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Increasing Diversity in Computer Science: Acknowledging, Yet Moving Beyond, Gender

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A review of gender equity research in education raised questions about gender and diversity and shaped our argument that the lack of diversity in computer science (CS) may be more complicated than a gender difference analysis would suggest. In the early 1990s, critical investigations of gender equity in K-12 public education (American Association of University Women [AAUW], 1992; Sadker & Sadker, 1994) led to increased public awareness about gender as an important factor to consider when evaluating school performance data. One consequence of this research was that the underrepresentation of females in the fields of CS and information technology, as well as in the physical sciences and engineering, has been examined most fully through the lens of gender.

Acknowledging broad-based gender differences is important, but such a position ignores intra-gender differences, as well as inter-gender similarities. For example, to what extent are there women who love programming and men who enjoy using applications to help people and solve real-world problems? Gender similarities are further obscured in a process of knowledge base building which advances primarily as a result of the publication of significant differences. Findings of no difference are not readily published in the scientific literature and, subsequently, fail to play a role in either academic or public discourse. Barnett and Rivers (2005) suggest that the current focus on gender-difference research, with its essentialist flavor, may be obscuring factors other than gender *per se* that prevent individuals from reaching their full potential in many arenas.

Using gender as a guiding principle in its efforts to increase diversity, Carnegie Mellon University (CMU) began a systematic self-study in 1995 that led to the implementation of changes designed to bring more women into the undergraduate CS program. This program had astounding success: within 5 years the proportion of women as entering freshman in the CS program increased from 7% to 37% (Blum 2001). Subsequently, CS program planners commissioned the authors to conduct a retrospective investigation of CMU student perceptions of changes in their views about the field of CS, changes in their own career aspirations, and their perceptions of and reactions to the dramatic increase in women students that occurred as they moved through their course of study during this critical period.

These issues are important to CS and engineering education. Leaders in the field, including universities and corporations, understand the importance of increasing diversity in CS. Examining the perceptions of CS students at CMU about a program designed to increase gender diversity is a good vehicle for deepening our understanding of what diversity means within the context of CS and how we can make positive changes at all levels of CS education.

Our major theoretical framework and overall method was phenomenology. The goal of phenomenology as a methodology for researching human experience is to examine the underlying reality of the phenomenon under study (cf., Berger & Luckmann, 1966; Merleau-Ponty, 1962; Shutz, 1972), or as Field (1981) explains, “to guide us back from theoretical abstractions to the reality of lived experience” (p. 291). We tried to discern what students thought about the changes that led to such a dramatic increase in the number of women students within undergraduate computing at CMU.

In the spring of 2002, 33 students (17 women and 16 men) from CMU’s undergraduate senior class in the School of Computer Science (SCS) participated in semi-structured, in-depth interviews. The students interviewed were seniors and were also in the last class to enter the undergraduate CS program before there was a near-critical mass of women entering. Their experience with the CS program, in particular during their sophomore through senior years, is important since it occurred during the first three years of CMU’s implemented efforts to attract a more diverse and visionary student body.

In research on equity and diversity in education, gender and ethnicity have been identified as important variables. As such, the interview questions were closely based on those used by Margolis and Fisher (2002) in an earlier and important study about CMU that elicited students’ perceptions of change associated with interest in and experience of CMU’s CS education. In this follow-on study, our efforts to locate gender differences in student perceptions, as articulated by the Margolis and Fisher (2002) study, were frustrated by the clear existence of gender similarities and evidence of other sources of diversity. Consequently, we broadened the scope of inquiry by examining the interview transcripts inductively for recurring themes and patterns and refining the original assumption that gender differences *per se* are the paramount factor in differentiating student perceptions of CS. As a result, we read and re-read each transcript in its entirety and coded the relevant text units (sentences) to themes as we uncovered them.

We found considerable evidence of similarities among the perceptions of these women and men as well as differences among men and among women. Whether we examined their notions of what CS is, explanations for the notoriously low proportion of women in the field, characterizations of a typical CS student, impressions of recent curricular changes, sense of the atmosphere/culture in the program, views of the Women@SCS campus organization, or suggestions for attracting and retaining well-rounded students in CS, we found few response patterns that differed strictly by gender. We encountered men and women who were passionate, hard-core programmers, and men and women who had other interests in the field; for instance, some students were applications-focused. These findings were all the more striking given that this cohort of students was selected under CMU’s old admissions criteria which emphasized programming interest and experience. Consequently, we think it is reasonable to assume that changes implemented to remove barriers from some of the more applications-focused women will also benefit those men who share this same concern/perspective.

The students we interviewed suggested that the standard view of CS to which most high school students are exposed -- which emphasizes programming -- is a narrow conception of the field. Our interviewees suggested that this presentation of CS can be repellent. Thus, we first recommend a more expansive presentation of CS at the high school level in order to attract more students, female and male, to the field at that critical juncture. Second, patterns we found within student comments suggest that universities should be more realistic in acknowledging and accommodating students' varying levels of prior exposure to computing. This strategy will require some CS professors to make considerable adjustments to their current pedagogical methods. Finally, students pointed to the need for an overarching CS student organization that provides academic and social support and not one that is based solely on gender or membership in an underrepresented group. Future studies should focus on students' stances on and perceptions of the field, acknowledging that males and females *may* have different views, but not assuming at the outset that they *will*.

We gratefully acknowledge support for this research from the Alfred P. Sloan Foundation to Carnegie Mellon University's Women@SCS, and to Lenore Blum, Director, and Carol Frieze, Associate Director.

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