Increasing Diversity in the Information Technology Workforce: Implications from a Study of Factors that Predict Achievement in CS

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Poster Summary

The number of women and minorities earning a bachelor's degree in information technology-related fields has been dropping steadily since the mid-1980's, in contrast with the general trends in graduation rates. According to the 2001-2002 Taulbee Report (http://www.cra.org/statistics/home.html), 82% of bachelor's degrees in computer science (CS) during this period were awarded to males, compared with 18% to females. The majority of degree recipients were White/non-Hispanic (58%) or Asian/Pacific Islanders (22%). In order to better understand the factors that predict achievement and retention of women and minorities in undergraduate CS programs, the study presented in this poster investigated factors that predict performance in undergraduate CS courses at a large university, and compared male and female students, minority (African American) and majority (White and Asian American) students with respect to these factors. Although several studies have examined gender differences in undergraduate CS programs in the past decade, studies that consider race are rare, largely due to the difficulty of studying under-represented groups (sample sizes tend to be too small for statistical analysis).

Two-hundred eight students, recruited from the first course for CS majors at the University of Pittsburgh, participated in this study. 82% of the sample was male, 18% female. 84% were White (144 male, 31 female), 13% were African American (22 male, 4 female), and 3% were Asian or Asian American (5 male, 2 female). Students completed a background survey and end-of-course surveys whose questions targeted factors that potentially predict performance (as measured by final grade) in Introduction to CS and subsequent courses. These factors include: year in college, amount of prior math coursework, prior programming experience (e.g., number of CS courses taken, informal computing activities such as building web pages and programming for fun), amount of access to computers in high school and college, encouragement to major in CS (from parents, peers, teachers, etc.), motivation (e.g., performance goal in course, reason for majoring in CS), confidence (in earning an A, B, or C), awareness of CS career options, and workload during the academic term. We also obtained students' SAT scores from the university.

To date, our analyses cover only the first two courses in the CS curriculum, Intro to CS and Data Structures. To summarize the results of analyses that included the whole sample (irrespective of gender or race), we found that aptitude, level of calculus completed before Intro to CS, confidence and motivation level at the end of each course predicted performance in one or both courses. With respect to gender, this study corroborated prior research in finding no significant gender differences in performance (grade) in either course, nor in aptitude. Male students entered the course with more prior experience [e.g., the number of CS courses taken in high school ($t = 2.7$); informal computer activities ($t = 2.3$)], motivation [e.g., programming for fun ($t = 8.5$)], and confidence [e.g., in achieving a B or higher ($t = 2.5$)]. The most dramatic differences between males and females were visible at the end of each course. Mainly, we saw a drop in female motivation by several measures. For example, at the end of Data Structures, fewer females than males found CS interesting ($t = 2.3$) or thought that they would enjoy a career in CS ($t = 3.1$). Although there was an increase in the percent of males who disliked programming, it was less sharp than the increased dislike among females. With respect to race, we found that the main differences between White and African American students coincided with variables that strongly predict performance—namely, aptitude and math coursework (Calculus, $t = 2.2$). African American students scored lower across the board on Math SAT, Verbal SAT, and combined score ($t = 4.8$, $t = 3.6$, $t = 4.9$ respectively). In addition, African American students earned nearly a letter grade lower in Introduction to CS than did White students. Hence, thus far this study demonstrates the need for better pre-college preparation for minority students who plan to major in CS, and suggests that the challenge for retaining female students lies in sustaining their interest. Future research should address how to meet these challenges.

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