AC 2012-4201: GREAT EXPECTATIONS: ENGINEERING KANSAS SCHOLARS

Dr. Lawrence E. Whitman, Wichita State University

Lawrence E. Whitman is the Director of Engineering Education for the College of Engineering and an Associate Professor of industrial and manufacturing engineering at Wichita State University. He received B.S. and M.S. degrees from Oklahoma State University. His Ph.D. from the University of Texas, Arlington is in industrial engineering. He also has 10 years experience in the aerospace industry. His research interests are in enterprise engineering, engineering education, and lean manufacturing.

Karen V. Reynolds, Wichita State University

College of Engineering

Great Expectations: Engineering Kansas Scholars

Abstract

The GEEKS Program (Great Expectations: Engineering Kansas Scholars) is a National Science Foundation (NSF) Scholarships for STEM students (S-STEM) project that awards scholarships of $5,000 per year for 2 years to academically talented low-income, full-time students (in three separate cohorts) to obtain degrees in engineering at Wichita State University (WSU). The recruitment efforts specifically target low-income students in three populations: women, minorities, and students from underserved urban schools. The objectives are: to increase the graduation success among low-income students; to increase the number of students in the target populations who earn baccalaureate degrees in engineering; to develop programs to increase retention, and to provide students a transition to work through the WSU cooperative education program or as an undergraduate research assistant. This paper presents the rationale, the history, the scholarship competition, the methods implemented and initial impact of the effort.

Rationale

This effort is based on two premises on non-persistent (financial and freshmen) success:

- Financial - Many students list financial concerns as a key reason for not enrolling at WSU in general. In the Non-enrolled Student Survey conducted at Wichita State University for the Fall 2006 semester, 57% of respondents indicated that the lack of scholarships impacted their decision not to attend the university. Scholarships were the number one factor in the decision for 26% of respondents. A previous study of the same type conducted for the Fall 2003 semester showed very similar results with 55% of respondents indicating scholarships impacted their decision and 36% indicating scholarships or cost of tuition was the top reason for non-attendance. Many students that cannot afford to attend a four-year university for their entire education often start out at a community college. During their two years at community college, the aim is to get their "basics" out of the way, meaning calculus courses, physics courses, chemistry, and general education. The problem with this scenario is that students tend to have the most trouble early in the engineering curriculum with these 'basic" math and science courses. While these students are struggling with these courses at a community college, they may not have the tutoring and mentoring services our program at WSU can provide. There may be no one encouraging them to stay the course, providing them the assistance they need, and assuring them that their perseverance will pay off. The students know they are not performing well in a class and assume this is a sign that engineering is not for them. Scholarships for these students can significantly impact the numbers of students graduating in engineering.

- Students tend to drop out at higher rates in their first two years of college. The literature and our own experience at WSU suggest two primary causes for early drop outs:
    - Limited engagement with engineering major during first two years, and
    - Difficulty with calculus and physics (Dym 2006; Reason, Terezini, Domingo 2006).

History and Demographics

The WSU College of Engineering offers eight baccalaureate degrees: Aerospace, Bioengineering, Computer, Engineering Technology (beginning in Fall 2012), Electrical, Industrial, Manufacturing, and Mechanical Engineering. The graduation rate of engineering students is currently 25 percent (graduating with an engineering degree, 47% actually earn any degree at WSU), and with the existing "merit-based only" scholarship program, the graduation rate increases to almost 86% percent (see Table 1 for details).

Table 1. Graduation Rate for 2001-2002 WSU Engineering Students

Category	Freshmen enrollment	graduated
Current scholarship program	**14 (101 applied)**	**85.7%**
All WSU Engineering	**130**	**47%/25%**

Building upon the existing successful program, GEEKS added a new need-based scholarship program that aims to increase the number of students graduated by achieving a 75% graduation rate for scholarship engineering students. The GEEKS Program includes tutoring sessions, group support, community living, and study arrangements that aim to increase academic success and retention rates. The selection of GEEKS students is based on the same criteria as the current scholarship program and is described in further detail in the next section.

Student Selection

Although others have discussed the difficulty in attracting qualified scholarship applicants for the S-STEM program (Yue and Hall 2007), our existing scholarship program provides a large pool of qualified candidates. Therefore, the main mechanism for advertising and recruiting of students to apply for GEEKS scholarships will be through the existing process. As previously mentioned, in November 2007, there were 140 applicants for the existing program and 55% of the applicants were financially needy in 2006 according to FAFSA data.

The existing WSU engineering scholarship competition selects scholarship recipients based on the highest points scored at an existing scholarship competition. See Table 2 for the Scoring Components and Weights.

Table 2. Scoring Components and Weights

Component	Weight
HS GPA	30%
Math ACT	20%
Composite ACT	20%
Reasoning Test	10%
Group Activity	10%
Essay	10%

The addition to the competition for the GEEKS scholarship is an optional essay to state financial need of the applicant. Awards of the GEEKS scholarships are made based on the perceived need measured from the essay. This is due to the scholarship competition occurring prior to FAFSA

results being available. The true financial need is verified through the results of the FAFSA in conjunction with the Office of Financial Aid. In 2011, the essay was supplemented with the *FAFSA4Caster*, a web-based tool that lets families forecast their estimated contribution to a student's college expenses. Students who apply for GEEKS scholarships must be United States citizens and maintain full-time student status at WSU. Scholarships are renewable for an additional year as long as students maintain a 3.0 grade point average.

Students who do not meet the GPA requirement are placed on probation for one semester. If a student on probation fails the GPA requirement a second semester, the scholarship is awarded to a new student based on their financial need and commitment to the requirements listed above. However, there are several mechanisms in place including tutors, mentors, and course instructors, to provide advance notice of possible problems. The Persistence in Engineering (PIE) program sends a form to all GEEKS course instructors at the midterm point in the semester to assess the student's current performance in all classes (this form is similar to that used by the athletics department and is provided only for those students who have granted prior authorization).

Interventions

In an effort to address the two problems associated with early drop out (limited engagement with engineering major during first two years, and difficulty with calculus and physics), the following methods were implemented: earlier engineering involvement, mentoring, cohort scheduling, tutoring, community-building (engineering floor), and cooperative education.

Earlier engineering involvement was implemented by encouraging scholarship recipients to take the introduction to engineering course, Engineering 101. This course provides an overview of each of the engineering disciplines in order to get students thinking about the broad possibilities available as an engineer. It also provides an initial "design experience" for students where they work in multi-disciplinary teams to complete projects. This course has served well in the past to "prime" students' interest in engineering. According to Seymour and Hewitt (2000), many students leave science majors because of their unfamiliarity with the university atmosphere; therefore, an additional component of this class is to provide the students with an introduction to the university. By encouraging scholarship recipients to take this course, they are provided with early exposure to the engineering discipline, which should stimulate and help maintain their interest during the first year.

Providing mentors for scholarship recipients within their specific engineering discipline. The college has enrolled in an e-mentoring service called "Mentornet." This service provides mentors on both a local and a national basis. This mentoring, in addition to planned interaction with upperclassmen, provides new students with connections to the engineering culture and an opportunity to get quick answers and feedback from their peers.

Scheduling classes in cohorts. Students are scheduled as a cohort group during their first two years (actual advising takes place with their faculty mentor, but the planned schedule provides that most courses are taken together as a cohort). This encourages student success in these classes, as well as forming camaraderie between students creating an atmosphere more conducive to learning. Olds and Miller (2004) reported that mentoring and learning communities have a positive impact on student retention; therefore, our goal is to provide this for our students. Table 3 shows a sample schedule for GEEKS in their first two years with shaded items being classes that all GEEKS likely take together. The schedule is to consider the required

prerequisites allowing students to graduate in five years while maintaining a lower number of credit hours during the years they are taking classes and employed as a cooperative education student.

Table 3. Cohort Scheduling

Freshman		Sophomore	
Fall	Spring	Fall	Spring
Engl 101 (3) College English I	**Engl 102 (3)** College English 2	**Comm. 111Q (3)** Public Speaking	**ME 398 (3)** Thermodynamics 1
Math 242Q (5) Calculus I	**Math 243 (5)** Calculus II	**Math 344 (3)** Calculus III	**ECE 282 (4)** Circuits 1
Chem 211Q (5) General Chemistry	**Phys 313Q (4)** University Physics I	**Phys 314Q (4)** University Physics II	ME325 (3) Computer Applications
Eng 101 (3) Intro to Engr	IME 222 (3) Engr Graphics	**AE 223 (3)** Statics	**IME 255 (3)** Engr Economy
		ME 250/251 (4) Materials Engr	**IME 258 (3)** Mfg Methods I
Total Sem Hr 16	**Total Sem Hr 15**	**Total Sem Hr 17**	**Total Sem Hr 16**

Providing students with tutoring for key subjects that are usually found to be difficult. In 2007, the CoE established the GEEKS tutoring program for engineering students. A GEEKS tutoring room was designated and is used exclusively for tutoring sessions. All scholarship recipients have the opportunity for both individual and group tutoring sessions through this free tutoring program. Scholarship students are strongly encouraged to attend regular (one or twice a week) group tutoring sessions, and have the option to schedule additional one-on-one or small group sessions with the Tutors. Multiple time slots and different tutors are available for key subjects including Calculus I and Physics that have been shown to be major stumbling blocks for students. Tutors provide additional instruction and study help and are available to guide students as they work through difficult concepts and problems. GEEKS tutors are engineering students who have completed the course they tutor with an A or B. Tutors are selected based on their academic history, previous tutoring experience, and faculty or instructor references. All tutors are required to complete GEEKS training which includes instruction about effective ways to tutor and how to differentiate the needs of students. Required weekly meetings provide tutors an opportunity to visit with advisors and other GEEKS tutors to discuss successful strategies and ways to improve the tutoring provided. Tutors work closely with course instructors to ensure that they are prepared to tutor students in the areas being covered in classes. When possible, additional opportunities are provided for tutors to be well informed and prepared. For example, in fall 2011, tutors for Physics I and for Engineering Physics attended the respective physics classes. Feedback from instructors, tutors, and students receiving tutoring was very positive. The consensus was that tutors were better prepared to tutor, developed stronger relationships with the instructors, and developed relationships with the students in the class making it more likely that students would seek tutoring. A mid-term survey is also administered to gain student feedback about the GEEKS tutoring program. Questions also solicit feedback about individual tutors that

is used to identify good tutoring techniques and provide additional strategies when necessary. Two representative samples of feedback are: "(Tutor) explains things very well and he is helping me understand concepts as well as problems." "This tutor has helped me understand this subject in a much simpler and easier way. It has helped me so much succeed in this class."

In Spring 2012, the College of Engineering is piloting an online tutoring program called ALEKS. Students registered for Calculus I for the Spring semester were given the opportunity to work on a self-directed online tutoring program to prepare them for Calculus I. The students in the pilot program will provide feedback, both before and after their Calc I class, to help evaluate the benefit of the tutorial. If results are positive, the CoE will consider a broader implementation of ALEKS that includes additional courses and more students.

An engineering floor in the residence hall was established. Scholarship recipients are encouraged to live on this dormitory floor for their first two years at WSU. This living arrangement is geared toward providing students with an environment in which they can support each other and hold impromptu study sessions. Some tutoring sessions are also provided in the residence halls for the scholarship students. Factory tours were arranged for students in the residence halls. Guest speakers were brought to the floor such as WSU NASA alum. Faculty from various majors are invited to dine with the students in the residence hall cafeteria. All of these activities are planned to establish a sense of community among the scholarship recipients. These activities provide students with the encouragement from peers and the camaraderie they need to achieve their best academic performance–it promotes "Great Expectations" in these future engineers and keeps them moving forward to their degrees.

The main rationale behind offering scholarships for only two years is to provide industry experience in the final three years. Each faculty/industry mentor works aggressively with the cooperative education department at WSU to place GEEKS in local intern/cooperative positions. WSU has the largest cooperative education program in Kansas. Many of our students currently hold positions as engineers at local companies while completing their degrees. Many of these students are offered full time positions while serving as cooperative education students. The plan is for students to take fewer hours after their first two years. This allows students to work in the cooperative education program and still progress toward their degrees.

Summary

The GEEKS program has successfully provided scholarships to over 50 academically talented, financially needy students. The program has implemented student success programs that have contributed to the retention rate of scholarship recipients. The key interventions implemented were: earlier engineering involvement, mentoring, cohort scheduling, tutoring, community-building (engineering floor), and cooperative education. As the program continues, additional plans for success will be implemented.

Acknowledgment

This material is based upon work supported by the National Science Foundation under Grant No. 0807019. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.