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Participation of Female Students in Computer Science Education

Siraj Ahmed Shaikh
Cranfield University, UK

Introduction

The purpose of this study is to investigate the lack of participation of female students in Computer Sciences (CS) and to examine some of the contributing factors to this phenomenon. It brings together a variety of views and perspectives, and relevant literature to present a snapshot of what is a revealing but a worrying picture. The concerns raised here emphasise the need to discuss and explore possible ways of encouraging female students into CS and facilitating and supporting their recruitment and retention in higher education (HE).

Early conceptions of CS

A foremost factor in the choice of subject in HE is students' experience and conception of the subject in prior education. Camp (1997) reports a decline in the number of women studying CS in high schools who then move on to graduate with a CS degree. Teague (1997) lists a number of reasons why this may be, including parental and social pressure, lack of role models and stereotyped career advice, and classroom experiences. This is not helped as CS is often aligned with mathematics as a discipline, contributing to its 'pure' and 'masculine' image (Teague, 1997; Edwards & Kay, 2001).

Lack of critical mass

For women to constructively participate in the discourse and reshape gender relations in classrooms, a 'critical mass' of women is necessary among men (e.g. Clayton & Lynch, 2002). Cohoon (2001) examines departmental characteristics that affect retention of female students and observes that CS departments with a higher number of female students are more likely to retain them. In a similar study carried out earlier, Cohoon (1999) concludes 'CS departments that lost many students often lost a disproportionately high number of one sex'. Gürer & Camp (2002) go further to argue 'all-female environments' are better as they set classroom discourses free from male domination, diminishing gender-related perceptions and tensions.

Lack of role models

One critical mass factor, which serves as both a cause and a consequence

of it, is the lack of female role models. The media coverage of information technology (IT) industry moguls, like Bill Gates (former CEO of Microsoft) and Steve Jobs (CEO of Apple), projects an image of a male-dominated profession where women are either not present or their achievements are not significant. This propagates a masculine image of the industry where only workaholic 'geeks', with no family and with an unethical 'hackers' mentality, can survive.

The presence of female faculty in CS is also an important source of mentoring; what better example of successful women in CS can be served to female students than their CS tutors? Pratt & Misra (2002), both female CS faculty members at one stage in their careers, endorse this and identify one of the reasons behind this as: 'women tend to be relationship oriented, communicate differently, and positive feedback is more important to them'.

According to Cohoon's (2001) survey, 'departments with no female faculty lost female students at high rates relative to men'. Jamnik (2005), while describing the importance of 'female academic networks' for such purposes, concurs with Cohoon's finding and notes that '33 percent of women in CS aspire to leadership positions, compared with 22 percent of men. Yet despite this statistic, only one in 20 computing professors, one in eight computing researchers and one in four PhD students are female' and holds the lack of visible female academic leaders responsible for this.

Disciplinary culture

Bjorkman *et al*. (1998) consider the increase in the number of women in CS from a different perspective and differentiate between quantitative and qualitative change. While increasing the number of women in quantitative terms is important, there is also a need to 'question the present order in the computing culture'. This is important as it moves the focus to 'making CS more accessible to women' away from 'making women interested in CS'. Qualitative change requires re-examining the discipline at many levels, including making students aware of gender issues in CS, rethinking teaching and assessment methods and changing the dominant culture of the discipline.

De Palma (2001) criticises the 'indeterminate' nature of the CS and suggests teaching the discipline more like mathematics: clarifying the central body of theory to make the discipline determinate; keeping it away from the so-called 'user-friendly' sophisticated tools and as close to logic as possible; and engaging students in small, recurring exercises for the sake of practice.

Barker *et al*. (2005) recommend a fine arts approach to pedagogy: encourage classroom interaction between students such as discussions and group tasks; clarify theory and concepts in the context of their practical uses and applications; and assess students using a more formative and collaborative approach where they share and discuss their solutions in class. Rich *et al*. (2004)

agree with such an approach and give an example of an introductory course in 'media computation' specifically designed to attract and retain women. The course purports to promote among students a sense of relevance of programming concepts for practical applications, a collaborative atmosphere and a creative streak. Two-thirds of the students were female, with only three (male) students withdrawing by the end of the course. A survey at the end of the course reveals an overall satisfaction by the female students: 'It's pretty logical, sort of like in math, so it's understandable'.

Conclusion

There is a need to encourage more women in CS by addressing a variety of factors. Young women have to be encouraged early on, in schools and colleges, by highlighting the contribution made by women in this field. Appropriate role models and mentors need to be recruited for this purpose. At the higher education level, there is a real need to adapt CS courses and teaching practices to make the environment friendlier for women. As well as the imperative to promote equality between women and men, if the IT industry, particularly in the UK and Europe, is to meet its shortfall in skills and expertise, then men and women need to be given an opportunity on equal and fair footing.

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About the author

Siraj Ahmed Shaikh is currently a Research Officer at the Department of Informatics and Sensors (DoIS), part of the Defence College of Management and Technology (DCMT) at Cranfield University, Shrivenham, UK. Previously, he was a lecturer in computing at the University of Gloucestershire. His research interests include computer science and security education.