ECE Scholars: NSF S-STEM Grant

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Agnieszka Miguel received her Ph.D. in Electrical Engineering in 2001 from the University of Washington, and MSEE and BSEE from Florida Atlantic University in 1996 and 1994. Dr. Miguel’s professional interests involve image processing, machine learning, and engineering education especially active learning, diversity, retention, and recruitment. Her teaching interests include MATLAB, circuits, linear systems, and digital image processing. She is a member of the IEEE, ASEE, SWE, and Tau Beta Pi. Currently, Dr. Miguel is the Chair of the ASEE Professional Interest Council I (PIC I) and Vice Chair of PICs, a position that gives her a seat on the ASEE Executive Board of Directors. She has held several other officer positions across the ASEE including: ASEE Pacific Northwest (PNW) Section Chair (2015 - 2017), Division Chair and Program Chair of the ECE and New Engineering Educators Divisions, and ASEE Campus Representative. Dr. Miguel is also a member-at-large of the Electrical and Computer Engineering Department Heads Association (ECEDHA) Board of Directors. She has been a member of the ECEDHA Annual Conference Program Committee since 2013.
The National Science Foundation awarded the Department of Electrical and Computer Engineering (ECE) at Seattle University a “Scholarships in Science, Technology, Engineering, and Math (S-STEM)” grant. The $611k “Seattle ECE Scholars” grant provided scholarships to academically talented and financially needy junior-year students who transferred to the ECE Department from two- and four-year colleges. Over the five years of the grant duration, 32 students were awarded up to $10,000 per student and per year during the two years needed to complete their Bachelor of Science in Electrical Engineering (BSEE) degree.

The main objective of the ECE Scholars program was to increase the number of electrical engineering students graduating from Seattle University and entering the engineering workforce. Seattle ECE scholars received financial, academic, professional development, and community building support to ensure their successful progression toward the BSEE degree. Student support services included peer tutoring, informal study partners, industry mentorship program, professional development seminars, and social activities.

In this paper, we discuss both the qualitative and quantitative results of this grant. We report on the academic achievement of the scholars and their career choices after graduation. We also summarize the outcomes of focus groups held once a year with the ECE scholars. The paper provides lessons learned and suggestions for those who would like to implement a similar program at their institutions.

1. Background

Seattle The Electrical and Computer Engineering (ECE) Department offers an undergraduate-only program that provides an integrated, contemporary perspective of the electrical and computer engineering profession. Students have the choice of earning a BSEE or a BSEE with Computer Engineering Specialization degree. Our students experience small class sizes, extra academic support, and an emphasis on oral and written communication, as well as leadership and teamwork skills. Our rigorous student-centered program provides a sound foundation in the areas of mathematics, physics, computing, and electrical and computer engineering theory and practice.

A distinction of our hands-on curriculum is the senior design experience. All senior engineering students participate in year-long design projects sponsored by local companies. Teams of four students, advised by industry professionals and faculty members, bridge the gap between educational and real-world experiences by working on practical design projects, preparing
engineering reports, delivering oral presentations and responding to review comments from a sponsoring company. Final project presentations are given on Projects Day, an annual event that takes place at the end of the spring quarter.

The main objective of this project was to increase the number of electrical and computer engineering students graduating from Seattle University and entering the engineering workforce by offering scholarships to academically talented and financially needy junior and senior students who transferred to Seattle University from two- and four-year colleges. Washington state is in urgent need of engineers. Demand exceeds the state production of engineering degrees at a two-to-one ratio, and that gap is expected to widen as the industry’s aging workforce retires. According to the Washington Higher Education Coordinating Board, the average number of baccalaureate and graduate degrees in engineering, software engineering, and architecture produced in Washington state (1,292) is only about half of what the state industry needs (2,440) [1].

With 34 community and technical colleges, the state of Washington has one of the most extensive systems of two-year colleges in the nation. Recently, community colleges have been brought into a national spotlight when President Obama admitted that community colleges will play a huge role in meeting the goal of United States becoming the world leader in the production of college graduates by the year 2020 [2].

The Washington Council for Engineering and Related Technical Education (WCERTE) is a voluntary organization of post-secondary educational institutions within the State of Washington who are involved with some portion of the total spectrum of engineering and engineering-related technical education. WCERTE members (including a representative from the Seattle University ECE Department) meet twice a year to discuss issues of importance to engineering educators in Washington state. Half of the 95 students currently enrolled in our program transferred from two- or four-year colleges. They have proven to be committed and hardworking students who are often in financial need. By selecting ECE Scholars among students who apply for admission to Seattle University in their junior year, we motivated students who are halfway through their program to persevere and continue their academic career. In addition, by offering support services, we helped new transfer students adjust more effectively to the academic and social life of their new school [3, 4, 5].

In 2013, when this grant proposal was submitted to the NSF, the yearly tuition at Seattle University was $34,200. When room, board, personal expenses, transportation, books, and supplies were included, the estimated yearly cost of attending Seattle University was $50,568 for students living alone and $42,645 for students living with parents. Fortunately, students studying at Seattle University are offered high levels of financial aid. In 2013, the university estimated a freshman discount rate of approximately 43%. Also in 2013, 86.8% of the 4653 undergraduate students at Seattle University received financial aid. The average aid awarded per undergraduate recipient was $23,718. In addition to federal, state, and institutional grants, Seattle University administers numerous institutional scholarships.
1.1 Program Design

The ECE Department has the capacity to graduate 35 students per year. When the grant was proposed, we had 95 students in our program. Graduating 35 students is equivalent to an enrollment of 140 students. The S-STEM scholarships grant enabled us to attract new students to our program by helping them finance their education. The Seattle ECE Scholars Program offered financial help to academically talented and financially needy junior and senior students who transferred to Seattle University from four- or two-year colleges. In addition, to ensure their success, SU ECE Scholars were offered extra academic support through peer mentoring, tutoring, and study partners program; enrichment events such as professional development seminars and industry mentorship program; and opportunities to contribute to the social life of the department through Friday afternoon networking events for all ECE students, faculty, and staff.

The S-STEM scholarships, of up to $10,000 per year, were awarded to academically talented new junior transfers who had the highest unmet need. These scholarships, when combined with other financial aid offered by SU, made college education more affordable to low-income students. The S-STEM scholarships was be renewable for the recipient’s senior year. Table 1 shows an example of the proposed financial support which assumes that all selected students were be funded at the highest possible level, i.e. $10,000 per year.

Table 1. Proposed Distribution of Transfer Scholarships.

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<tr>
<th>New Junior Awards</th>
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As shown in Table 1, we were planning for seven juniors to receive scholarships during the first year of the grant. Then, these seven students were to continue receiving their scholarships in year 2 as seniors. Additionally, in year 2, we were planning to also award seven new junior scholarships. This way, the total number of scholarships awarded in year 2 was supposed to be 14. In years 3 and 4, we were planning to again offer 7 new scholarships each year and were to continue to support students who received their first scholarship during the previous year. Therefore, the total number of scholarships awarded in years 3 and 4 was 14 each. Finally, in year 5, we were not planning to award new scholarships but to continue to support the 7 students with scholarships started during year 4.
1.2 Scholarship Eligibility

As mentioned above, the SU ECE S-STEM scholarships were awarded to students transferring to SU from two- or four-year colleges and entering their junior year. We define junior standing according to the student’s progress toward his or her BSEE degree, not according to the total number of credits they have earned. Most community college students transfer after they have successfully completed close to 90 quarter credits of science, math, engineering, and humanities. Because of the structure of our curriculum, we advise all prospective junior transfers to take the first quarter circuit analysis course (equivalent to our ECEGR 210 - Electrical Circuits I) before they join the department. In this proposal, we define ECE junior transfers as students who, assuming satisfactory academic progress, will be able to complete their remaining required circuit and electronics lecture and laboratory courses during their first year of attendance at SU. Such students will then be ready to participate in our three-quarter-long senior design experience during their second year at Seattle University.

A student transferring to Seattle U for his/her junior year (as defined above) and who submits his/her scholarship application by March 1 had to meet the following requirements for scholarship consideration:

- Planned to enroll full time at Seattle University (12 or more credits per quarter, across three quarters in an academic year).
- Had declared Electrical Engineering as his/her major.
- Held US Citizenship or permanent residency.
- Transferred courses equivalent to:
  - MATH 134 - Calculus I
  - MATH 135 - Calculus II
  - PHYS 121 – Mechanics
  - PHYS 122 - Electricity and Magnetism.
- Had completed or is currently registered in a course equivalent to ECEGR 210 - Circuits I.
- Had a cumulative transfer GPA of 3.0 or above.
- Had an unmet financial need (determined by standard cost of attendance, minus expected family contribution, minus non-work-study and non-loan aid).

An S-STEM scholarship awarded in the junior year could be renewed for the student’s senior year. To continue to be eligible for the S-STEM scholarship, a student had to:

- Be enrolled full time (12 or more credits per quarter, across three quarters in an academic year).
- Made expected progress towards the completion of his/her BSEE degree.
- Had a cumulative GPA of 3.0 or above.
- Adhered to the Seattle University Code of Student Conduct.
- Participated in at least two thirds of the enrichment and support activities
If a student lost eligibility in one quarter, he/she was placed on scholarship probation. The PIs conferred with other faculty members in the department to determine ways to help the student. If a student was on scholarship probation for two quarters, he/she lost the scholarship.

2.2 Academic Support and Enrichment Activities

In this section, academic support services and enrichment activities implemented as a result of the grant are described.

**Peer Tutoring Program** We implemented one-on-one peer tutoring for ECE core courses. Our academically strong junior and senior students were offered jobs as tutors for ECE lecture and laboratory courses that are required for transfer students during their junior year (such as circuits analysis, electronics, and linear system analysis). Tutoring sessions took place in our conference room which can be easily reserved for this purpose. Tutoring was available, free of charge, to all students in the department but S-STEM scholars were encouraged to take advantage of this opportunity.

There are many advantages of a peer tutoring program. The tutors, in addition to having an on-campus job related to their field of study, got to review basic electrical and computer engineering knowledge that they would use in other classes or in their senior design sequence. (It is often said that to truly learn a subject, one has to be faced with the challenge of teaching it to somebody else.) Because the tutors and the students are members of the same cohort, they established a better rapport than the rapport that a student and an instructor could establish.

**Industry Mentorship Program** With most our alumni working in the Seattle metro area, the department has a strong relationship with local industry professionals. We designed an industry mentorship program that helped strengthen the connections between alumni and interested junior and senior scholars and guided the ECE Scholars through the process of obtaining an internship and navigating the job application process.

We paired two students with one mentor. We attempted to recognize students’ professional interest and assign mentors from companies they were interested in. We started the program with a dinner and an orientation session aimed at explaining to the scholars the benefits of a relationship with an industrial mentor. We also developed clear guidelines for mentors and mentees with suggested list and sequence of activities. Mentors and students were asked to interact at least twice a month. The interactions could happen in person (recommended), through a phone call, or via email. Each month, we provided a topic for conversations such as: getting to know each other (October), resume and cover letter review (November), life-long learning (December), mock interview (January), job shadowing (February), case study (March), networking (April), transition planning (May). In addition to the opening event, we also organized two workshops. In winter quarter, we had a panel on job search strategies and
interviewing. The mentors were the panelists and the event included networking opportunities for all students and mentors. Similarly, in spring quarter, we organized a panel on negotiation and work culture, also with networking opportunities. Finally, at the end of the academic year, we had a closing event with mentors bringing colleagues or friends who work at different companies to enhance the networking opportunities for students.

**Professional Development Seminars** Our alumni are often interested in giving lunch-hour seminars to current students that present their career path, introduce career opportunities in their field of expertise, and prepare students for engineering job search. These seminars, which started a year before we submitted our grant proposal, were well received by our students. We continued these seminars (typically 3-4 each quarter) throughout the duration of the grant.

**Social Activities** One of the challenges of transferring to a new school is not having a peer support system to rely on. In addition to facilitating the participation in academic support structures, such as peer tutoring, we developed new social activities aimed at building a stronger sense of community among our students. At the beginning of the fall quarter, we organized a new student BBQ to introduce our new freshman and transfer students to returning students. The goal of the event was to make the new students feel welcome and instill the sense of nurturing community in all members of our department.

To continue the tradition of departmental social events, we initiated Friday afternoon networking events. ECE faculty, students, staff, and available alumni meet in our conference room for a tea and cookies. The conference room is just across from our laboratories and computer rooms and is used for departmental and student meetings and as a study and lunch break room. This weekly social event gave the current and past members of our department the chance to gather for a casual conversation about latest engineering news, to share our successes, and support each other in challenges. This is an informal event but students are encouraged to suggest themes for these weekly events.

### 3. Results

#### 3.1 Scholarships

The current academic year 2017-18 is the 5th year of the grant. Over the last five years, we have given 32 scholarships to students who transferred to Seattle University. There have been 6 women among the scholars. Among the 32 scholars, three left the university. One of these three scholars left for personal reasons (moving to the city where his girlfriend was studying). Two scholars left for financial reasons; the scholarship support was not high enough to alleviate the hardship of having to spend significant time outside of school working to support their family. Both students had academic difficulties which could be attributed to them not being able to allocate enough time for studying.

29 scholars either already graduated or are on their way to graduate in June 2018. The average GPA of the 29 scholars at the end of each of the first four years of the grant was 3.67, 3.70,
3.69, and 3.52, respectively. Two students had to be given extra academic support because their GPA fell below 3.0 and they were in danger of losing their scholarship. Fortunately, they increased their GPA. All the scholars who graduated so far found jobs as electrical or computer engineers or went to graduate school.

The main challenge with the scholarship program was recruiting transfer students. The number of scholarship applications was smaller than expected. We have worked with the WCERTE organization as well as with individual advisors at local community colleges on spreading the news about our scholarships. We have also sent emails to students who were accepted as transfer students soon after they received their acceptance letters.

**Academic Support and Enrichment Activities**

Peer tutoring program has been relatively successful. Many students in our program took advantage of tutoring hours and gave us positive feedback about it. Challenges of the peer tutoring program include finding students willing to be tutors, coordinating with faculty teaching the course, and finding tutoring time that works for most students.

Industry mentorship program required the most time from the PIs and the administrative assistant. It has been a successful and popular program. Students reported that their mentors were especially helpful in resume writing, preparing them for interviews, suggesting places to apply to for internships or permanent positions, and discussing job offers. They also enjoyed company tours especially the Boeing VIP tour. A challenge of the mentorship program was finding enough mentors and scheduling common events (mentors tended to have lots of travel and family obligations). Also, some mentors were not able to allocate enough time to their mentoring activities because of increased work obligations.

Professional development seminars were also quite successful. They were given during a special hour on Tuesdays when no classes are scheduled. In addition, we provided snacks so students, who had classes immediately before and after the seminars did not have to miss the seminar to look for lunch. Challenges included not being able to find seminar speakers and students not going to seminars because they needed to work on homework assignments.

Social activities have been very successful. They were well attended and it was clear that all attendees enjoyed themselves. We noticed that having these events motivated students who were officers in departmental clubs to organize more events.

**Feedback from Student Focus Groups**

We have organized focus groups with junior and senior students at the end of spring quarter to gather feedback on the support programs available to the scholars. In general, the comments were very positive. Students had some suggestions for improving the support services or offering new ones such as:
“Refresher Workshops”: Supplementary tutoring in foundational courses that transfer students have taken at their 2-year institution or are lacking background in. The goal of that tutoring would be to ensure that all students have similar preparation for junior courses taken at Seattle University.

- More formal onboarding process for the juniors offered by the seniors.
- Mentors bringing a colleague from a different company to the panel sessions to offer another perspective on the issues discussed.
- More social events at the beginning of the quarter for the juniors to get to know the seniors.
- More guidelines for mentors including topics, goals and purpose of the peer mentoring.

Conclusions

The ECE Scholars program supported 32 students throughout all of part of their two years spent at Seattle University. Three scholars left the program and did not graduate in engineering. All of the other scholars who already graduated found jobs in electrical and computer engineering or were admitted to graduate schools.

It is difficult to tell if the ECE Scholars program increased the number of ECE graduates or if the market force was the primary cause of the enrollment increase in the ECE Department at Seattle University. However, we can clearly see that the grant had a positive impact on the department in terms of strengthening the collaborative community that we have been supporting over the past several years. Because the ECE Scholars did not have to work outside of the department, they were more present and willing to engage with other students and help organize formal or informal social and professional events.

In summary, the ECE Scholars program was successful in enabling 29 students to be more successful in their undergraduate studies of electrical and computer engineering and impacted the department by contributing positively to its learning community.

References


