

AC 2009-1420: BUILDING AN ENGINEERING TECHNOLOGY WORKFORCE: A PLAN FOR REACHING YOUNG PEOPLE, ADULTS, AND WOMEN

Dorene Perez, Illinois Valley Community College

DORENE PEREZ, Program Director/Instructor of CAD/CAE at IVCC, is Principal Investigator for National Science Foundation grant #0802505, was PI for NSF grant #0501885, and served as a consultant on NSF grants at Moraine Valley and Sinclair Community Colleges. Co-Leader of the Tech Prep and Partnerships for College and Career Success teams, she has been recognized for pioneering in online courses. Prior to teaching, she served five years as a CAD manager in industry.

James Gibson, Illinois Valley Community College

JIM GIBSON, Program Director/Instructor of Electronics at IVCC, is Co-Principal Investigator for NSF grant #0802505 and was co-PI for NSF grant #0501885. A former State Director of the Illinois Association of Electronics and Electrical Educators, he has extensive industrial experience. In 2005, he was named Outstanding Faculty by the National Association of Industrial Technology. He holds an M.S. and B.S. in Industrial Technology, minor in chemistry, from Illinois State University.

Sue Caley Opsal, Illinois Valley Community College

SUE CALEY OPSAL, anatomy and physiology instructor at IVCC, is Co-Principal Investigator for NSF grant #0802505 and served as internal evaluator for NSF grant #0501885. She has extensive experience leading math, science and technology camps for middle school girls and is an experienced grant writer. In 2008, she received the Faculty Excellence Award. She holds an M.S. and B.S. in biology from the University of Wisconsin.

Rose Marie Lynch, Illinois Valley Community College

ROSE MARIE LYNCH, communications instructor at IVCC, is Co-Principal Investigator for NSF grant #0802505 and was co-PI for NSF grant #0501885. Co-leader of the Tech Prep and Partnerships for College and Career Success teams, she served as co-director of the Center for Excellence in Teaching, Learning and Assessment. In 1999, she was named Illinois Professor of the Year by the Carnegie Foundation. She holds a Ph.D. in English from Ball State University.

Building an Engineering Technology Workforce: A Plan for Reaching Young People, Adults and Women

“Building an Engineering Technology Workforce: A Plan for Reaching Young People, Adults and Women” is a comprehensive recruiting project to increase the number of people who prepare to enter engineering and engineering technology careers. With support from an Advanced Technological Education grant from the National Science Foundation and guided by research in career selection, the project addresses the barriers that prevent the target groups from selecting engineering:

- For young people, the major barrier is perceived difficulty.
- For adults, the major barrier is lack of awareness of engineering career benefits.
- For women, the major barrier is the perception of engineering as not feminine and not relevant to their lives.

This project builds on an NSF grant Illinois Valley Community College (IVCC) received in 2005, which incorporated some recruiting efforts. Activities in that grant generated interest in engineering, but the activities were sporadic. Informed by those results, the initiatives in this project that target young people are being offered in a sequence to create and build interest in and commitment to careers in engineering technology.

While this project is designed to encourage people to commit to engineering careers in general, activities highlight the opportunities from two-year degrees, the work of engineering technicians. Thus, efforts to reach adults seeking career changes focus primarily on the rewards from pursuing and meeting the practical goal of completing a two-year program.

Addressing Barriers to Selecting an Engineering Career

Research conducted by the South Carolina Advanced Technological Education Center of Excellence indicates the major reasons students don't choose engineering technology programs are

- The perceived difficulty of engineering technology programs, and
- The lack of awareness of engineering technology career benefits.¹

Perceived difficulty is the biggest barrier for traditional-age students; many young people are especially uncomfortable with math and science requirements, as a National Science Foundation report points out.² Lack of awareness of benefits or opportunities is the biggest barrier for older, non-traditional students.³

The South Carolina ATE Center's research also shows that family and friends of women are not likely to recommend engineering technology careers because of the male-dominated image of the field.⁴ In addition to engineering being perceived as a man's job, The Extraordinary Women Engineers Project (EWEP) Report indicates that family, teachers and counselors don't recommend engineering careers to women because they don't understand what engineering is.⁵ Additional research into women's educational and career choices identifies a conflict between the image of engineering and women's needs

and goals. Young women believe that engineering careers do not provide camaraderie or a supportive community, and engineering careers are not feminine.⁶ A survey of K-12 teachers and counselors suggests they believe women are not prepared to do well in engineering.⁷ Another survey, conducted by the ASEE Engineering K12 Center, found that "...[teachers] believe that many – and especially females and minorities – cannot succeed in the engineering world."⁸ Thus, it is not surprising that research reveals many young women avoid engineering because they lack technical experience and technical confidence.⁹

The activities in this project address those barriers.

For young people:

- The perceived difficulty of engineering technology programs is being addressed by engaging middle school and high school students in inquiry-based activities that integrate science, technology, engineering and math (STEM) to make them more aware of the practical applications of math and science, make them more comfortable with math and science, and encourage them to pursue further study.
- Lack of awareness of engineering technology career benefits is being addressed by providing students with information, as a part of the inquiry-based activities, through their interactions with industry representatives, and on field trips. Promotional materials will also be disseminated to their parents.

For adults seeking career changes:

- Lack of awareness of engineering technology career benefits is being addressed by developing informational and promotional materials and disseminating them where they will be accessed by adults. Those materials highlight salaries and job opportunities; and they focus almost entirely on two-year degree programs at IVCC that will prepare them to be engineering technicians.

For women:

- For young women, the perceptions that engineering technology careers are not feminine and lack a sense of community and relevance is being addressed by engaging them in team exercises that result in "make and take" products and through their interactions with women in engineering technology careers and women studying in engineering programs. Their lack of technical confidence is being addressed by limiting some activities to women and by providing the technical background necessary for the activities. Gender-specific promotional materials will also be disseminated to them and their parents.
- For adult women, the misperceptions of engineering technology and lack of awareness of career opportunities is being addressed in informational and promotional materials that are age and gender-specific. Their misperceptions of engineering and lack of technical confidence are being addressed in events similar to those offered to young women and age appropriate.

Providing Activities for Young People in a Sequence

From 2005 to 2008, IVCC offered engineering-career-related activities to middle school and high school students in the IVCC college district as a part of an NSF-funded project.

Those activities did generate interest in engineering careers, but that interest did not result in enrollment growth in engineering or engineering technology programs at IVCC. Given the barriers to selecting an engineering career that have been identified, the activities in that project were too sporadic to change attitudes. The previous activities also did not address the need for better preparation and confidence in math and science.

Informed by results from the previous NSF grant, current project activities that target young people are being offered in a sequence to create and then build interest in and commitment to careers in engineering technology. The sequence starts with short-term special events offered to a broad base of students. Capitalizing on that interest, longer-term, more intense activities are provided.

The sequence of activities is not yet fully developed since this three-year project is in its first year. Middle school students have participated in short, hands-on, high interest STEM activities this year; longer activities, such as clubs and inventors' camps, are being planned for next year.

At the first high school participating in the project, the sequence includes:

- Special events, such as an Edible Car Contest in which student teams compete in building vehicles entirely from food items.
- A Tech Club, affiliated with the Technology Student Association and open to students with an interest in any STEM area. Club members participate in hands-on activities, projects, field trips, leadership activities, and eventually will participate in contests.
- A Taste of Engineering Course (TEC) offered for IVCC credit and open to high school juniors and seniors who are members of the Tech Club. The project-based course utilizes the building of a guitar to introduce students to engineering-related concepts. The course emerged from the e-CREATE program of the Midwest coalition for Comprehensive Design Education at Purdue University¹⁰ and is taught by a team of high school and community college instructors who are utilizing a course outline drafted by R. Mark French, assistant professor in the Department of Mechanical Engineering Technology at Purdue.¹¹
- A Leadership Team of promising high school students, modeled after a highly successful team at IVCC. Members of the Tech Club who demonstrate leadership potential will be invited to join. They will be provided with opportunities for developing and practicing their leadership skills, which will include assisting with high school and middle school activities. Future plans call for one or two members of the Leadership Team to receive an award to attend a project-based engineering camp hosted by a university.

Science, technology and math exercises are being integrated into those initiatives; and science, math and technology teachers are being encouraged to integrate engineering activities into their courses. Teachers are being provided with STEM modules, such as those available through the ASEE K-12 Center,¹² and two NSF Centers, the Regional Center for Next Generation Manufacturing¹³ and the National Resource Center for

Materials Technology Education¹⁴. Teachers will also be paid a stipend to develop their own.

To encourage broad participation and “buy in” from the high school staff, grant initiatives at the high school are being guided by a planning committee that includes representatives from the math, science and counseling departments. The committee also reviews grant activities to see that they complement the high school’s efforts in Project Lead The Way and High Schools That Work.

Informational and promotional materials targeting young people and targeting their parents are still under development. Posters designed to motivate young people to select engineering careers have been developed through a poster contest for high school students. Next year the contest will be expanded to include and target middle school students.

A tea for high school women is being planned. High school juniors and seniors identified by their instructors as potential engineering or engineering technology candidates will be invited. The young women will be introduced to women engineers and women engineering students who can serve as role models. As a traditionally female social event, a tea may be effective in helping to dispel the misperception of engineering as a male enclave.

Providing Activities for Adults

Efforts directed at adults have concentrated on developing informational/promotional materials and offering a special event for women during this first year of the project. While national organizations such as the Institute for Women in Trades, Technology and Science do provide resources that target adult women and promote two-year programs¹⁵, there is a need for additional materials targeting adults, especially adult men. A series of flyers is being developed for dissemination at a shopping mall, at community events, and on campus through the Dislocated Workers Center, the Adult Education Center, and a Job Fair. One set of flyers, for example, is designed to resemble paychecks to draw attention to salaries for engineering technicians. In general, the promotional materials that target adults focus on the job opportunities, rewards and benefits available to engineering technicians and provide information about two-year programs at IVCC since adults are likelier to consider short-term, affordable educational commitments at a site close to home.

The special event planned for women is being offered in collaboration with the Starved Rock Associates for Vocational and Technical Education, a regional agency that provides career education services. Single mothers will be engaged in an activity resulting in a “make and take” product, a child’s toy. The informational materials they will be given, as described above, will focus on opportunities from two-year programs.

Building on Early Initiatives

Next year, the high school sequence of activities will be expanded to a second school, and the middle school sequence will be fully developed and piloted at one school. Web sites, one targeting middle school students and one targeting high school students, are being developed and should also be available. Adult initiatives will be expanded to reach people in outlying areas of the community college district.

In the third and final year of the project, initiatives will expand to an additional high school and middle school, and adult outreach will continue to expand throughout the college district.

Evaluating Project Effectiveness

All initiatives in this project are being evaluated on the basis of whether they increase or improve participants' awareness and perceptions of engineering careers. Eventually, the entire project will be evaluated on the basis of whether participants are more likely to consider an engineering career and/or if they actually enroll in engineering or engineering technology. Since the project is just getting underway, it is too early for significant results. Preliminary indications are encouraging; evaluations of early activities are positive and show an increase in awareness. On-going evaluations of activities throughout the three years of the project will allow the most effective initiatives to be identified and less effective ones to be modified or dropped. The result will be an effective and replicable plan for building an engineering technology workforce.

References

1. South Carolina Advanced Technological Education Center of Excellence. Monograph: Recruitment and retention of engineering technology students. 2000. p. 13. <http://www.scate.org/pdfs/monograph/pdf>.
2. National Science Foundation Engineering Task Force. The engineering workforce: Current state, issues, and recommendations. 2005. p. 25.
3. South Carolina Advanced Technological Education Center of Excellence. Monograph: Recruitment and retention of engineering technology students. 2000. p. 13. <http://www.scate.org/pdfs/monograph/pdf>.
4. South Carolina Advanced Technological Education Center of Excellence. Monograph: Recruitment and retention of engineering technology students. 2000. p. 37. <http://www.scate.org/pdfs/monograph/pdf>.
5. Extraordinary Women Engineers Project. Extraordinary women engineers: Final report. 2005. p. 1. <http://www.engineeringwomen.org/pdf/EWEPFinal.pdf>.
6. Thom, J.M., R.E. Thompson, and C. Hoy. Understanding the barriers to recruiting women in engineering and technology programs. Proceedings of the 2001 American Society for Engineering Education Annual Conference & Exposition. 2001. http://www.asee.org/adPapers/01059_2001.pdf.
7. Yasar, Senay., et. al. Development of a survey to assess K-12 teachers' perceptions of engineers and familiarity with teaching design, engineering and technology. Journal of Engineering Education, July 2006. p. 213.
8. Douglas, Josh, Eric Iversen and Chitra Kalyandurg. Engineering in the K-12 classroom: An analysis of current practices and guidelines for the future. ASEE Engineering K-12 Center. 2004. p. 11.
9. Thom, J.M., R.E. Thompson, and C. Hoy. Understanding the barriers to recruiting women in engineering and technology programs. Proceedings of the 2001 American Society for Engineering Education Annual Conference & Exposition. 2001. http://www.asee.org/adPapers/01059_2001.pdf.

10. Midwest Coalition for Comprehensive Design Education. E-Comprehensive product REalization in Advanced Technology Education. Guitar project. <http://e-create.org/projects/guitar.php>.
11. French, Richard Mark. Engineering the guitar: Theory and practice. Springer. 2008.
12. American Society for Engineering Education. Engineering K-12. <http://www.engineeringk12.org>
13. Regional Center for Next Generation Manufacturing. <http://www.nextgenmfg.org>
14. National Resource Center for Materials Technology Education. <http://www.materialseducation.org>.
15. Institute for Women in Trades, Technology & Science. WomenTech World e-Store. <http://womentechstore.com/index.html>.