Best Practices Conference 2006
Summary

Recruiting and Retaining
Engineering and Computer Science Students
Technology Workforce Development

January 10-11, 2006

Southern Methodist University

sponsored by the

Texas Engineering and Technical Consortium

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Best Practices Conference 2006

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Best Practices Conference 2006 - Session Summaries

Foreword

This document is a companion document to *Best Practices Conference 2006: Discussion Papers*, which contains papers presented at a Texas Engineering and Technical Consortium conference held on the Southern Methodist University campus on January 10 and 11, 2006.

The first two pages of this document list a 10-point summary of ideas classified as "Best Practices" from the conference. The list is not exhaustive, but indicative of what the Technology Workforce Development Grant Program has established in positive experiences during the first four years of its existence.

The last two sessions of the conference contained oral summaries and discussions of the preceding five sessions, including a discussion of "next steps." The remainder of this document summarizes those two concluding conference sessions.

The *Discussion Papers* as well as the PowerPoint visuals that accompanied each of the presentations are available on the TETC web site at http://www.tetc.us/ and/or on the Texas Higher Education Coordinating Board's website for the Technology Workforce Development Grants Program at http://www.thecb.state.tx.us/AAR/Research/Techworkforce/.

Background

In 2001, the 77th Texas Legislature passed Senate Bill 353, the Technology Workforce Development Act, in response to requests by industry to increase the number of electrical engineering and computer science graduates from higher education institutions in the state. This legislation (Texas Education Code, Subchapter X, 51.851-51.860) 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 donor industries. Currently, there are seven industry members. Besides State and industry funding for the grants, TETC also received two federal grants with a combined contribution of $4 million.

The Texas Higher Education Coordinating Board (CB) conducted three grant competitions. TWD 2002 provided 33 grants totaling $8.2 million dollars. TWD 2003 provided 15 grants totaling $2.4 million dollars. TWD 2005 provided 25 grants totaling $3.6 million dollars. All award cycles were still active in January 2006.

To increase the number of graduates in electrical engineering and computer science, the institutions are using strategies that improve the effectiveness of outreach, recruitment, retention, mentoring, curriculum improvement, and internships, as well as securing participation from underrepresented groups.

Ten Best Practices for Increasing Engineering and Computer Science Graduates

TETC Best Practices Conference, January 2006
Southern Methodist University, 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 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

Ten Best Practices (continued)

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.

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.

Discussion Session I – *Best Practices for Retention*

Torrence Robinson (TI), Moderator; Paul Lin (UNT), Recorder

This session featured three papers that describe programs intended to increase the retention of engineering or computer science students. The first two papers describe programs which provide additional instructional support to students through tutors, mentors, or supplementary instruction. The third provides stipends directly to students in exchange for work on departmental research.

In all three papers, the authors explain ways in which they improved the quality of instruction to make students more successful in their academic experiences.

Presentation Overviews

I. *Intensive Intervention in the First Courses in Computer Science*

Kleanthis Psarris, The University of Texas at San Antonio

Summary

- Modernize the content of the first computer science course by integrating the laboratory material with the lectures.
- Provide peer tutoring to enhance learning.
- Incorporate advising and career services support to improve student understanding of career opportunities early in their academic programs.
- Provide one-on-one mentoring.

Observations and Conclusions

- Percentage of students who took first course and graduated within six years increased from about 25 percent to about 35 percent.
- Student mentors recruited had earned a 3.8 GPA for the course themselves and received scholarships.
- Ratio of mentors to students was about 1:2; UTSA is spending about $50,000/year on tutors and $60,000 per year on mentors.

II. *Collaborative Learning as a Tool for Retention of Engineering Students*

Frank J. Claydon, University of Houston

Summary

- “Redshirt Camp” created for Electrical and Computer Engineering students between freshman and sophomore years, with weekly follow-up workshops during sophomore year.
- All rising sophomores and transfer students invited. There was no cost to the student for the camp.
- Emphasis is on collaborative learning. Students who complete the camp received a book scholarship.

Observations and Conclusions

- Students who participate significantly increase pass rates on subsequent courses.
- Most important camp/workshop topics are problem solving, time management, and critical aspects of math and physics.
- Facilitators must be trained on collaborative learning techniques.
- Camp to be made mandatory for transfer students.

III. *Women in Research Development (WiReD) Program*

Peggy Doerschuk, Lamar University

Summary

- Female students given $1,000 per semester stipend to work one-quarter time on research projects.
- Autonomous robotics is current research area. LEGO® MINDSTORMS™ robotics kits were used.

Observations and Conclusions

- Program has proved successful in increasing retention rate of women students.
- ExxonMobil provided student stipends for three years.
- It would be desirable to increase stipends so students would not need off-campus jobs.

Discussion Session II – *Best Practices for Retention* (Continued)

Brad Beavers (Intel-Austin), Moderator; Anastasia Kurdia (UT-D), Recorder

The session included four papers which collectively addressed retention challenges along the following lines:

- How can we provide more effective academic help to students so that they do not "give up" on engineering when they encounter particularly tough courses?
- What significant non-academic factors reduce engineering retention and how might we counter those factors?

The four papers were:

I. ***Peer Teachers***, Valerie Taylor, Joseph Hurley, Lawrence Petersen, Jennifer Welch, Frank Shipman, Texas A&M University
II. ***Students Mentoring Students***, Raymond Shoults and William Dillon, The University of Texas at Arlington
III. ***Mentoring and Learning Communities for Entering Freshmen***, Richard H. Fowler and Peter A. Ng, The University of Texas-Pan American
IV. ***Engineering Retention Enhancement through On-Campus Jobs***, Heinrich Foltz and Edwin LeMaster, The University of Texas-Pan American

Common Themes

1. Students helping students is an effective concept. TAMU implemented this with a "Peer Teacher" model; UTA implemented it as a mentor model through student organizations. Key points:

- Student teachers must *help*, not *do* (e.g., peer teachers at TAMU never touch the mentee's keyboard).
- This should be a paid job for the teaching students to build a stronger sense of commitment.
- Peers/mentors must be screened or interviewed against clear criteria; program quality is most influenced by them. A feedback loop is necessary to evaluate their performance.

- Peers/mentors must have no connection to the grading process; a safe environment to ask "dumb" questions must be established.
- There is a widely recognized need to apply the peer/mentor model to math classes, not only engineering or computer science. Foundational math coursework is a common exit point for some potential engineering students.

2. Many students need more than academic help, especially on a campus which is comprised of commuting students, many of whom may be first-generation college attendees. Key points:

- Students need an on-campus community and a network of teachers, faculty, and peers for fun, accountability, and help. In the UTPA experience, many students need help to form these networks and to know how to interact on campus since they may not have family or peers to serve as role models for this behavior. UTPA works hard on building this community.
- These same students, once networked, still need significant mentoring and counseling beyond the academics. Examples: financial aid, time management, realistic work/course load balancing, and career options/directions. Mentoring at UTPA covers these topics in addition to the academics.
- Employment is often a social expectation in addition to a financial one. UTPA has implemented a program to give employment *on campus* to meet this need while still keeping the students engaged in the on-campus community structures mentioned above.

3. Do the retention programs described have an additional benefit of helping recruitment?

- Feedback consistently indicates a positive impact but the magnitude of that impact has not been measured and is not yet clear.

Parents of prospective students sometimes ask about what kinds of help students can get, but it is not clear how many (if any) enrollment decisions are decided by this topic.

Common Challenges

The common challenge discussed during the session was funding. Cost of student employment was one key consideration of the papers, even if/when the implementation of administration was absorbed into existing staff roles (this was mostly the case, with staff supporting these programs through passion and praise, not because of special remuneration). Student fees and usage of deregulated portions of tuition increases are options for longer-term funding.

Summary Comments

During the closing comments, the session moderator reflected on his own freshman engineering experience 25 years ago. He noted that there were many tough classes and high dropout rates back then, as now, but in that era the "freshmen weed-out" was openly discussed as a necessary and healthy part of determining ready students. It was noted that 25 years ago, as today, it was often the students who quickly formed study groups and leveraged their peers and grad students who were most successful. Looking

at today's situation with a shortage of STEM graduates, it is clear that "freshman weed-out" is a brute force approach that needs modification. The modification is not to make classes less difficult but rather to guide and accelerate students' engagement is the school community such that they quickly form a network of help. The four papers in this session all addressed this topic. Feedback from the conference attendees strongly endorsed the learning communities as a key part of undergrad engineering retention.

Discussion Session III – *Best Practices for Recruiting*

Dan Marcek (H-P), Moderator; Vishal Bahn (UTA), Recorder

The goal of the Texas Engineering and Technical Consortium is to double the number of engineering and computer science graduates. While there are clearly opportunities for increasing the number of graduates by improving graduation rates, the most effective mechanism for increasing graduates is enrolling more students in engineering and computer science disciplines.

The perception that employment in the information technology industry is subject to boom-and-bust cycles and that the industry is moving offshore adversely affects enrollments in engineering and computer science. Students, parents, and counselors are not aware of the opportunities in this industry.

Recruitment of women into engineering and computer science fields has been disappointing. Percentages and absolute numbers of women entering these fields are down or essentially static over 20 years.

This session includes three papers. The first describes an innovative program for attracting girls to computer science. The second shows how programs specifically structured to meet the needs of working adults can increase enrollment. The third focuses on the importance of high school counselors in student career decisions.

Presentation Overviews

I. Girls Reaching and Demonstrating Excellence (GRADE) Camps: An Innovative Recruiting Strategy at the University of Houston to Increase Female Representation in Engineering

Frank J. Claydon, University of Houston

Summary

- Of 400 high school students, about 40 currently take a pre-college curriculum and about 8 choose engineering and of those only one or two are female.
- A “camp” for high school girls between their junior and senior years provides information about engineering as a career.
- The emphasis of the camp is on career exposure rather than on career choice. It utilizes active, cooperative learning and hands-on experiences.
- Students who successfully complete the camp were awarded $1,000 scholarships if they subsequently enrolled in electrical and computer engineering at UH.

Observations & Conclusions

- Pre- and post-camp assessment tests indicate that the camps positively impact student perspectives on engineering as a career.
- The camps are successful because they make girls feel comfortable in an engineering setting.

II. Enhancing the Computing Workforce by Providing Higher Education to Working Professionals

Moonis Ali, Texas State University-San Marcos

Summary

- The Austin area has a large number of technology workers who are unable to pursue a computer science degree because they have full-time jobs during the day.
- Texas State University-San Marcos implemented an undergraduate degree program specifically for these students at its Round Rock Education Center.
- The degree program is a cooperative venture with Austin Community College. It also makes extensive use of adjunct professors who are working professionals in the Austin area.
- The program was advertised in a variety of ways, including billboards and direct mail.

Observations and Conclusions

- Since its initiation in fall 2001, the program has grown to produce approximately 60 baccalaureate graduates per year.

III. Counselor Update Events

Janet Lind, The University of Texas at Dallas

Summary

- High school counselors are extremely influential on college-bound students. Because of publicity regarding the dot-com bust and outsourcing, many counselors do not encourage good students, especially female students, to study engineering or computer science.
- UTD staff conducts Counselor Updates in Texas and neighboring states to provide counselors with information about opportunities in engineering and computer science. These sessions typically precede the department's "College Nights" recruitment activities by a few weeks.

Observations and Conclusions

- Because the numbers are relatively small and because the times between counselor contacts and student enrollments are typically long, it is difficult to measure effectiveness.
- However, the need to improve counselor attitudes and knowledge regarding opportunities in engineering and computer scientists is very apparent.

Discussion Session IV – *Best Practices for Curriculum Revision*

Monte Cely (AT&T), Moderator; Archana Krishna (SMU), Recorder

Section IV of the conference presented five curriculum revision best practices. The general goal of these curriculum revisions was to enhance retention of new or transfer

undergraduate students. Common themes were that retention rates can be enhanced through the following approaches:

- New and revised course offerings should create a sense of excitement about the academic degree program and corresponding professional opportunities.
- A sense of community and belonging should be created among freshmen, sophomore, and transfer students.
- The courses can become attractive and engaging by coupling them with hands-on experience in labs, team projects, and early research opportunities.

Supporting strategies and tactics include:

- Engagement of key faculty interested in and capable of teaching introductory courses.
- Exposure to senior faculty in the department.
- Resources, including funding, to support faculty time, teaching assistants, lab gear, and tools.

Presentation Overviews

I. Setting Student Expectations with a Majors-Only Programming Course

David M. Keathly, University of North Texas

Summary

- Student retention was improved by splitting the introductory computer science courses to suit the needs and capabilities of both majors and minors.
- Retention rates were improved with the Help Labs that were staffed by graduate students who assist students in the use of various departmental and university computer systems and related resources.

Observations and Conclusions

- Retention rate between freshman and sophomore increased from 40 to 60 percent.
- There was also an increase in the number of students with computer science minors who enrolled in the non-major course.

II. Introduction to Electrical and Computer Engineering Course to Improve Retention Rate

Archie L. Holmes, Jr., The University of Texas at Austin

Summary

- The students were grouped in teams.
- The course used a challenge model. The model is based on a Purdue University idea, in which the students are given challenges and deadlines. Challenges were categorized into different levels.
- Team competitions were more of a hit/miss success.

Observations and Conclusions

- Through the projects the students learned design tradeoffs, software engineering, etc.
- Peer grading allowed the evaluation of individuals in a team and to overcome unequal contributions to the team's success.

III. Curriculum and Instructional Enhancement of Gateway Courses

Narasimha Reddy, Texas A&M University

Summary

- The intention for this strategy was to interest and challenge students, through hands-on labs, for a variety of problems and challenges. The introductory course helped the students to understand the roadmap of their program.
- The key thing was to involve senior faculty in teaching the course.
- The focus was on the 80 percent of the students who are sure of pursuing electrical engineering and computer engineering.

Observations and Conclusions

- The number of graduates increased steadily from 126 to 204 between the fall of 2001 and the fall of 2004.
- Faculty teaching higher-level courses gave positive and qualitative feedback.

IV. Introduction to Electrical and Computer Engineering Course to Improve Retention of Freshman Students

Mohammad Saed, Texas Tech University

Summary

- A new and innovative introductory course for electrical and computer engineering students helped improve retention rates. The objective of the course was to provide fundamental concepts and tools that are very useful throughout their time of study and for their future careers.
- Workshops or lab sessions were integrated with the course and helped stimulate student learning. These workshops don't focus only on robotics but on various other subject matters.
- Common ground was achieved by enforcing MATLAB and PSpice usage for projects.

Observations and Conclusions

- Course withdrawal rates were reduced while course completions increased..

V. Turing Scholars Program

Calvin Lin, The University of Texas at Austin

Summary

- The strategy provided an honors program aimed at higher-SAT and higher-GPA students.
- It offered opportunities for undergraduate research with nationally ranked faculty. This created a smaller community within the larger computer science department and the university.
- This program aimed at recruiting and retaining the best undergraduate students in the school.

Observations and Conclusions

- Some of the best students from Texas chose UT Austin over other highly ranked schools like MIT, Carnegie Mellon, etc.
- Some of the honor students obtained internships in organizations like NASA. Others obtained employment at IBM, Microsoft, or Sun Microsystems. Thirty-six of these honor students obtained an average of two scholarships during the 2003-2004 academic years.

Discussion Session V – Experiences with Statewide Implementation of the Infinity Program

Tammy Richards (SMU), Moderator; Dhia Majhoub (SMU), Recorder

The Infinity Project was developed at SMU and subsequently adopted for statewide implementation at TETC universities in 2002. It has also been adopted at over 160 high schools and a number of other colleges and universities. The Infinity Project provides a series of hands-on experiences that generates interest in engineering careers among high school students or college freshmen.

By developing linkages with high schools and using programs such as the Infinity Project, SMU has been able to maintain engineering enrollments and increase the percentage of female engineering students to nearly double the national average.

This session consists of four papers dealing with experiences related to the use of the Infinity materials in freshman engineering classes at TETC universities.

Presentation Overviews

I. Paradigmatic Labs for Introduction to Electrical Engineering

Harley R. Myler, Lamar University

Summary

- The Infinity Project was incorporated into the electrical engineering curriculum as a freshman class. The project leader thought that the course provided an inadequate emphasis on topics other than digital signal processing.
- The course was expanded through the addition of lab exercises based on National Instrument's ELVIS system.
- The department developed a simpler, less-costly prototyping board that works with the ELVIS station for students to buy and use. Courses throughout all four years of study utilize this board.

Observations and Conclusions

- Students in the course obtained a broader introduction to electrical engineering. ELVIS and the locally developed prototyping board provided a common platform that was used in a number of more advanced courses.
- Enrollment and graduation data suggest that the new introductory course has been effective in recruiting and retaining electrical engineering students.

II. Increase Retention through the Use of the Infinity Project

John O. Attia, Prairie View A&M University

Summary

- Prairie View A&M University developed a new introductory electrical engineering course in 2002 and used the Infinity materials essentially without modification.
- Two faculty members attended the 2002 Infinity Workshop to be trained on the use of the Infinity kits.

Observations and Conclusions

- The retention rate of students who have taken the Infinity course is above 80 percent, well above the rate for students in the institution as a whole.

III. Cross-Disciplinary Early Engineering Design Experiences for Undergraduates

Scott C. Douglas, Southern Methodist University

Summary

- The Infinity project has a proven track record as an effective tool for teaching electrical engineering principles and generating interest in electrical engineering among students.
- In many institutions, the introductory engineering course includes an introduction to a variety of disciplines, so using the Infinity materials without modification is not feasible.
- This strategy used an extension to the Infinity concept by incorporating cross-disciplinary design experiences (electrical engineering and mechanical engineering).

Observations and Conclusions

- Administration of the cross-disciplinary design experiences was complicated because it involved coordinating faculty and graduate assistants in at least two departments.
- Student received the experience very well, according to surveys.
- Much real-life engineering work involves cross-discipline design experience, and this provided an early introduction to this kind of work.

IV. Modification of the Infinity Kits to Provide Improved Hands-On Experiences

Jonathan Bredow, University of Texas at Arlington

Summary

- The Infinity kit, as currently structured, may not allow sufficient opportunity for students in an introductory electrical engineering course to experiment with hardware.
- This strategy provided tested plans for Infinity kit modifications that support experiments with basic circuit components, electronic circuits, and comparing and combining digital and analog implementations of common functions.
- UTA developed a new curriculum for the “modified” Infinity kits that utilize MATLAB or LabView to deliver program code to a processor incorporated into the system.

Observations and Conclusions

- The modified Infinity kits are currently being tested in selected experiments in a freshman electrical engineering course at UTA and in outreach activities to the Arlington Independent School District.

Concluding Discussion

Ray Almgren, Moderator

Ray Almgren, Vice President, Product Marketing and Academic Relations, National Instruments, Austin, led the discussion and posed the questions for this final session of the conference. *What should be the consortium's next steps? What use should be made of what has been learned at the conference? What does the consortium need to do to encourage implementation of the ideas discussed?*

Summary of Discussion

One of the goals of the conference was to identify programs that should be given a priority in future grants, and there was support from several people for doing that. For example, the consortium might consider giving a priority to funding peer teacher programs or one of the other successful ideas.

There was broad-based support for making information presented at the conference available to persons who didn't attend. Putting the information on the web was suggested. Ray Almgren noted that he was meeting soon with representatives of the American Society of Engineering Education (ASEE) and would look into opportunities to disseminate best practices information through its conferences and publications.

There was some discussion about the extent to which good work done in other universities around the country is being used in Texas. It was pointed out that many of the papers presented at the conference referenced out-of-state work, but TETC might wish to prepare an archive of relevant papers that would be easily accessible by Texas departments.

Participants were asked if they would be willing to visit other campuses as "master teachers" of best practices. Although there were no volunteers, when they were asked if they would be willing to visit other campuses to present a lecture on best practice for which visuals had already been prepared, a number of persons indicated that they would do this. It was suggested that preparation of this lecture might be an appropriate task for TETC and UT-Dallas.

It was suggested that the conference results be provided to possible corporate sponsors, such as Oracle or Microsoft, as justification for joining the consortium.

There was some discussion about future conferences. There was strong support for continuing the conference on an annual basis and for involving more faculty members. Future conferences could possibly have somewhat different emphases. For example, rather than concentrating on what has been done, perhaps the conference should focus on brainstorming ideas that could be tried in the future. As another example, a future conference might wish to give more emphasis to recruiting rather than retention, which was a major focus of this conference. It was noted that future conferences should be more widely publicized.

Tegwin Pulley, Vice President, Workforce, Diversity & WorkLife Strategies, Texas Instruments, noted that TETC has good recognition in state government. The Governor's Office has a strong emphasis on workforce issues and, as a result, TETC was selected to submit a Workforce Innovation in Regional Economic Development

(WIRED) grant to the U.S. Department of Labor. The Texas Workforce Commission has committed to providing $1 million to TETC if the grant is funded.

At several points during the conference, the relationship between problems in K-12 education and low engineering and computer science graduation rates were noted. It is believed that many of the ideas developed by TETC will also be useful in the K-12 system, although because it is much larger, implementation problems will be much more difficult.

Ray Almgren thanked all those who attended for their contributions and participation. He 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.

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