



Ten Ways Academic Libraries Can Help their Departments Increase Retention of Women Engineering Students

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Abstract

Since 2000, the percentage of undergraduate engineering degrees awarded to women in the United States has consistently remained around 20%. While more women may initially choose engineering as their major, too many do not earn an engineering degree. However, in graduation comparisons among different engineering departments, some programs, specifically agricultural, biological, biomedical, and environmental engineering, consistently show great success in the enrollment and retention of women. Research into women's preference for these engineering disciplines suggests that women earn larger proportions of undergraduate degrees in programs where they perceive their career will benefit society in the long term and that these preferred programs offer both the motivation to persevere in the curriculum and, once completed, greater prospects for a more rewarding career. Based on these findings, university engineering departments can help motivate women to major in engineering and to stay engaged throughout their college careers by offering opportunities to address societal challenges and reinforce the potential contribution they can make through their career. Academic libraries can provide valuable support to their universities' engineering departments in this important endeavor. This paper accompanies a poster presented at the 2018 American Society for Engineering Education conference in Salt Lake City and provides a discussion of initiatives in progress on programs implemented at the University of Florida (UF).

Background

For almost two decades, the percentage of undergraduate engineering degrees awarded annually in the United States (U.S.) has remained relatively constant, almost 4.6 percent (%) of all bachelor's degrees. In engineering, women earned about 20% of all undergraduate degrees whereas in non-engineering science disciplines, such as health sciences and biology, their share is far larger. For example 80% of undergraduate degrees in health professions and 58% in biology are awarded to women.¹

For the various engineering disciplines, studies have found that women favor areas they perceive as more socially engaging, making a difference in people's lives, and working to solve major problems.² This is evident from the percentage of women graduates in specialty engineering departments such as environmental engineering, agricultural & biological engineering, and biomedical engineering. Many of these departments have undergraduate graduation rates for women of 50% or more. Female role models may also play a crucial role in encouraging women to major in engineering.³ Lacking confidence is a factor in engineering attrition. Although women engineering students may earn higher grades than men, the women often feel that they have to earn higher grades in order to prove themselves.⁴ Helping women build confidence in their abilities is a way library programs can support women engineering students.

Purpose

As a large public university, UF has an enrollment of around 55,000 students of which about 10,000 are associated with the 9 departments, 15 degree programs, and 20 centers and institutes within the Herbert Wertheim College of Engineering. About 2/3 of the engineering students are undergraduates. Although many more women start in engineering, only about 21% of graduates earning bachelor's degrees in engineering are women, similar to the national average. All of the six UF libraries offer programs to enrich the education of students; however, the Marston Science Library focuses on programs geared specifically towards science and engineering students. To help increase participation of women in engineering, we discuss ten ways academic libraries can assist engineering departments to increase enrollment and retention of women engineering students. These practices have been implemented during the past two years in the library programs at UF.

1. Coordinate an engineering speakers series featuring women scientists and engineers;
2. Sponsor a girls technology summer camp where women engineering students help teach middle school girls;
3. Hold a human library book event showcasing women engineering contributions;
4. Conduct technology workshops for women engineering students;
5. Team with the Society of Women Engineers to conduct outreach programs at the library;
6. Showcase great women engineers through library exhibits;
7. Teach a science communication class for women that focuses on developing effective oral and written skills;
8. Conduct a seminar for women engineering students preparing for the Fundamentals of Engineering exam, the first step towards becoming a Professional Engineer;
9. Use social media for awareness building and outreach to women engineering students;
10. Develop a workshop for women on preparing an elevator talk for job recruitment fairs.

Discussion

To attract and retain more women students in engineering at the undergraduate level, we are exploring a variety of programs at the UF libraries. The following describes ten of those programs that the UF libraries have supported and can similarly be implemented at other academic libraries.

1. Coordinate an engineering speaker series featuring women scientists and engineers

Female role models in engineering departments play a significant part in influencing the number of women earning undergraduate degrees.³ Inviting women scientists and engineers to speak on their research and success is a powerful way of demonstrating to women engineering majors that women can succeed in engineering and have interesting and rewarding careers. In February 2017, one of the speakers at the UF science and engineering library was Dr. Tracy Fanara, a UF engineering alumnus, environmental engineer for Mote Marine Laboratory, and a contestant on the television show MythBusters.

2. Sponsor a girls technology summer camp where women engineering students help teach middle school girls

Through outreach programs, women engineering students promote the engineering profession to middle school girls as they begin taking the math and science classes they will need as an

engineering college major.⁵ Started in the summer of 2016 and continuing in the summer of 2017, a week-long full day camp for middle school girls was held at the UF science and engineering library. Teaming with women engineering students to teach the middle school girls creative technologies reinforced the women engineering students' belief in their own abilities.

3. Hold a human library book event showcasing women engineering contributions

Successful women are role models, acting as live books where students can interact with them to ask questions related to the discipline and its possibilities.⁶ Human library book events allow the “books” to tell their stories and the audience to ask questions. Sharing their struggles and sometimes roundabout paths in their careers during a human library book event at the UF humanities and social sciences library in 2016 helped students to see that the road may be bumpy but can be navigated.

4. Conduct technology workshops for women engineering students

Creative fabrication workshops that incorporate technology can both teach valuable engineering skills and inspire students to create objects that assist others.⁷ The UF science and engineering library offers free workshops where students can improve their engineering skill sets. Workshops on software, tools, and modeling provide introductions to creative endeavors. The UF science and engineering library also sponsors a student group that designs and 3D prints prosthetics for children. This student club, primarily made up of undergraduate engineering students, has a student president and founder who is a woman and their faculty advisor is one of the science librarians.

5. Team with the Society of Women Engineers (SWE) to conduct outreach programs at the library

Founded in 1958, SWE is a non-profit educational service organization dedicated to promoting the need for women engineers and encouraging young women to consider an engineering education. By teaming with the student chapter of SWE, new technologies such as 3D printing are introduced to middle schoolers.⁸ As a collaboration between the UF science and engineering library and the student chapter of SWE, middle schoolers learn about 3D printing and women in the student chapter of SWE get to share their college experiences.

6. Showcase great women engineers through library exhibits

Engineering identification may be increased by helping students understand how engineering is useful, which increases their sense of belonging in engineering.⁹ Through exhibits, academic libraries can relay information about the important contributions of women engineers and how their work has significantly influenced society. In spring 2018, the UF science and engineering library showcased famous women scientists and engineers of the 20th century as part of the celebration for the United Nations International Day of Women and Girls in Science on February 11, 2018.

7. Teach a science communication class for women that focuses on developing effective oral and written skills

In a semester long class, students learn how to speak about their research, design research posters, write a grant application, and develop collaborative working relationships. Engineers need strong communication skills to succeed.¹⁰ In an honors course, Discovering Research &

Communicating Science, taught in Fall 2015 and 2016 at UF by engineering librarians to primarily women, these science and engineering students gained valuable experience in effective oral and written communication skills and received constructive feedback. Through their course reviews, the women said that the class helped them build confidence in making presentations.

8. Conduct a seminar for women engineering students preparing for the Fundamentals of Engineering (FE) exam, the first step towards becoming a Professional Engineer (PE)

Fewer than 12 percent of all PEs are women but there are many advantages of holding a PE license. A PE license generally is a benefit in negotiating salary and can be an advantage in the hiring process.¹¹ The FE exam is the first of two exams that an engineer must pass to be licensed as a PE. Engineering students may take the FE exam in their senior year of college. At the UF science and engineering library sponsored workshops, engineering students, especially women are encouraged to take the steps to become a PE. The workshop includes information on registering and taking the FE exam and library resources that can help students to prepare for the exam.

9. Use social media for awareness building and outreach to women engineering students

Social engagement increases women engineering students' motivation to continue studying engineering. Combining engineering and community engagement produces more socially conscious innovators.¹² Using social media to build awareness of engineering projects that have benefited society helps motivate students, especially women, to study engineering. The UF science and engineering library uses social media to promote student awareness through library events.

10. Develop a workshop for women on preparing an elevator talk for job recruitment fairs

In response to a potential employer's inquiry, "Tell me about yourself", being prepared for that moment with a 1 to 2 minute answer may land a job interview.¹³ An elevator talk is a short sales pitch. At the UF science and engineering library workshop in Spring 2018, women learned how to write such an elevator talk and had the opportunity to practice it with others. This workshop helped them build confidence for career fairs and job interviewing.

Conclusions

For most of the ten programs discussed in this paper, the library requested feedback from students regarding their participation experience. For the human library event, more than 90 percent of the participants said it was very helpful and they would attend again or recommend the event to colleagues. Similarly, for the girls technology camps, feedback from the campers and their parents was very positive and concluded with requests to hold the camp again the following year. Since libraries are central to all students, academic librarians are in a unique position to outreach to women engineering students and young girls who may be considering a major in engineering. For women already in undergraduate engineering programs, libraries can help encourage them to stay in engineering by providing insights into the ways engineers benefit society.

References

1. National Science Foundation, National Center for Science and Engineering Statistics. 2017. *Women, minorities, and persons with disabilities in science and engineering: updated January 30, 2017*. Retrieved February 10, 2017 from <https://www.nsf.gov/statistics/2017/nsf17310/>.
2. Silbey, Susan. 2016. Why do so many women who study engineering leave the field?. *Harvard Business Review*. Retrieved from <https://hbr.org/2016/08/why-do-so-many-women-who-study-engineering-leave-the-field?>
3. Sonnert, G., Fox, M. F., and K. Adkins. 2007. Undergraduate women in science and engineering: Effects of faculty, fields, and institutions over time. *Social Science Quarterly* 88 (5): 1333-1356. doi:10.1111/j.1540-6237.2007.00505.x. <http://www.jstor.org/stable/42956246>.
4. Orr, M., K, Ngambeki, I., Long, R. A., & Ohland, M. W. 2011. *Performance trajectory of students in the engineering disciplines*. 2011 Frontiers in Education Conference (FIE), S3H 1-5.
5. Purdue School of Engineering and Technology. IUPUI Engineering Summer Camps Encourage Girls and Minority Students to Explore STEM Careers. Last modified March 20, 2017. Accessed December 11, 2017. <http://www.engr.iupui.edu/main/about/news-events/news/2017/iupui-engineering-summer-camps-encourage-girls-and-minority-students-to-explore-stem-careers.php>.
6. Dobreski, B. and Y. Huang. 2016. The joy of being a book: Benefits of participation in the human library. *Proceedings of the Association for Information Science and Technology* 53 (1): 1-3. doi:10.1002/pra2.2016.14505301139. <http://onlinelibrary.wiley.com/doi/10.1002/pra2.2016.14505301139/abstract>.
7. Reiser, S. and R. Bruce. 2014. Cultivating creativity (and majors) with computational craft. IEEE Southeast Conference, Lexington, KY. doi:10.1109/SECON.2014.6950654, <http://ieeexplore.ieee.org/document/6950654/>.
8. Buhler, A., Gonzalez, S, Bennett, D., and Winnick, E. 2015. 3D printing for middle school outreach: A collaboration between the science library and the Society of Women Engineers. Proceedings of the American Society for Engineering Education 122nd Annual Conference, Seattle, WA.
9. Ro, H. K. and D. B. Knight. 2016. Gender differences in learning outcomes from the college experiences of engineering students. *Journal of Engineering Education* 105 (3): 478-507. doi:10.1002/jee.20125.
10. Clarkson, M. D. 2016. Communication training for scientists and engineers: A framework for highlighting principles common to written, oral, and visual communication. IEEE International Professional Communication Conference, Austin, TX.

11. Nayak, S. and J. Agrawal. 2011. Earning PE certification: A career strategy worth pursuing. *Journal of the Minerals, Metals & Materials Society* 63 (5): 23-24.

<https://login.lp.hscl.ufl.edu/login?URL=http://search.proquest.com/accountid=10920?url=https://search.proquest.com/docview/868718030?accountid=10920>

12. Ravel, M. K., B. Linder, W. C. Oakes, and C. B. Zoltowski. 2015. Evolving engineering education for social innovation and humanitarian impact: Lessons learned across a range of models. IEEE Global Humanitarian Conference, Seattle, WA.

13. Cox, A. M. and L. Marris. 2011. Introducing elevator speeches into the curriculum. *Journal of Education for Library and Information Science* 52 (2): 133-141.

<http://www.jstor.org/stable/41308888>.