CLEAR Scholars in Engineering: Promoting Student Success through Cohort-Building and Industrial Engagement

Dr. Karen D Alfrey, Indiana University Purdue University, Indianapolis

Karen Alfrey is a Senior Lecturer and Director of the Undergraduate Program in Biomedical Engineering at IUPUI. She has been a member of ASEE since 2003.

Dr. Stephen Hundley, Indiana University Purdue University, Indianapolis

Stephen Hundley is Chair and Associate Professor in the Department of Technology Leadership and Communication in the Purdue School of Engineering and Technology at IUPUI. He also serves as IUPUI's Associate Vice Chancellor for Strategic Initiatives.

Dr. Terri L. Talbert-Hatch, Indiana University Purdue University, Indianapolis

Terri Talbert-Hatch

Dr. Terri Talbert-Hatch is the Assistant Dean for Student Services in the School of Engineering and Technology, IUPUI. In this position she is responsible for recruitment of undergraduate students, scholarships, career services, and the schools residential based learning communities which include two apartment buildings on campus and one floor in the newest residence hall on campus – IUPUI Tower. She is the faculty advisor to the school's Student Council and the Society of Women Engineers student organization but, also supports all the school's student organizations. Dr. Talbert-Hatch is Co-Chair of the School's Diversity Council and chair of the IUPUI Sophomore Student Success Committee. She also serves on various IUPUI committees related to student success and financial aid. She is a lecturer for Motorsports Engineering and also teaches a summer bridge class for STEM students living on campus.

Dr. Talbert-Hatch serves as the Treasurer for the CEED Division of ASEE.

Dr. David J. Russomanno, Indiana University-Purdue University Indianapolis

David J. Russomanno is dean of the Purdue School of Engineering and Technology and Professor of Electrical and Computer Engineering at Indiana University-Purdue University Indianapolis (IUPUI). Before joining IUPUI, he was the R. Eugene Smith Professor and Chair of the Department of Electrical and Computer Engineering within the Herff College of Engineering at the University of Memphis. Prior to his academic career, Russomanno was employed by Intergraph Corporation, Pratt and Whitney Aircraft, and Michelin Tire Corporation as an engineer. Russomanno has secured several million dollars in extramural funding for basic and applied research, as well as for initiatives to improve the recruitment and retention of STEM students. Sponsors of his research include the National Science Foundation, the U.S. Army Research Laboratory, the U.S. Army Night Vision and Electronic Sensors Directorate, the U.S. Army Redstone Technical Test Center, as well as numerous sponsors from the private sector. His research interests include intelligent sensors and supporting software infrastructure, knowledge representation and inference, data and knowledge visualization, software engineering, logic programming applications, and STEM education. Russomanno received the B.E.E. in electrical engineering from Auburn University in 1986 and the M.E. in electrical and computer engineering, and the Ph.D. in computer engineering from the University of South Carolina in 1989 and 1993, respectively.

CLEAR Scholars in Engineering: Promoting Student Success through Cohort-Building and Industrial Engagement

Introduction

The National Science Foundation (NSF) Scholarships in Science, Technology, Engineering and Mathematics (S-STEM) program provides grants to institutions of higher education to support scholarships for academically well-prepared undergraduate students with demonstrated financial need. The goal of the program is to contribute to the number of well-prepared scientists and engineers in the workforce by increasing the number of students with financial need who enter the STEM workforce after completing a degree program in science or engineering[1,2].

In spring 2012, we received an S-STEM grant to establish the "CLEAR Scholars in Engineering" program at Indiana University-Purdue University Indianapolis (IUPUI). This program provides financial support, mentoring, and leadership and career development to undergraduate students with demonstrated potential to succeed in engineering, but who face significant financial challenges, possibly in combination with other barriers to meeting their full academic potential, such as being a first-generation college student or a member of an underrepresented group. In addition to scholarship support, CLEAR Scholars are provided with an intentional set of activities that promotes student retention, achievement, and persistence to graduation through: (a) Community-building through a cohort model; (b) Leadership and career development; (c) Engagement with industry; (d) Advising through mentoring; and (e) Resources for academic success (hence the acronym CLEAR). The ultimate goal of this project is to produce engineering baccalaureate degree graduates with lower student loan indebtedness and greater preparation for post-degree roles.

We present here our early results and lessons learned from the process of getting this program off the ground, as well as our plans for continued growth.

Program Design

The CLEAR Scholars program provides scholarship support and academic, career, and leadership development opportunities to a cohort of students with demonstrated financial need as well as potential to succeed in engineering, demonstrated by maintaining a GPA over 2.7 in freshman math, science, and engineering courses. Students enter the CLEAR Scholars program as sophomores; this level is chosen as the point of intervention both because students will have already completed freshman-level coursework, demonstrating preparedness for engineering, and because the resources offered by this program help bridge the gap between the strong foundation of academic and social support offered by freshman programs and the career development support that many students do not engage with until the junior or senior year. Educators have long been concerned with retaining students and helping them succeed, but their focus has been primarily on first-year students[3]. Second-year students are frequently an invisible population and

sophomores receive the least attention of any class[4]. They are the quiet ones, finishing their general education courses, changing their academic majors and residences, worrying about finances, and prone to the "sophomore slump" – a phase in college when students often feel depressed, frustrated, anxious, or dissatisfied[5]. Strategies for helping sophomore students include creating special programs, developing mentoring relationships, and providing individual counseling[6]. Thus, the sophomore year provides institutions a profound opportunity to promote retention, academic and career development, and personal transition and growth[7].

CLEAR Scholars remain in the program (and receive annual scholarship support) through the sophomore, junior, and senior years, provided they continue to maintain a GPA over 2.5 and participate in CLEAR Scholars activities (and the program continues to be funded). Our goal is to bring in 8 to 12 new students per year into the program; scholarship amounts for each student vary according to their need, and we may adjust the numbers of scholarships awarded in order to provide larger awards to students with significant need and strong academic and professional promise. Our current cohort is receiving annual scholarships ranging from $2000 to $10,000 (the maximum allowable award), with an average annual award of $5333 per student (about the cost of one semester of tuition and fees at in-state rates). To the extent possible, we strive for a cohort that is diverse in terms of both students' backgrounds and engineering majors represented.

CLEAR Scholars participate in monthly meetings focused on activities that promote academic success, leadership development, and career development. In addition, these meetings foster a sense of community among our scholars. Multi-year, cohort-based small-group peer relationships can foster integration, retention, and persistence in college students[8]; and in successful cohorts of engineering students, there is evidence that building community produces many benefits, including student progress towards completing courses, the development of friendships between students, formation of study groups, and improved student retention[9,10]. A typical semester includes the following schedule of activities:

Month	Focus of Cohort Meetings
January	Resources for Success Workshop facilitated by school-/campus-level office (e.g., Learning Assistance Center; Writing Center; Math Assistance Center) to promote Scholar achievement at the start of the spring semester (based on needs assessment).
February	Career Development Workshop to help students prepare for summer internship, cooperative education, study abroad, or undergraduate research opportunities.
March	Leadership Development Workshop, facilitated by an industrial representative from the Dean's Industry Advisory Council (DIAC) on an emerging leadership-oriented topic of interest to engineering students.
April	Industry Engagement Field Trip, a 2-3 hour site visit with a local organization representing one of the 6 engineering disciplines in the school; this event will be held with the support of DIAC member organizations.
May	End of year wrap-up, reflection, and celebration meeting, and a preview of summer electronic mentoring and cohort assignments and facilitation activities.

Over the summer, CLEAR Scholars remain in contact and receive electronic mentoring via email and the campus's online learning management system. In addition, they are encouraged to participate in job shadowing in an engineering context and to share their experiences with their peers.

Preliminary Results and Lessons Learned

Early Successes
Although the program is still in its early stages, so far it is on-track to meet its stated goal of promoting the retention, persistence, and post-graduate success of our Scholars. Of the nine students who entered the first CLEAR Scholars cohort in Fall 2012, all nine remain in their chosen engineering majors and are making good progress toward graduation. This is a strongly positive outcome for a cohort that includes four 1st-generation college students as well as four students who are members of underrepresented ethnic groups. Furthermore, the cohort was recruited not simply from the top students in the school but from a diverse pool of applicants with a range of prior academic performance: Four students entered the program with GPAs over 3.5, three with GPAs between 3.0 and 3.5, and two with GPAs below 3.0 (the lowest being 2.75, just above our minimum requirement of 2.7). That all of these students have been retained in their majors and are making good academic progress is an encouraging early indicator for the success of the CLEAR Scholars program.

In an end-of-semester survey in Spring 2013, CLEAR Scholars were asked to identify the most valuable aspects of their experience so far in the program. Unsurprisingly, all students spoke highly of the scholarship support they received through the program. For some, this allowed them to cut back significantly (or entirely) on work commitments outside school and to concentrate more fully on their studies; for most, it helped alleviate their worries over mounting educational debt. Beyond financial support, two clear themes emerged from the student responses about what they valued about the CLEAR Scholars experience: getting to know their fellow scholars and engaging with industry leaders through workshops and site visits.

Primarily from the necessity of accommodating course schedules that sometimes overlap with our meeting time, we typically schedule monthly meetings to start at noon with pizza and a question or two for general discussion followed by our programming for the month starting at about 12:20. Our scholars have really come to value the period of social time at the start of each meeting, describing it as "a place where we can relax and chat during a stressful year". Students use the time to commiserate over shared experiences – recent exams being a popular topic – and to offer advice to one another on academic topics such as which professors to seek out or avoid for certain classes, and why. As indicated on their end-of-semester surveys, our scholars appreciate the chance to get to know not only other students from their own major, but those with other engineering backgrounds as well. Although it was not part of our original plan for how to

structure monthly meetings, the time for socializing at the beginning of each meeting has emerged as a useful and valued aspect of the CLEAR Scholars experience.

We work closely with Student Services, including the Career Services Center, to plan programming for our monthly meetings. In addition, we have leveraged connections in the Dean's Industrial Advisory Council (DIAC) for the School of Engineering and Technology to engage industry leaders in our monthly cohort activities. This engagement with industry resulted in two experiences that the CLEAR Scholars identified as the most valuable during the 2012-2013 academic year. The first was a round-table discussion led by William Klenk, the Executive Director of Off-Highway and Hybrid Electric Products at Allison Transmission (and a DIAC member), on leadership in the workplace. He outlined the most crucial qualities for being an effective leader in an engineering workplace and engaged students in discussing the qualities they most valued in the leaders they had observed. The other highly valued CLEAR Scholars experience was a site visit to Raytheon that included a tour, a chance to see and ask questions about several products, prototypes, and testing set-ups, and a sit-down chat with several current employees about their responsibilities and the work environment. Through both these experiences, our scholars were to engage directly with industry leaders and to gain a clearer perspective on the engineering workplace and its attendant expectations and responsibilities. The importance of introducing leadership and career development topics to engineering students early in their curriculum is well-documented[11,12]; for our own students, these experiences have reinforced their decision to become engineers. In fact, one of our scholars now lists Raytheon as the company he would most like to work for after graduation.

Perhaps a result of this emphasis in our monthly programs on career development, our scholars have been proactive in seeking out industrial internship and co-op opportunities: two participated in internships or co-ops in Spring 2013, and another two participated in Fall 2013. Perhaps the best learning experience students can have is actually to work in the environment for which their education is preparing them[13]. Such opportunities have a tremendous impact on shaping future behavior, including whether to pursue engineering as a profession or to consider engineering graduate school[14]. Thus, leadership and career development workshops are providing CLEAR Scholars with the competence and confidence to prepare for both internships and cooperative education during school, and for a variety of post-degree roles and contexts upon graduation.

Challenges and Areas for Continued Improvement
The most challenging aspect of the CLEAR Scholars program so far has been identifying and recruiting cohorts of students who would most benefit from the program. We send an announcement about the program and information about how to apply to all freshman engineering students each spring, and work closely with the director of the New Student Academic Advising Center (NSAAC) for Engineering and Technology to spread the word to freshman instructors and advisors who might be aware of students with academic promise but significant need. However, when the applications roll in, we find that most are from the "usual

suspects": high-performing students who jump at every opportunity for an additional reward or scholarship. Although some of these students do turn out to be a good fit for our program, many others are Honors College students who already have significant scholarship support and access to the kinds of academic, career, and leadership development opportunities the CLEAR Scholars program provides.

As a result of this challenge, we have become much more proactive about working not only with the NSAAC, but also with our financial aid office, to identify in advance students who may be good candidates for the program and to reach out to them directly to invite them to apply. In April, after the close of priority registration for the upcoming Fall semester, we worked with the director of the NSAAC to generate a list of students who, based on their course enrollments, appeared to be on-track to take the sophomore-level engineering courses for their majors in the Fall. We then worked with financial aid to narrow this list to only those that were FAFSA-eligible (a total of 160 students in Fall 2013) and to get a sense of the unmet need of each student so that we could reach out via a direct email to those with the greatest need, informing them of the program and inviting them to apply. However, even this improved process had its pitfalls. Some parts of students' financial aid packages, including campus scholarships, are not applied until mid-summer, just prior to the beginning of the campus fiscal year on July 1. Thus, in our preliminary analysis of financial need in late spring, many students who appeared to have the most significant financial need while also showing strong academic performance (with GPAs near 4.0) were in fact already the recipients of major campus scholarships (in some cases, covering all tuition and fees) that had simply not posted yet for the fall semester. Once we had more complete financial aid data for the fall semester, we were able to recruit a new incoming cohort of students; however, their entry into the program was delayed from a planned start of August to October. We continue to refine our recruitment process, as well as the data we request from financial aid, with the goal of identifying each new incoming cohort of students by early summer and integrating them into the CLEAR Scholars program beginning in August of their sophomore year.

Conclusions and Future Work
Although still in its early stages, the CLEAR Scholars program is making strides toward our stated goals of recruiting, retaining, and graduating academically well prepared students with demonstrated financial need and providing them with an intentional set of academic, leadership, and career development experiences and resources to help prepare them for post-graduate success in the engineering workplace. We are encouraged by our scholars' successes so far, both in their progress toward degree completion and in their success in obtaining STEM-based internship and co-operative education opportunities.

As a next step in assessing the effectiveness of the program, we will work with our campus Institutional Research office to identify a criterion-matched group of students not in the CLEAR

Scholars program but who possess similar backgrounds, academic majors, test scores and levels of academic performance prior to the sophomore year, and financial need. This group will serve as a control group to which we will compare the CLEAR Scholars on such measures as their academic performance after the sophomore year, retention in engineering majors, participation in STEM internships, graduation rates, and indebtedness upon graduation. It is hoped that these results will show a positive effect of participation in CLEAR Scholars on improving GPA, retention in engineering, and graduation rates as well as a reduction in indebtedness at graduation.

BIBLIOGRAPHY

1. NSF Scholarships in Science, Technology, Engineering, and Mathematics (S-STEM). http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5257, accessed 22 December 2013.

2. 2012 NSF S-STEM Projects Meeting. http://www.asee.org/conferences-and-events/nsf-sstem/2012, accessed 22 December 2013.

3. Tobolowsky, B.F. and Cox, B.E. (Eds.). (2007). *Shedding light on sophomores: An exploration of the second college year.* Columbia, SC: National Resource Center for the First Year Experience and Students in Transition.

4. Schreiner, L.A. and Pattengale, J. (Eds.). (2000). *Visible solutions for invisible students: Helping sophomores succeed.* Columbia, SC: National Resource Center for the First Year Experience and Students in Transition.

5. Gahagan, J. and Hunter, M.S. (2006). The second-year experience: Turning attention to the academy's middle children. *About Campus, 11*, 17–22.

6. Lemons, L.J. and Richmond, D.R. (1987). A developmental perspective of sophomore slump. *NASPA Journal, 24*(3), 15-19.

7. Hunter, M.S., Tobolowsky, B.F., Gardner, J.N., Evenbeck, S.E., Pattengale, J.A., Schaller, M. and Schreiner, L.A. (2009). *Helping sophomores succeed: Understanding and improving the second-year experience.* San Francisco: Jossey-Bass.

8. Topping, K.J. (1996). The effectiveness of peer tutoring in further and higher education: A typology and review of the literature. *Higher Education, 32*(3), 321-45.

9. Quinn, R.G. (1993). Drexel's E4 program: A different professional experience for engineering students and faculty. *Journal of Engineering Education, 82*(4), 196-202.

10. Kenimer, A. and Morgan, J. (2002). Building community through clustered courses. *Proceedings of the 2002 American Society for Engineering Education Annual Conference & Exposition,* Session 2793.

11. Samai, P.G. and Drossman, M.M. (1989). Career development for engineering students. *Proceedings of the Frontiers in Education Conference*, 126-129.

12. Anderson-Rowland, M.R. and Rodriguez, A. (2009). Life planning for engineering students. *Proceedings of the 39th ASEE/IEEE Frontiers in Education Conference*, M3F-1.

13. Felder, R.M. and Brent, R. (2004). The intellectual development of science and engineering students 2. Teaching to promote growth. *Journal of Engineering Education, 93*(4), 279-291.

14. Atman, C.J., Sheppard, S.D., Turns, J., Adams, R.S., Fleming, L.N., Stevens, R., Streveler, R.A., Smith, K.A., Miller, R.L., Leifer, L.J., Yasuhara, K., and Lund, D. (2010). *Enabling student success: The final report for the Center for the Advancement of Engineering Education*. San Rafael, CA: Morgan and Claypool Publishers.