Work in Progress: Utah’s Engineering Initiative

Amy Aldous Bergerson, Cynthia Furse

University of Utah, amy.bergerson@utah.edu, Cfurse@ece.utah.edu

***Abstract* - In response to a shortage of engineers in Utah an interdisciplinary team at the University of Utah developed an outreach program intended to increase the number of students recruited into the College of Engineering and who complete engineering degrees. An innovative mix of service learning, outreach, and peer mentoring comprises the program. Recruitment efforts include outreach, integration with teachers and public relations. In outreach, college students work with high school teachers and engineering faculty to prepare and present engineering-based teaching modules that meet requirements of the state core science curriculum. Education and public relations materials aimed at students, parents, teachers, and counselors also contribute to outreach. Retention efforts include academic advising, tutoring, peer mentoring, and service learning. Retention programs are based on college student retention research, and focus on engaging students both academically and socially. This paper reports on the first year of the initiative, including the creation of outreach teams and the development of high school teaching. We also discuss how participation in the outreach team impacted current students.**

*Index Terms* – Outreach, Recruitment, Retention, Students.

Introduction

The state of Utah faces an increasing shortage of engineers. According to the 2007 Utah Engineering Workforce Data Survey, there are currently over 400 open engineering positions statewide that require at least a Bachelors degree, and another 575 anticipated positions will need to be filled in 2008. In response to this shortage, an interdisciplinary team of faculty at the University of Utah developed an outreach program intended to increase the number of students recruited into the College of Engineering, and raise the number of students who complete engineering degrees. In addition to University of Utah faculty and staff, faculty from Salt Lake Community College (a main feeder school for the University of Utah) and local high school faculty and MESA/STEP advisors participated in the development of the program. An innovative mix of service learning, outreach, and peer mentoring comprises the program.

The goal of the project is to establish a sustainable high school/two-year college/University transition program that nurtures students and increases the number of engineering/ computer science graduates at the University by at least 180 per year. The program is funded in part by the National Science Foundation. This paper describes the recruitment and retention efforts of the program’s first year in detail.

Program Overview

In 2000, Utah’s governor challenged the state’s higher education system to double the number of engineering and computer science graduates. Utah’s Engineering Initiative supports this vision through a university/community college/high school partnership that captivates the imaginations of high school students, mentors them through a pre-engineering curriculum, and seamlessly transitions them to successful college graduation in their selected engineering discipline. Once they enter the University, this program helps them gain confidence as tutors/mentors, collaborating in curriculum module development and team engineering projects, and participating in service learning community engineering projects. The focus of the program is on recruiting students and retaining them to graduation.

 Essential to the program is an interdisciplinary approach. Grant team members include: faculty representing each discipline in the College of Engineering who coordinate and lead outreach team efforts; faculty from Nursing and Educational Leadership and Policy involved in program assessment; staff from the University’s Bennion Community Service Center, assisting in the development and implementation of the service learning component; academic advisors both at the University and College levels; faculty from Salt Lake Community college, who participate in outreach teams as well as endeavors to smooth students’ transition between the College and the University; teachers and MESA/STEP advisors from local high schools; and an advisory board comprised of local businesses supporting engineering initiatives. This energetic and diverse team ensures that multiple angles to the issues of recruitment and retention are addressed in the program’s efforts.

Recruitment Programs

A primary goal of Utah’s Engineering Initiative is to increase awareness of engineering as a college major and career field. Programs developed to reach this goal include high school outreach, targeted public relations materials, and improved advising both at the University and College levels. Assessment and evaluation of each of these components is ongoing.

 High school outreach is the most developed aspect of the program. Each Department within the College of Engineering has established an outreach team, which includes current University of Utah students and faculty, Salt Lake Community College students, and high school teachers. Teams typically have 3-5 students ranging from freshmen to seniors, a faculty advisor and one high school teacher. In the first year of the program, outreach teams developed hands-on demonstration projects to present in local high school classes and MESA/STEP meetings.

 The focus of the demonstration projects was to illustrate the application of engineering to real life situations. For example, Electrical Engineering students showcased an electro-magnetic ring launcher, which illustrated the concepts of projectile motion, induction, and heat. Mechanical Engineering students created a hydraulic arm, which in itself was an iterative project that included several prototypes. Focusing on the local community, Civil and Environmental team developed a project highlighting the math of Trax, Salt Lake City’s light rail train system. All of the projects emphasized the “real” side of engineering, helping high school students understand how engineering solves society’s problems.

 In addition to developing modules that enhanced high school teachers’ core curriculum, outreach team faculty focused the college students’ development of strong presentation skills and the ability to connect at the high school students’ level of academic and social development. The teams showcased their demonstration and talked with high school students about engineering generally in sessions lasting from 15 minutes to an hour. At the end of each presentation, high school students and their teachers were asked to complete a short evaluation form, which provided feedback to the grant team regarding the effectiveness of the presentations. Initial data show that the presentations were effective in educating students about engineering as a career field.

 While meeting with high school student groups was a successful way to introduce them to engineering, one challenge to the program team was the reluctance of high school teachers to make time during class for outreach presentations. In response to this challenge the outreach teams developed teaching modules in both written and video formats, which high school teachers could easily incorporate into their course materials. Teacher and student feedback on approach indicates that while it is easier for the teacher to include the information in class sessions, the students find the interaction with college students to be more effective. This is not surprising, given that several college students on the outreach teams indicated that having similar personal contact with college engineering students would have made a positive impact on their own decisions to pursue engineering as a major. As the program team moves into its second year, we face the challenge of maximizing the opportunities for our message to reach high school students while respecting the time limitations of high school teachers. Currently, teams are experimenting with FaceBook, YouTube and other forms of media for presenting engineering modules to high school students, as well as working to minimize the time needed for the live demonstration projects.

 Also in response to the difficulty in accessing students in their high schools, the outreach teams have been active in on-campus recruitment programs. The University of Utah Engineering Day featured the outreach teams and their demonstration projects, as did the MESA Day program. Outreach team students also were active in mentoring high school students in the preparation of science fair projects as well as in the judging of the State science fair. Finally, the College actively recruits high school students who have an interest in participating on the outreach teams once they are University students. All of these interactions with high school students contribute to recruitment efforts.

 Another aspect of recruitment has been the systematic updating of all College of Engineering public relations materials. Realizing that the College’s materials were outdated and not appealing to a high school audience, we recruited students from the University of Utah’s “Public Relations Cases and Campaigns” course to develop a new concept and campaign for the College of Engineering’s student recruitment efforts. Teams of students created strategic plans for marketing the College, media kits (including fact sheets, news releases, features, brochures, newsletters, and direct mail pieces), and client presentations that were presented to the grant team. Materials developed by the communications students have been incorporated into both College and departmental public relations materials. In addition to updating materials and modernizing their “look,” students developed marketing campaigns targeting particular groups of students. This targeted approach now allows College marketing materials to speak directly to the following audiences: middle and high school students, Latino students, women students, transfer students and parents. As the U.S. population grows more diverse, it becomes increasingly important for the College to understand how to recruit specific populations of students into engineering. This step towards marketing materials that address specific populations reflects a response to this understanding.

 Another aspect of recruitment is improved academic advising. Advising is an issue in recruitment at both the high school and post-secondary level. The program team is working with high school advisors to provide information about engineering. The goal of this effort is to assist high school counselors in identifying students who have an interest in, and an ability to succeed in engineering.

 In fall 2008, the University implemented mandatory advising for all students. Every student is now required to meet with an academic advisor prior to registering for classes. The grant team is working with advisors who counsel undecided students, to increase awareness of Engineering options. One aspect of this effort is refining advisors’ knowledge of the different emphases that exist within the engineering umbrella, which will help students to focus their interests earlier in their academic careers. Additionally at the post-secondary level, the College of Engineering’s advising team is apprised of opportunities available for current students to participate in the NSF grant activities, including high school outreach. Increasing awareness of the College and its unique opportunities will draw students into engineering majors.

 The final element of recruitment is a summer camp experience for high school students. Realizing that summer camps for pre-engineering students abound, the University of Utah camp was developed as a “summit” at which students met to solve a problem of interest to the broader society. The 2008 topic was Bio-Innovation. High school students utilized different engineering concentrations to address the issue and worked with University faculty and students, local industry representatives, and entrepreneurs to develop action plans, which were presented at the end of the three-day camp. The camp emphasized hands-on learning experiences and speakers who spoke about opportunities in engineering that enhanced high school students’ understandings of what a career in engineering entails. Preliminary data from the summer camp shows its success in three areas: enhancing participants’ understanding of an interest in engineering, providing stimulating and real life applications of engineering for participants, and familiarizing participants with the University of Utah in general, and the College of Engineering specifically.

Retention Efforts

Retention of University of Utah students is another focus of the project team. In addition to retaining current students, programs focused on college student persistence emphasize smoothing the transition between Salt Lake Community College and the University for those students who transfer. Improved academic advising, tutoring, peer mentoring, and service learning are all part of the initiative’s retention efforts.

 Academic advising plays a role in the retention of students as well as their recruitment. Advisors at both the University and College of Engineering levels have received additional information regarding the many options that dwell within the engineering umbrella. Additionally, we are working with academic advisors at Salt Lake Community College to assist in the transition of community college students to the University environment. Armed with this information, advisors are better able to inform students of the opportunities and counsel them towards specific engineering programs. Our belief that students who find a “fit” in their major will persist and attain their degrees is supported by persistence research.

 E-LEAP is another aspect of our retention efforts. E-LEAP is a cohort based, year-long course, in which students focus on ethical issues in engineering in the fall and on how engineering contributes to community building in the United States during spring semester. Professors and advisors from the College of Engineering visit the E-LEAP classes, which exposes students to the College and helps them understand the resources available to them as they determine their specific major. The focus of the course on teamwork, and presentation and library skills, provides students with the tools they will need in their future engineering coursework. The connections to people and resources, as well as the skills developed in the E-LEAP course are all connected to college student retention. We are currently assessing the impact of the E-LEAP course on students’ awareness of engineering as a major, and on their decision of whether to continue in an engineering field.

 The College of Engineering has improved its tutoring efforts, providing a service that is available during both days and evenings. Walk-in tutoring is available, or students can sign up for specific emphases. Peer tutoring allows students to meet others who have progressed further in their program of study, thus acting as a peer mentoring program as well. Peer mentoring is also a component of the outreach teams mentioned above. In these teams, students who are earlier in their programs, or who are considering transferring from Salt Lake Community College have the opportunity to work with advanced engineering students, which allows for mentoring relationships to develop. Students who transfer to the University come with pre-established relationships as well as knowledge of the programs and people within them. Students on the outreach teams are reporting an increased commitment to engineering as a major, a heightened understanding of what engineering is about, and improved relationships with other students as well as engineering faculty as a result of their participation on these teams. All of these factors contribute to the retention of students.

 Finally, a College of Engineering service learning course is approved and will be offered to students in any engineering specialty, focusing on creating hands on projects for in-school and after-school K-12 programs. As part of the course, students will be asked to consider how community issues can be addressed through engineering solutions, and present these problems and solutions to a non-technical audience. Service learning can increase retention of students by allowing them to apply complex classroom concepts to daily life, thus enhancing their understanding of the significance of their work in the larger world. In addition, the presentation of these projects contributes to the grant’s recruitment efforts by further expanding the understanding of the College of Engineering and its specific departments with K-12 students.

 Students participating in the initiative’s outreach teams are experiencing connection to the College in ways that has an impact on their retention. Beyond the relationships mentioned above that have formed between students across stages in the major, and even across institutions, these students are participating in a type of service learning which allows them to showcase their skills with high school students. While the demonstration projects were intended primarily to show high school students the connections between engineering and the “real” world, this benefit is also present for the current engineering students. As they develop the demonstration projects and present them to high school students, they are able to clarify the connection between their work and the larger community as well. College student retention theory has shown that this connection is essential in the process of developing academic integration, which plays a key role in college students’ persistence. Several students have noted the impact of the outreach team experience in helping to maintain their commitment and enthusiasm for engineering as well as developing these real life connections with their coursework.

Program Assessment

Several elements make up the assessment of this program, including data on student recruitment and degree attainment, effectiveness of outreach team presentations from the perspectives of both high school teachers and students, qualitative and quantitative data exploring the impact of the outreach team experience on current college students, evaluation of the 2008 summer camp “summit”, and assessment of the effectiveness of E-LEAP courses.

 We are discovering that collecting assessment data is more difficult that we envisioned. In terms of the outreach presentation data, we found that faced with time constraints (sometimes demonstration projects are limited to 15 minutes) outreach teams often did not have time to pass out and collect evaluation forms.

 Data from the students involved in the outreach teams has been more consistently collected. From our quantitative data, we have learned that students want to see more structure to their outreach experiences, which is not surprising given that so far we only have data from our first group of teams. At the same time, it is clear that these students see a benefit to themselves and to the high school students from their efforts. This is most clear in the qualitative comments students have made. Our qualitative data collection will continue to focus on the impact their involvement in the outreach teams has on their persistence in engineering, which will be particularly interesting for those students choosing to continue to work with the project for more than one year.

 Summer camp data have just been analyzed, and we discovered from both survey and qualitative data that several goals of the summit were achieved. Students reported learning a great deal about engineering, and finding that this information had an impact on their interest in and commitment to engineering as a major. Further, the summit was effective in introducing students to the College of Engineering, as well as familiarizing them with the University of Utah.

 We have just begun collecting data from the E-LEAP courses, and are excited to see what impact these classes have on students’ decisions regarding college major. And, while it is too early to tell whether the program is having any significant impact on the numbers of students admitted into College of Engineering programs, we anxiously await this data.

Future Steps

We are enthusiastic about the prospects of Utah’s Engineering Initiative for increasing the enrollment and degree completion of students in engineering majors. After completing the first year of the project implementation, we several steps emerged as needing further refinement and development in the coming year. Our plans for year two include:

1. Further development and assessment of E-LEAP and service learning courses.

2. Continuing to focus on the role of outreach team participation on current college student retention, including the continued collection of qualitative data describing the experiences of students on the teams.

3. Enhanced faculty mentoring, which will provide support for faculty in their efforts to support students.

4. Continued focus on improving academic advising. This focus must include emphasis on both college-level and high school advising, with the development of ways for moving information about engineering into the hands of advisors at both levels.

5. Further development of peer mentoring, with a focus on the opportunity for peer mentoring within outreach teams and in service learning courses.

6. Qualitative data collection focusing on the experience of women in engineering, which continues to be a particular challenge at the University of Utah.

Conclusion

Utah’s Engineering Initiative is an innovative, comprehensive effort to increase the number of students enrolling in and completing engineering degrees. While it is still too early to know if these broader goals are being met, we have met several objectives leading to their achievement: the development of effective outreach teams making presentations (both personal and virtual) in high schools, the familiarizing of high school students with engineering at the University of Utah, a positive impact of participation in teams on current students’ commitment to their majors, the development of E-LEAP and service learning courses that make clear connections between engineering and the “real” world, and the development and implementation of a summer camp “summit” experience which opened the eyes of many undecided students to the possibilities of a career in engineering. Further, one of the most ambitious elements of the project, its interdisciplinary focus, has been challenging, but rewarding in the levels of implementation and assessment that are possible for the program. While not without challenges, we feel the first year of implementation has been a success, and look forward to working toward implementing our next steps in the coming year.

Author Information

Amy Aldous Bergerson, Assistant Professor, Department of Educational Leadership and Policy, University of Utah. Amy.bergerson@utah.edu

Cynthia Furse, Professor, Department of Electrical Engineering, University of Utah. Cfurse@ece.utah.edu