Retaining Female Students in Systems Engineering
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Background
Research regarding impacts of decision influencers, teaching approaches and program design (including social environment) on how female engineering undergraduate students succeed tends to be aggregated with that about overall retention and across conventional engineering programming, without recognition of differentiation of systems engineering programs. In 2015, Engineers Canada announced a 30 by 30 campaign designed to recruit and retain women as registered professional or in-training engineers as 30% of the total newly licensed engineers by 2030 (Engineers Canada, 2015a). To that end, Canadian universities have been tasked with identifying opportunities to better recruit and retain female students in engineering programs. Knowing that much of the recruitment begins in the grade school system and, often at home, this research was conducted to better understand how students choose an engineering academic pathway, who and what are the key influencers in that decision, and what activities and pedagogical approaches to engineering education are most effective in the retention of recruited female students.

Purpose/Hypothesis
This research provides an analysis of student interactions through systems engineering programs at the University of Regina related to learning and social environments that effectively support and promote learning opportunities and a sense of belonging for female engineering undergraduate students.

Design/Method
Using quantitative surveys plus individual and group interviews with nearly 1200 student participants and 30 early-career female professionals in total, information was collected (and is more comprehensively presented in a draft journal article) about how students choose to study engineering, understand their learning, and develop a sense of belonging and level of confidence in the classroom and laboratory.

Results
Students value a sense of making a difference in the world and demonstrate preference for active learning models. Female students further noted the importance of creating and maintaining strong social networks, constructive learning environments, and healthy relationships. Systems engineering is grounded with contexts of society, environment, and sustainability in the design and management of complex engineering systems and full incorporation of the STEAM model. Trends in UR student registrations (UR, 2015) indicate that this more holistic and interdisciplinary approach in systems learning tends to be more attractive to female students than are the more traditional engineering education models (Engineers Canada, 2015b; Statistics Canada, 2014).

Several commonalities in female and male populations were noted, as well as interesting divergences in the expectations and experiences of students (data available pending journal publication). A strong correlation was noted between family influence and selection of engineering; for the latter, minimal influence or presence of strong female mentors was documented. Where the female and male student populations’ responses diverged was in the areas of self-confidence (self-assessment of STEM competence), self-determination (selection of specialization), and the presence of mentors who reflect and model the diversity of students in the classroom (mentor gender).

The results from the apparent divergence in responses around self-confidence and self-determination were discussed further in interview settings in an attempt to identify the fundamental reasons for the differences in confidence with female students. Many students
identified the presence of strong male mentors in their engineering experiences. And female students agreed more strongly than their male counterparts that the gender of mentors plays an important role in decision-making and long-term success in an engineering career.

Some of the key items emerging within the context of questions posed during qualitative analysis included student perceptions of academic capability and how those intersected with independence in academic decision-making. As noted above, female students more strongly indicated independence in selection of their engineering discipline, but did not indicate confidence in their “core” engineering academic abilities. On the surface, these may appear to be in stark contrast given that each is related to personal views on self-confidence in their chosen academic field. However, female students spoke clearly and strongly about their decision-making processes in entering the engineering program as being instrumentally tied to a pre-conceived expectation for disciplinary interest, expectations, and impact. That is, a disproportionately large number of female students enrol in engineering programs with a very specific set of goals and career expectations already decided.

Academic leaders in the UofR engineering program anecdotally note that they perceive that female students who choose engineering as a career have done so with much more forethought, consideration, and deliberation than their male counterparts who tend to be more highly encouraged to enrol in engineering programs by family and guidance counsellors alike as a matter of course. Those anecdotal observations are supported by graduate rates for female and male students in the UofR engineering program. For instance, internal UofR data for the 2014 graduating cohort denotes that, in the first-year of their engineering programs, the student body was comprised of 19.9% female and 80.1% male self-identified students; the graduating cohort was 23.9% and 76.1%, respectively.

References


