End of the Year Report

What the Issue is

In addition to recruitment, retention or persistence of women through graduation in Computer Science (CS) education has been one of the biggest challenges for the CS education field. Currently, women represent only about a quarter of the labor force (BLS, 2015) and earn only about 18% of the baccalaureate degrees (NSF, 2012) in CS. Attrition rates are highest in the first two years of CS programs (Biggers, Brauer, & Yilmaz, 2008; Miliszewska, Barker, Henderson, & Sztendur, 2006). At Utah State University, the situation is even more dire as women represent only about 10% of the CS undergraduates (personal communication, May 2017), which is almost half the national average.

Why it is Important

Underrepresentation of women is problematic for a variety of reasons. The field itself needs more skilled and qualified workers (currently, 70% of job openings are not being filled) (Ashcraft, Eger, & Friend, 2012). More importantly, gender imbalance creates social inequality (Miliszewska et al., 2006), lack of diversity in perspectives (Ashcraft, Eger, & Friend, 2012) and lack of diversity in innovative thinking (DuBow, 2013). Despite numerous efforts to increase female participation in CS education, the numbers have been on a constant decline and are currently at a historic low (Iskander, Gore, Furse, & Bergerson, 2013). What is more, there are fewer women in CS than in any other STEM field (Ashcraft, Eger, & Friend, 2012).

Our Approach

While there has been a lot of research on the underrepresentation of women in CS, most studies researching retention focus on this issue from the perspective of those women who decide to leave the program. In other words, the majority of current interventions are based on studies identifying factors that lead women to drop out of their programs (e.g. Roberts, McGill, & Hyland, 2012; Ulriksen, Madsen, & Holmegaard, 2015), while studies that focus on women who persist in CS programs are rare (e.g. DuBow, Kaminsky & Weidler-Lewis, 2016; Rosson, Carroll, & Sinha, 2011; Wilson, 2002). Thus, the goal of our research study has been to understand retention from the perspective of those female students who persisted in their CS major. More specifically, this study investigates the factors contributing to the persistence of women in the major, the resources and support available to them, the communities of practice that they belong to, and the trajectories or pathways that they follow towards graduation. To that end, the study uses Wenger’s (2008) communities of practice as a theoretical framework.

Note: this study is conducted as a dissertation study of doctoral student in ITLS department at USU, Katarina Pantic.

Methods

The research design planned for this study is qualitative research design (Glesne, 2014). The study consisted of two phases. In the first phase, we conducted two focus groups during which all participants...
completed a brief demographic survey. Focus groups were chosen to establish initial connections with the population of CS women at these universities, but also to develop some initial understandings of how women in CS majors perceive, feel and think (Krueger & Casey, 2009) about their CS major experience and trajectory towards retention.

During the second phase, participants produced journey maps, participated in interviews and reported on their daily routines through participation in a two-week long experience sampling method. The interviews were chosen to gain further access to participants’ motives, values, concerns and needs (Glesne, 2014). The interviews started with participants explaining a pre-prepared journey map, which is a map of one’s journey through school (Nyquist et al., 1999), followed by a set of open-ended questions. After the interview, the participants were instructed to sign up for participation in a text message-based survey experience which was hosted on Survey Signal website (aka experience sampling method). As a consequence, they received text signals for surveys at five random times for 14 days. The survey collected data on their daily routines, such as where they were at each point, what they were doing or how connected that activity was to their major.

**Sample.** We defined CS female persisters as upperclassmen, based on literature which suggests that the majority of attrition happens during the first two years of the program (Biggers, Brauer, & Yilmaz, 2008; Miliszewska, Barker, Henderson, & Szendur, 2006). Considering such definition, the sampling in this study was purposeful (Patton, 2001) and it consisted of 10 female undergraduate students who have declared CS as their major and are in advanced stages of their undergraduate studies. Nine women participated in Phase One of this study, and all 10 women participated in Phase Two. The sample overlapped 90% between the two stages.

Participants were recruited through printed recruitment flyers, departmental email to all the women in the major in upperclassman standing and word of mouth. All participants volunteered to participate by contacting student researchers working on this study.

**Progress of the study (Preliminary Results)**

At this point, we are done with the data collection phase of our study and are analyzing data.

**EMS Results.** So far, we analyzed the Survey signal data which provided us with some interesting insights into the daily routines of women persisting in CS. This portion of the data has been analyzed statistically. We found that women spent most of their time (57%) at home, with only about 5% of time spent at work, on average, which is interesting as 90% of the sample was employed part-time. In terms of how they spend their time, school work took about 1/3 (28%) of their time. Another third of their time was spent introducing balance into their lives through relaxing activities, such as watching TV, playing an instrument and similar (15%), socializing (7%), working out (3%), practicing a religion (4%) and/or volunteering (1%). Interestingly, more than half the activities (55%) they did during their waking hours were marked as either “quite unrelated” or “somewhat unrelated” to their major, suggesting that persisting women in CS do not spend all their time doing CS-related things.

While interesting, these results are not easy to put into context as there are no studies on how men persisting in CS or women dropping out of the major spend their time. Therefore, we decided to replicate the study with a male sample. To that end, we applied for and received a $1,000 research
award from ITLS department at USU. This part of the study has been submitted for IRB approval with a plan to be conducted in Fall 2018 with the same number of male participants.

**Cross-case Study.** We are now in the phase of analyzing individual case studies thematically and narratively. The plan is to showcase each story individually, but also find some commonalities between all the women who persist in CS education by doing a cross-case study. This analysis is ongoing. Some preliminary results show that different women have different trajectories of persistence throughout the CS major, suggesting that CS departments need to be flexible in adjusting to different personality types. Some overarching themes, however, did emerge. In terms of work/study style, two types of students emerged: those who like to study on their own and those who need and seek a lot of social support. Independent learners often reported not being intimidated or offended by male peers’ behavior. They also reported consciously working on a life-work balance, which included some type of spiritual (e.g. religious activity) and physical routine (e.g. basketball, skiing etc.). Though they reported seeking help rarely, if they did, they preferred going to a professor. Social learners were more likely to report doubting their choice of major, an insecurity which was often fueled by social pressure. In order to belong and persist, they reported actively seeking ways to gain legitimacy through competitions and job hunts, as well as social engagement in a variety of clubs. Their study style often involved more peer than faculty help. In other words, they relied more frequently to organizing study groups, seeking peer help and going to the tutoring lab.

**Intended Deliverables**

Work on our CWG grant is in its analysis phase. The main product coming out of our CWG grant will be a dissertation of one of my doctoral students, Ms. Katarina Pantic. We submitted our review of literature in preparation for this study to the *Journal of Women and Minorities in Science and Engineering* under a title *Factors Influencing Retention of Women in Computer Science Majors*. Upon finishing data analysis, we will target other peer-reviewed journals and conference proceedings with articles presenting our results from this study. Some conference proceedings that we will be targeting are SIGSCE and IEEE. In addition to *Journal of Women and Minorities in Science and Engineering*, we also plan on targeting *Computer Science Education, Journal of Computer Assisted Learning* and other journals focusing on CS education. Finally, we plan on preparing a report for NCWIT with Tips for Persistence in CS Education.
References


