served from 2001 through 2003. Mr. H. Thomas Dickey, Director of Operations and Austin Site Manager at Intel Corporation, was chair until the spring of 2005. Mr. Ray Almgren, Vice President for Product Marketing and Academic Relations at National Instruments, chaired the committee until January 2006.

Best Practices

In January 2006, TETC held a one-and-a-half day Best Practices Conference on the SMU campus (TETC host institution). The conference was attended by more than 100 academic and industry representatives. Bevlee Watford, National Science Foundation Program Director for Undergraduate Education, gave the keynote address.

A TETC industry/academic steering committee selected 19 projects for presentations and divided the proceedings into topical sessions of retention, recruiting, curriculum revision, and state implementation of the Infinity Program. Session moderators guided and summarized the discussions. One result of the conference was a TETC "Ten Best Practices" list (Table 4). The list was made available to proposal writers for the 2006 TETC-TYT grant competition.

This report emphasizes four insights from the Best Practices Conference. They are important for future policy development, not only on an institutional department level, but also on a state level in guiding workforce development progress:

1. Work-Study versus scholarships
   TWD project leaders found that on-campus jobs can be advantageous to certain students, especially first-generation and low-income students who face family pressures to hold a "real" job while in college. Work-study support, in either the lab or office, provides an opportunity to learn about the discipline, become acquainted with the department members, and foster commitment to the academic program.

The *Closing the Gaps by 2015: 2006 Progress Report* reported similar findings:

> *"Students… who received work/study had the highest six-year graduation rate (55.4 percent), followed by students who got loans only (50.8 percent), and then by students who received combinations of aid that did not include work/study (48.9 percent). Those receiving grants only had the lowest graduation rate – 40.2 percent only."*
>
> (Closing the Gaps by 2015: 2006 Progress Report; Appendix A, p. 17)

2. <u>Confidence building engineering education versus the "weeding-out" approach</u>
   As industry representatives listened to suggestions on how to create confidence-building learning environments particularly for female and first-generation students, they recalled the typical "sink or swim" environments they had experienced in college. To make successful use of Texas' valuable student talent pool, institutions must create learning environments for effective partnering. Educators need to do more to retain students through nurturing and team-building.

3. <u>Public perception of the technology profession</u>
   Engineering and computer science educators involved in outreach to secondary schools and recruitment across disciplines have noticed the prevalence of misconceptions and lack of correct information about their fields. The terms "geeky" and "nerdy" imply a socially isolated, overtaxed, and predominantly male oriented work environment, expertise of little use to life skills or success outside the discipline, and, surprisingly, low expectations of earning power. TWD project leaders found that these misconceptions are not limited to inexperienced youth. They can even affect high school counselors who may actively dissuade interested students from the engineering fields. Many prospective students, especially first-generation students, rarely have opportunities to learn first-hand about engineering from relatives, neighbors or family friends, or through the popular media.

   In contrast, academic engineering leaders see these fields as the perfect foundation to support students while they gain experience in confronting and solving problems, a life skill that is useful in many varied post-baccalaureate career paths.

> *"Obviously, engineering is the source of invention and production that drives the modern economy. Every product we enjoy is the result of the creative work of engineers. What is less known is that engineering is the most common first degree among Fortune 500 CEOs. Engineering graduates also go on to medical and law schools, and return for MBAs.*
>
> *"The fact is that we need to educate many more engineers than work in traditional engineering jobs, since so many of them use their engineering training as a foundation for other professions. Engineers are problem solvers, and people who are not afraid of problems are needed throughout our society."*
>
> Dean Streetman, College of Engineering, The University of Texas at Austin

TWD project leaders have begun to address these issues with high school counselors and during career events. The state could refute particular misconceptions about engineering careers through its *College for Texans* campaign.

Excellent progress has been made with targeted summer camps for high schoolers. Students, including female and minority students, are introduced to the variety of available engineering/computer science fields and the benefits of an education in those fields. Summer camps increase confidence, emphasize teamwork, showcase professional role models, and inspire through hands-on experience.

4. Statewide implementation

Statewide collaboration between TWD project leaders attempting to implement and use the Infinity curriculum demonstrated that even a good idea is not necessarily easily transferable between campuses with different demands and environments. At the same time, project leaders and industry representatives realized that many of the approaches to workforce development at undergraduate institutions may be used for improving secondary education. However, the difficulty of transferring and successfully implementing ideas increases tremendously for K-12 education.

TETC executives and TWD members came to the conclusion that ultimately, the increase in engineering and computer science success will be an issue of enlarging the pipeline beginning at the elementary school level. While high school students who have completed only Algebra 2 have a 40 percent chance of receiving a bachelor's degree, high school students who have completed a pre-calculus course before entering college have a 75 percent chance of success ("Betraying the College Dream" Stanford University Bridge Project, March 4, 2003; http://www.stanford.edu/group/bridgeproject/).

At the end of the Best Practices conference, TETC Chair Ray Almgren urged consortium members to think of TETC not only as a funding mechanism but also as an agent for change in engineering and computer science education nationwide (Best Practices Conference 2006, Summary; http://www.thecb.state.tx.us/reports/PDF/1172.PDF). There was consensus that TETC should continue the conference on an annual basis and should actively disseminate its best practices findings and make them accessible to all interested parties.

Table 4 **Ten Best Practices for increasing engineering and computer science graduates.**

These practices were established at the TETC Best Practices Conference, held in January 2006 at Southern Methodist University, the TETC Host Institution.

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 (work-study) 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

Table 4 continued

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.

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. Ideas will often need to be "tweaked" to accommodate differences in students, faculty, curriculum, facilities, or schedules.

Summary Comments from Industry Leaders

Industry representatives were enthusiastic participants and moderators for the 2006 Best Practices meeting. Ms. Judy Shaw, Process Engineering Manager, Texas Instruments and Chair, TWD Grants Program Advisory Committee sums up the year:

> *"2006 got off to a strong start with the Best Practices Conference held at SMU in January. Over 120 attendees from academia and industry gathered to learn new ideas for recruiting, supporting, and motivating engineering/computer science students. Discussions were lively and common themes emerged; peer mentors, for example, have proven to be highly effective and to have high return of investment in numerous institutions.*
>
> *"Later in the year, the 2006 grant cycle was announced and awards approved. Numerous high-quality proposals from across the state were assessed by a highly-qualified review team. Throughout the year, the Advisory Board members and their organizations have been consistent in their support.*
>
> *"In all cases, these are gratifying signs that more and more, we are 'getting it' in Texas when it comes to the need for more technical graduates. And, not only are the needs being recognized, the programs are working. At TETC-funded schools, electrical engineering graduation rates are up 36.2% and computer science graduation rates are up 24.7%.*
>
> *"On behalf of all of the TWD Advisory Committee members, thanks go to the Coordinating Board and to TETC for the opportunity to support this vital activity."*

Ray Almgren, Vice President of National Instruments and Chair of TETC, described the consortium's impression on progress of the workforce development projects for the future of the state:

> *"The Texas economy is very strong and dependent upon the contributions from scientists and engineers in many industries including energy, communications, computing, information technology, aerospace, and construction. To maintain our state's technology leadership and economic growth, we must ensure a strong flow of highly qualified scientists and engineers from our universities and colleges in Texas.*
>
> *"TETC is making significant progress identifying and addressing critical issues that will ultimately lead to more students graduating from our universities with science and engineering degrees. TETC has and will continue to work closely with all of the universities in Texas to ensure we are recruiting more students into our programs so that we can graduate the needed supply to "close the gap" identified by the Texas Higher Education Coordinating Board."*

Conclusions

A total of $19 million in funding has been received or is budgeted for current grants from state, industry, and federal sources for the Technology Workforce Development grant program since the 78th Texas Legislature established it in 2001. Throughout Fiscal Year 2006, TETC industry members worked with the Governor's Office, resulting in TWD funding with U.S. Department of Labor funds passed through the Texas Workforce Commission. This allowed the competitive review and selection of 11 new grants to 10 institutions with $3 million in funding.

The academic members of TETC are using the funds and in-kind contributions from TETC to fund new initiatives and to support ideas which are difficult to justify with normal State appropriations. TWD grants cannot fund all of the proposed projects for engineering and computer science education but the program continues to play an innovative role in educating engineering and computer science students in Texas higher education institutions. Projects funded through TWD touch many students through new approaches to outreach, recruitment, retention, and curriculum revision.

A TETC conference in January 2006 identified 10 best practices for increasing computer science and engineering graduates. The practices include using peer teachers, exposing students to their discipline early in their academic years, and providing work-study jobs rather than scholarships.

At several points during the TETC Best Practices conference, the relationship between problems in K-12 education and low engineering and computer science graduation rates were noted. TETC members believe that many of the ideas developed by TETC will also be useful in the K-12 system. However, because the K-12 system is so large, implementation will be much more difficult.

Appendix A: List of Awards

Technology Workforce Development Grants Proposals: 2006

TETC-Texas Youth in Technology (TYT) Demonstration Project

	Award Phase I	Award Phase II
1. **Prairie View A&M University** Recruitment and Retention Programs for the Department of Electrical and Computer Engineering	$94,432	$189,997
2. **Texas Engineering Experiment Station** Assessment of Computer Science at Texas A&M University Peer Teachers Program	$93,289	$191,711
3. **Texas Tech University** Curricular Development, Multidisciplinary Team Internship, and Undergraduate Peer-Mentors for West Texas Students	$94,969	$189,988
4. **Texas Tech University** Integrated Outreach, Mentoring, and Placement of Texas Youth in Engineering Careers	$94,742	$183,344
5. **The University of Texas at Austin** Increasing the Applicant Pool and Retention in Computer Engineering	$95,000	$168,200
6. **The University of Texas at Dallas** Jonsson School Undergraduate Scholars Program	$95,000	$190,000
7. **The University of Texas at El Paso** Reaching Out Across Disciplines: Learning from Each Other to Produce More Graduates in Computer Science	$94,929	$189,953
8. **The University of Texas at San Antonio** An Engineering Pipeline for High School to Undergraduate through a Structured Research and Mentoring Experience	$94,585	$188,028
9. **The University of Texas-Pan American** Increasing Engineering and Computer Science Retention through Mentoring and Learning Communities	$7,920	$37,616
10. **University of Houston** Step Forward: Preparing Low-income High School Students for Academic Success in Electrical and Computer Engineering at the University of Houston	$93,943	$180,945
11. **University of Houston-Clear Lake** Computer Science Scholars: Recruiting, Retention, and Mentoring	$91,192	$189,927
	Award TWD 2006 Phase I	**Award TWD 2006 Phase II**
	$950,000	**$1,899,709**

Total for TETC Texas Youth in Technology (TYT) Demonstration Project: **$2,849,709**

Technology Workforce Development Grants: 2005

Computer Sciences, Best Practices

	Award
12. **The University of Texas at Arlington** *Expansion of CSE @ UTA Robot Programming Contest to Increase Computer Science and Engineering Recruitment*	$161,415
13. **The University of Texas at San Antonio** *Developing Computer Science Career Paths*	$280,187
14. **Texas State University-San Marcos** *Enhance Computing Workforce and Provide Higher Education in Computer Science to Working Professionals*	$247,240
15. **University of Houston-Clear Lake** *Minority Oriented Recruiting Effort in Computer Science (MORE-CS)*	$65,612
16. **The University of North Texas** *Recruiting and Retention Strategies for Computer Science at UNT*	$125,322
17. **Texas A&M University-Texarkana** *Operation Bootstrap*	$200,224
Total Award Program Area	**$1,080,000**

Computer Sciences, Innovative Strategies

	Award
1. **University of Houston** *Online/Classroom Hybrid Computer Science Program: A Pilot Project*	$99,914
2. **The University of North Texas** *Improving Student Recruiting and Retention through an Interdisciplinary Computer Science Curriculum*	$49,656
3. **Texas Engineering Experiment Station** *Innovative Programs to Increase the Enrollment in Computer Science*	$55,760
4. **The University of Texas at Austin** *The Science of Computing Recruiting Road Shows*	$90,840
5. **The University of Texas at Arlington** *Webtronics Competition and Proactive Student Retention: Increasing Undergraduates in Software Engineering*	$58,500
Total Award Program Area	**$354,670**
Total Award Computer Science Program	**$1,434,670**

Electrical Engineering, Best Practices — Award

1. **The University of Texas at Austin** — $277,120
   Use of Freshman Interest Groups to Improve Student Graduation at UT-Austin
2. **The University of Texas at San Antonio** — $160,053
   A Repeatable and Reproducible Approach for Improving Retention and Graduation Rates of Minorities and Women in EE
3. **The University of Houston** — $372,561
   Undergraduate Retention and Recruiting of ECE Students at the University of Houston: Best Practices
4. **Prairie View A&M University** — $188,063
   Increasing Graduating Rates of Electrical and Computer Engineering Students: Integrated Recruitment and Retention Approaches
5. **Texas A&M University-Kingsville** — $106,028
   Expansion of EE Program at TAMUK with Curriculum Reformation, Scholarships, and Tutoring
6. **The University of Texas at Tyler** — $125,000
   Back to Basics: A Student-Tutor Matching Program
7. **Texas Tech University** — $235,168
   Recruiting and Retention Efforts to Increase Electrical and Computer Engineering Graduates
8. **The University of Texas at Dallas** — $156,007
   UTD School of Engineering and Computer Science - TETC Undergraduate Expansion Program

Total Award Program Area $1,620,000

Electrical Engineering, Innovative Strategies — Award

1. **Baylor University** — $62,857
   Attracting Engineering Majors from Community and Small Private Colleges
2. **Texas Tech University** — $82,075
   WE CAN: Women in Engineering: Curriculum, Applications, and Networking
3. **The University of Texas at Austin** — $106,000
   Development of Course Modules to Enhance Retention and Graduation Rates
4. **The University of Texas at Arlington** — $96,905
   Innovative Strategies to Establish a Pipeline with Local School Districts
5. **The University of Texas at Tyler** — $95,599
   Introducing the Design and Development Lab "The Hobby Shop" to Increase Retention of Electrical Engineering Students
6. **The University of Houston** — $79,176
   Retention of Female Undergraduate ECE Students at the University of Houston

Total Award Program Area $522,612

Total Award Electrical Engineering Program $2,142,612

Total Award 2005 Technology Workforce Development Grants Program $3,577,282

Technology Workforce Development Grants: 2003

Computer Sciences

1. ***The University of Texas at Austin*** $447,990
   Recruiting and Retaining Computer Science Students
2. ***Texas Engineering Experiment Station*** $173,158
   Increasing Computer Science Retention with Peer Teachers and Learning Modules
3. ***Texas A&M University - Corpus Christi*** $235,817
   More Attention for Retention and Recruitment
4. ***Texas Tech University*** $35,930
   Integrated, Seamless, Education System to Recruit and Retain Students
5. ***The University of Texas - Pan American*** $67,105
   Increasing Computer Science Graduates and Enrollment through Learning Communities and Outreach

Total Award Computer Sciences $960,000

Electrical Engineering

1. ***Texas A&M University – Kingsville*** $50,325
   Expansion of Electrical Engineering Program at TAMUK with Scholarships and Tutoring
2. ***The University of Texas - Pan American*** $104,518
   Electrical Engineering Recruitment and Retention through On-Campus Jobs and Summer Scholarships
3. ***The University of Texas at El Paso*** $139,767
   Creating Learning Communities at UTEP to Increase Throughput
4. ***Texas Tech University*** $255,562
   Electrical Engineering Recruitment and Retention at Texas Tech
5. ***Texas Engineering Experiment Station*** $313,828
   Improving the Quality, Quantity, and Diversity of Electrical and Computer Engineering Graduates
6. ***Prairie View A&M University*** $52,449
   Increasing the Quantity and Diversity of Students Pursuing Degrees in Electrical and Computer Engineering
7. ***The University of Texas at San Antonio*** $69,000
   Improving Retention in Electrical Engineering Using Programmable Logic Devices
8. ***Southern Methodist University*** $31,248
   SHinE: Strengthening Hispanics in Engineering
9. ***The University of Texas at Arlington*** $91,803
   Recruitment and Retention to Increase the Number of Undergraduate Students in the Electrical Engineering Program
10. ***University of Houston (Main)*** $331,449
    Undergraduate Retention and Recruiting of Electrical and Computer Engineering Students at the University of Houston

Total Award Electrical Engineering $1,439,949

Total Award 2003 Technology Workforce Development Grants Program $2,399,949

Technology Workforce Development Grants: 2002

Computer Sciences

Lamar University

- *Study, Research, and Achievement in Lamar University Computer Science* $98,790

Southwest Texas State University

- *Enhance Computing Workforce & Provide Higher Education in Computer Science to Working Professionals* $609,502

Tarleton State University

- *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide* $23,014

Texas Engineering Experiment Station

- *Increasing Computer Science Retention by Developing and Deploying Self-Paced Learning Modules* $422,692

Texas Tech University

- *Efficient, Cost-Effective, Seamless, Advising Process to Increase CS Graduates* $194,822

Texas Woman's University

- *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide* $57,500

University of Houston - Clear Lake

- *Texas Scholars in Computer Science* $508,916

University of Houston - Victoria

- *Recruitment and Retention of Computer Science Students* $63,192

University of North Texas

- *Retention Strategies for Computer Sciences* $129,575

The University of Texas at Arlington

- *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide* $113,144

The University of Texas at Austin

- *Target Diversity: Increasing Graduation Rates by Recruiting and Retaining Underrepresented Populations* $366,788

The University of Texas at San Antonio

- *Building Strategic Pathways to the Baccalaureate Degree in Computer Science* $487,102

The University of Texas at Tyler

- *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide* $44,400

Total Award Computer Sciences $3,119,437

Electrical Engineering

Baylor University

- *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide* $38,000

Lamar University

- *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide* $71,000

Prairie View A&M University	
• *Increasing Electrical Engineering Program Enrollment: New Program, Increased Retention and College Transfers*	$385,800
• *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*	$77,600
Rice University	
• *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*	$29,763
Southern Methodist University	
• *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*	$96,697
St. Mary's University of San Antonio	
• *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*	$49,670
University of Houston (Main)	
• *Undergraduate Retention and Recruiting of ECE Students at the University of Houston*	$604,450
Texas A&M University – Kingsville	
• *Expansion of the EE Program at TAMU-K with Scholarships and Tutoring*	$64,280
Texas Engineering Experiment Station	
• *Enhancing the Quality and Quantity of Electrical and Computer Engineering Graduates*	$850,192
• *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*	$58,000
Texas Tech University	
• *Electrical Engineering Workforce Development at Texas Tech*	$317,518
The University of Texas at Arlington	
• *Recruitment and Retention to Increase the Number of Undergraduate Students in the Electrical Engineering Program*	$306,670
• *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*	$89,697
The University of Texas at Austin	
• *Increasing and Improving Texas Capability in Electrical Engineering*	$850,000
• *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*	$92,150
The University of Texas at Dallas	
• *UTD School of Engineering and Computer Science -- TETC Undergraduate Expansion Program*	$695,000
The University of Texas at El Paso	
• *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*	$90,000
The University of Texas - Pan American	
• *Electrical Engineering Recruitment and Retention Enhancement*	$268,180
The University of Texas at San Antonio	
• *Launching the Texas Engineering Education Pipeline: Deploying the Infinity Project Statewide*	$89,700
Total Award Electrical Engineering	**$5,124,367**
Total Award 2002 Technology Workforce Development Grants Program	**$8,243,804**

Appendix B: Project Summary Highlights

The following highlights are summaries CB staff compiled from annual reports submitted by the TWD project leaders.

Outreach Projects

This project established a robotics camp for 9th- to 11th-grade high school girls. Several local and national news stories, including CNN Headline News, featured the camp. School districts throughout Texas requested that the camp be held during both summer and regular school terms. **University of North Texas**

The department offered summer workshops focused on local, underrepresented minority high school students. At the beginning of the workshops, all students were considering higher education but had no clear idea about possible areas of study. By workshop end, nine of 10 students seriously considered engineering a viable option and most were interested in computer and electrical engineering specifically.
St. Mary's University of San Antonio

Five electrical engineering seniors received scholarships to participate in instruction at five area high schools. The students served as mentors during lab experiments and were involved in project development, classroom lectures, and round-table discussions. This project reached more than 140 students.
The University of Texas at Arlington

This project provided a workshop for 30 high school teachers, as well as technical support and training, for Infinity Project curriculum teachers at two high schools with a majority of minority student population. A total of about 70 students benefited.
The University of Texas at Tyler

G.R.A.D.E. (*girls reaching and demonstrating excellence*) camp is a week-long day program designed for entering 9th to 12th grade girls who want to find out what engineering is.
University of Houston

This institution held a robotics workshop for 11 K-12 teachers to allow them to foster student interest in math, science, and engineering with robotics. Four undergraduate students assisted.
Texas A&M University-Texarkana

The department designed and produced a CD that introduces the electrical engineering program, showcases laboratories and facilities, and provides information about career opportunities in the field. High school counselors and seniors received copies in the mail and this generated significant student interest in the program.
Texas A&M University-Kingsville

The grant initiated summer camps for girls in cooperation with three local schools to engage the students in hands-on learning activities in robotics, computer hardware and web page development. Student members of Lamar's Women in Research Development (WIRED) group guided the campers and maintained contact via electronic mail lists. **Lamar University**

Recruitment Projects

A two-week summer camp for nine female high school students let them bond with four female electrical engineering college students, gave them a good understanding of the engineering profession, and built their optimism that they could succeed in engineering.

Texas Tech University

The program's focus is on increasing enrollment and persistence of students in electrical and computer engineering with WELCOME (Women in Engineering Learning Community for Maximizing Excellence) activities throughout the academic year, promotional items, and a website. Twenty-six percent of the enrolled female students participated. External follow-up funding will open WELCOME to female students in other engineering departments.**University of Houston**

University faculty visited high schools to speak directly to over 4,000 students with a high percentage of female or Hispanic students. This effort increased matriculation of incoming freshmen by more than 12 percent at a time when enrollments continued to decline around the country.

Texas A&M University-Corpus Christi

The institution is conducting regional Science Olympiad competitions which each bring about 200 students, teachers, and parents to campus. They allow faculty to showcase programs and facilities.

Tarleton State University

Students mentoring students: mentoring office initiated by the IEEE (Institute of Electrical and Electronics Engineers) student branch organization and funded by TWD.

The University of Texas at Arlington

The project created a new, five-week summer class for junior college students who have completed at least 30 semester hours. The department advertised the opportunity in newspapers, television and select mailings. This strategy helped build up the numbers of progressing and advanced students.

University of Houston-Victoria

The E-COACH web-based career-mapping tool set developed with this project has provided workshops to high schools and junior colleges, helping students discover career interests. The website has had almost 10,000 hits, with more than 500 in June of this year alone. A local high school counselor wrote a paper on the value of this tool in helping students discover a career.

Texas Tech University

The department bootstrapped a unique honors program with TWD funding. Several dozen competitively selected students form a close-knit cohort skip introductory pre-computer science courses and take honors courses. The students finish the program, often ahead of time, with published honors theses and oral defenses. This gives the institution a competitive recruitment edge over other nationally ranked universities.

The University of Texas at Austin

The “Hobby Shop,” a design and development lab providing hands-on design experience for electrical engineering freshman students, was the center of a show-and-tell activity during the college’s open house in the spring of 2006. Undergraduates explained and demonstrated their student projects. **The University of Texas at Tyler**

Retention Projects

These grants allowed the department to outfit its freshman class laboratory with Infinity Technology Kits and its students to envision, design, and test modern technology with pre-design lab experiments. Retention rates for the 340 students who completed the Infinity Project course are between 81 and 86 percent. The overall institution retention rate is 69 percent and the national engineering retention rate is less than 48 percent.

Prairie View A&M University

With the help of TWD grants, this department has sponsored Redshirt Camps for sophomores each semester since 2003. The camps focus on novel problem-solving techniques, student group work, and provide experiences necessary for future classes, research, and work. Pass rates improved 19 percent over that for non-participating students.**University of Houston**

Industrial mentoring program pairs undergraduate women with successful women in industry. Mentors and mentees meet annually for a day of discussions and communicate regularly via email.

Lamar University

A peer mentorship program awarded $1,000 per semester to students assisting freshmen for 10 hours a week. Each mentor assisted three to five students individually or in groups and held open question-and-answer sessions advertised to all majors. Retention among participating freshmen was higher than 90 percent compared to the less than 70-percent average for others.

The University of Texas at Dallas

With the introduction of “learning communities” for entering engineering students and the implementation TWD curricular reforms, retention rates for freshman students increased from 75 percent in 2003-04 to nearly 85 percent in 2005-06. **Baylor University**

A paid summer research opportunities program, under the supervision of full-time faculty, provided students with skills and expertise that are not normally within reach of undergraduates. The program required final reports and presentations. All students participating in the program are progressing well, graduated, pursing graduate work, or working in industry. **Texas Tech University**

A non-competitive program of on-campus technical employment (work-study) for new electrical engineering students provided financial support, increased engagement on campus for first generation students, and reduced time conflicts with off-campus jobs. The first cohort of students had a one-year retention rate of over 95 percent compared to the university average of less than 70 percent. **The University of Texas-Pan American**

Curriculum Revision Projects

This institution collaborated with Austin Community College to offer a baccalaureate program in computer science designed for working professionals. The addition of upper-level classes with an expanded time schedule allowed 91 students to graduate. At the same time, it allowed the community college to attract more students to its lower-level courses.

Texas State University-San Marcos

TI and NI in-kind donations of hardware and software together with the Infinity concept led to curriculum changes across the State, introducing robotics and signal processing to incoming students.

Southern Methodist University

This grant helped create the computer engineering program at the institution by introducing six new courses and building a computer laboratory with microprocessor development systems and software. The first graduate from a student body of now over 60 in the program received her bachelor's degree in May 2006.

Prairie View A&M University

Project leaders focused on curriculum development and content innovation for distance-learning versions of two of their freshman engineering courses. The courses are delivered at minimal cost to local community and small private schools that in turn agree to provide students with computer access and part-time mentors.

Baylor University

The funding allowed development of separate sections of the introductory computer science course for majors and non-majors. The first course for majors provides a breadth-first approach rather than a depth-first approach. The computer literacy course for non-majors aims to generate a general interest in computer science. Curriculum changes progressed incrementally based on lessons learned while working on the grant.

University of North Texas

Based on a student survey, the freshman level engineering course was restructured to motivate and excite the students by combining two-hour lectures with two-hour labs. The course introduces examples of work duties for engineering, basic technologies, and a four-year educational road map. The teaching philosophy has moved from "memorize and reproduce" to "understand and apply."

Texas A&M University

Appendix C: List of TWD Publications

Akl, R. and R. Garlick, 2006 accepted, Retention and Recruitment of Women in computer Engineering. International Conference on Engineering Education, paper 3318 (July).

Ali, M., 2006, *Enhancing Computing Workforce by Providing Higher Education to Working Professionals*. Proceedings Texas Engineering and Technical Consortium Best Practices Conference, Dallas, TX, pp. 23-24, (January).

Attia, J.O., 2006, *Increase Retention Through the Use of the Infinity Project*. Proceedings Texas Engineering and Technical Consortium Best Practices Conference, Dallas, TX, pp. 43-44, (January).

Bagert, D.J., J.M. Gregory, S.A. Mengel, and L.R. Heinze, 2002 *Engineering Education Innovation with Software Engineering Projects*. Frontiers in Education, Boston, MA.

Baker, M.C. and T. Karp, 2006 accepted, *WE CAN: Introducing High School Girls to Electrical Engineering*. 36th ASEE/IEEE Frontiers in Education Conference, San Diego, CA (October).

Bredow, J., 2006, *Modification of the Infinity Kits to Provide Improved Hands-On Experiences*. Proceedings Texas Engineering and Technical Consortium Best Practices Conference, Dallas, TX, pp. 47-48, (January).

Bredow, J.W., C. Wright, and B. Manley, 2006 accepted, *A model for cooperation between university and K-12 components in science and technology education*. 36th ASEE/IEEE Frontiers in Education Conference, San Diego, CA (October).

Christensen, M.P., S.C. Douglas, S.L. Wood, C. Kitts, and T. Mahler, 2004, *The Infinity Project Brings DSP Brains to Robots in the Classroom*. Proceedings 11th DSP and 3rd Signal Processing Education Workshops, Taos, NM (August).

Christensen, M.P., D.A. Willis, and S.C. Douglas, 2006a, *Cross-Disciplinary Early Engineering Design Experiences for Undergraduates*. Proceedings Texas Engineering and Technical Consortium Best Practices Conference, Dallas, TX, pp. 45-46, (January).

Christensen, M.P., D.M. Willis, and S.C. Douglas, 2006b, A Modular Approach for Combining First-Year Design Experiences Across Engineering Disciplines. Proceedings 2006 Annual American Society for Engineering Education Conference, Chicago, IL, (June).

Demuynck, M.A., W.J. Zimmermann, D.E. Edwards, and M.M. Holt, 2004, *Expanding Horizons for Women and Minorities: Stimulating Interest in Engineering Through Web-Based Modules*. ASEE Gulf-Southwest Annual Conference, Lubbock, TX.

Demuynck, M.A., W.J. Zimmermann, M. Hamner, and M.M., Holt, 2005, *Enhancing The Computer Science Curriculum Through Web-Based Modules*. Association of Computing Education (ACET) Conference, Fort Worth, TX.

Doerschuk, P., 2006, *Women in Research Development (WiReD) Program*. Proceedings Texas Engineering and Technical Consortium Best Practices Conference, Dallas, TX, pp. 7-8, (January).

Doerschuk, P., 2004, *A Research and Mentoring Program for Women in Computer Science*. Proceedings of the 34th ASEE/IEEE Frontiers in Education Conference (October).

Doerschuk, P., 2003, *Research Experience in Computer Science for Undergraduate Women," Peggy Doerschuk*. Proceedings of the 2003 International Conference on Information Technology: Coding and Computing (April).

Douglas, S.C., 2006, *The Infinity Project: On the Design and Implementation of a High School Engineering Curriculum*. Proceedings 2006 Annual American Society for Engineering Education Conference, Chicago, IL (June).

Edwards, D.E., M.A. Demuynck, and M.M., Holt, 2004, *Texas Engineering Partnerships: Expanding Opportunities for Women*. Proceedings ASEE Gulf-Southwest Annual Conference, Lubbock, Texas, 2004.

Enjeti, P. and J.W. Howze, 2003, WebCT Automated Homework in ELEN 214: "Basic Electric Circuit Theory" Course Engages EE Undergraduate Students at TAMU Campus. Second Annual TAMU WebCT Day.

Enjeti, P. and L. Palma, 2005, *Usage of WebCT Vista to teach electric circuit theory*. TAMU teaching with technology conference, College Station, TX (February).

Foltz, H. and E. LeMaster, 2006, *Engineering Retention Enhancement through On-Campus Jobs*. Proceedings Texas Engineering and Technical Consortium Best Practices Conference, Dallas, TX, pp. 17-18, (January).

Fowler, R.H. and P.A. Ng, 2006, *Mentoring and Learning Communities for Entering Freshmen*. Proceedings Texas Engineering and Technical Consortium Best Practices Conference, Dallas, TX, pp. 15-16, (January).

Glover, J.R., J.L. Ruchhoeft, J.M. Trenor, S.A. Long, and F.J. Claydon, 2006, *Girls Reaching and Demonstrating Excellence (GRADE) Camps: An Innovative Recruiting Strategy at the University of Houston to Increase Female Representation in Engineering*. Proceedings Texas Engineering and Technical Consortium Best Practices Conference, Dallas, TX, pp. 21-22 (January).

Glover, J.R., J.L. Ruchhoeft, J.M. Trenor, S.A. Long, and F.J. Claydon, 2005, *Girls Reaching and Demonstrating Excellence (GRADE) Camps: An Innovative Recruiting Strategy at the University of Houston to Increase Female Representation in Engineering*. Proceedings of the 2005 American Society for Engineering Education Annual Conference and Exhibition, p. 129, Portland, OR (June).

Glover J.R., J.L., Ruchhoeft, J.M. Trenor, S.A. Long, and F.J. Claydon, 2004, *Making the GRADE (Girls Reaching and Demonstrating Excellence) at the University of Houston*. SWE Career Fair at Annual Conference (October).

Gregory, J. M., 2003, *Sleep Model to Predict Active and Passive Performance*. SLEEP, Abstract Supplement 26, pp. 408-409.

Gregory, J.M. and V.R. Barefield, 2002, *Mathematically Defining the Nature of and Engineer*. Proceedings of the ASEE Gulf-Southwest Section Meeting, Lafayette, LA.

Gregory, J.M. and L.R. Heinze, 2002, *Helping Undecided Students Select a Major in Engineering*. Proceedings of the ASEE Gulf-Southwest Section Meeting, Lafayette, LA.

Gregory, J.M., L.R. Heinze, D.J. Bagert, and S.A. Mengel, 2002, *E—COACH: A Paradigm Shift for Efficient Advising*. Frontiers in Education, Boston, MA.

Gregory, J.M., S. Swaminathan, and S.A. Mengel, 2006, *Avoiding Delays in Graduation: Efficient Education Planner.* Proceedings of the ASEE Gulf-Southwest Annual Conference, Baton Rouge, LA.

Gregory, J. M., X. Xie, and S.A. Mengel. 2004, *SLEEP (Sleep Loss Effects on Everyday Performance) Model*. Aviation, Space, and Environmental Medicine 75(3):A125-A133, Section II

Gregory, J. M., X. Xie, and S.A. Mengel, 2003a, *Active and Passive Learning Connections to Sleep Management*. Frontiers in Education, Bolder, CO.

Gregory, J.M. X. Xie, and S. Mengel, 2003b, *Sleep Management: A Frontier for Improved Academic Performance*. Proceedings of the ASEE Gulf-Southwest Annual Conference, Arlington, TX.

Gregory, J.M. and X. Xie., 2004, *SLEEP Model Assessment of Injury Risks*. SLEEP, Abstract Supplement 27:373.

Hamner, M., M.M. Holt, E., McGee, and D. Dickey-Davis, 2004, Exploring the Differences Between Science and Non-Science Majors in an Environment that Controls the Presence of Males. ASEE Gulf-Southwest Annual Conference, Lubbock, TX.

Islam, P. and M.A. Demuynck, 2004, *Tutorial Support and Retention Through Web-Based Modules For Math And Computer Science*. Seventh Annual Student Creative Arts and Research Symposium, Texas Woman's University, Denton, TX.

Karp, T. and M.C. Baker, 2006, *Women in Engineering: Curriculum, Applications, and Networking (WE CAN)*. Signal Processing in Education Workshop, Jackson, WY (September).

Kavi, K.M. and D.M. Keathly, 2006, *Setting Student Expectations with a Majors-Only Programming Course*. Proceedings Texas Engineering and Technical Consortium Best Practices Conference, Dallas, TX, pp. 29-30, (January).

Kulkarni, A.D. and K. Pleasant, 2006, *The Infinity Project Curriculum for pre-engineering students*. Proceedings of ASEE Gulf-Southwest Annual Conference, Engineering Education in the 21st Century: Pipeline and Workforce, March 15-17, Baton Rouge, LA.

Lavender, G. and C. Lin, 2006, *Turing Scholars Program*. Proceedings Texas Engineering and Technical Consortium Best Practices Conference, Dallas, TX, pp. 37-38, (January).

Leung, Y.C. and M.A. Demuynck, 2006, *MCS-net and Visual Application Builder (VAB): An Introduction*. Ninth Annual Student Creative Arts and Research Symposium, Texas Woman's University, Denton, TX.

Lind, J., 2006, *Counselor Update Events*. Proceedings Texas Engineering and Technical Consortium Best Practices Conference, Dallas, TX, pp. 25-26, (January).

Myler, H.R., 2006a, *Paradigmatic Labs for Introduction to Electrical Engineering*. Proceedings Texas Engineering and Technical Consortium Best Practices Conference, Dallas, TX, pp. 41-42, (January).

Myler, H.R., 2006b, *Value Added Engineering Education*. Gulf Southwest Section ASEE Annual Conference, Baton Rouge, LA (March).

Myler, H.R., 2004, *Early Electrical Engineering Concepts Engagement in a Freshman Level Introductory Course*. Gulf Southwest Section ASEE Annual Conference, Lubbock, TX, (March).

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