Women in Computer Science
Experiences from Victoria University

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Abstract: This paper reports on research conducted at Victoria University in Melbourne. It looks at factors that influence women's entry into Computer Science, their journey through their studies, and issues that engage women on their way to becoming computer scientists. Of particular significance is the finding that women enrolled in Computer Science are successful, and perceive no major barriers to their success. However, despite the fact that Victoria University has created a range of initiatives to encourage participation, the percentage of female enrolments in Computer Science has declined significantly in recent years. Barriers continue to exist to limit the participation of women in Computer Science. The challenge remains to identify the nature of these barriers.

1.   INTRODUCTION

Questions of gender inequality began to surface in Australia during the nineteen seventies. The Federal government commissioned a report [1] that included the responsibility to examine the extent of underachievement by women in education and its contribution to the inferior status of women; and to study the ramifications of the increasing participation by women in the labour force on Australian education and schools. The report found that the curriculum was giving students a heavily biased picture of the world and of the possibilities for women. Girls were being given far less encouragement to continue to post-school education and to consider a wide range of careers.

Despite the fact that many initiatives have been launched in the intervening years, a cursory glance within the computer classrooms of Victoria University would suggest that these initiatives have had little impact. In terms of student enrolments and academic appointments the current situation seems no different from twenty-five years ago. Indeed most

of the terms of reference raised in the 1975 Commission seem relevant today. Why?

The participation rates of females in tertiary education have increased dramatically, but their participation in Science and Engineering, and Computer Science in particular, has remained abysmally low [4]. Attention to the ongoing problem of low participation rates by women in Computer Science has been diverted by the use of politically correct language, the inclusion of women in publicity photographs, and the propagation of policies that are regarded as "gender-neutral."

The 'macho-image' of computer science presents an obvious problem. Does this explain the reluctance of women to study computer science? Increased representation of women in non-traditional courses depends on the portrayal of these courses as flexible, rewarding, and receptive to women [8]. There appears to be no intrinsic reason why women would not choose to study Computer Science [3]. Other authors have identified issues that are important to the recruitment of women into Computer Science courses [2]. Social background, local role models, interest, ability level, and recruitment measures aimed at women have been identified as crucial in any attempt to encourage females to study Computer Science [7]. The question thus remains: to what extent do these, or other factors, influence the decisions of women to choose Computer Science as a first-preference selection in their choice of a university career?

2.   WOMEN IN TERTIARY EDUCATION

Within Australia, female students accounted for 54.7% of all students in 1998. The number of female students in 1998 represented an increase of 2.5% over 1997, whereas the corresponding increase for males was 1.4%. The growth in the number of female university students is also reflected by the growth in the number of females graduating from award courses - 56.6% of all graduates in 1990 and 57.8% in 1997 [4]. Initiatives triggered by [1] impacted significantly on the achievements of women in tertiary education and on their roles within the labour force. The picture is less clear, however, when we examine the areas where women have been most successful, or, by contrast, those areas where they have been least successful. Engineering and Science constitute broad groups of study in which women continue to be under-represented.

In 1990 the Federal government set targets of a 40 per cent enrolment rate for most non-traditional areas. Nationally, women's access to non-traditional fields of study has reached and exceeded the target. While in Science, overall, women have made good progress, a disaggregation of this

broad field of study reveals that women are still under-represented in areas such as Computer Science. Access continues to be a problem. Once women have gained access to non-traditional courses, success rate and retention are not particular problems [5].

3.   CURRENT INITIATIVES

Victoria University promotes Computer Science using promotional activities such as Open Days, career nights, school visits, Computing Workshops and a Science Week for Year 9 and 10 students. Female staff and current students are well represented during these events. Postgraduate female students are employed as tutors in the undergraduate course. This not only increases the presence of females in the course but also highlights their competence. The main initiative has been an annual Graduate Information Night. Recent graduates, both male and female, come to these functions and discuss their work related experiences. Despite these initiatives, there has been a downturn in female enrolment figures in Computer Science in recent years.

Table 1:Participation by Women in Computer Science at Victoria University
(As percentage of total students in Computer Science)

1993	1994	1995	1996	1997	1998	1999
30	31	32	28	21	18	20

The source for this data is DETYA Enrolment files, Victoria University. The 30% access rate of 1993-96 represents a willingness by women to study Computer Science. By contrast, the situation in recent years is particularly disturbing. This research arose from the desire to explain this trend.

4.   RESEARCH STUDY

The research is a qualitative survey about the possible difficulties confronting female students in Computer Science courses. The survey included questions in five broad areas: entry into Computer Science, pursuit of a Computer Science course, social and cultural factors, role models, and workplace environment. Female students, at all year levels, in undergraduate and postgraduate courses, as well as former female graduates of these courses, were asked to respond to the survey. Seventy two percent responded.

The respondents' age varied from 19 to 42 years. A majority of the women were single without children, and represented an ethnically diverse

group. Languages spoken at home included: English, Vietnamese, Chinese, Macedonian, Singhalese, Russian, Arabic, Persian and Bulgarian.

4.1   Entry into Computer Science

Some women did not know what course to study, and quoted their good marks in mathematics at high school as a reason for choosing to study Computer Science: *"I had a hard time deciding what to study. I decided on Computer Science, because I enjoyed doing maths and computing in high school."* The vast majority, however, had an interest in the computing industry and regarded computing as an area with good career prospects: *"Interest in the industry. Good opportunity to be well paid."*

There were also a number of women who quoted their fascination with computers as a reason for entering the course: *"Computers fascinated me. I decided that the best way to understand and master them is to study them."*

All women expected the Computer Science course to equip them with both theoretical and practical knowledge of computer systems: *"I expected the course to give me a sound knowledge to enter industry, and therefore be up-to-date and relevant."* The expectations of some women were much more precise: *"To get involved in Web design and object oriented databases."*

Although some women found the course more complex than anticipated, they were mostly satisfied with course content and structure: *"Yes. In the way of subjects that were offered and their contents, although some of them were more difficult than I originally thought."*

Asked about how to encourage more women to study Computer Science, the respondents almost unanimously agreed that the course should be better advertised and promoted among high school girls: *"Advertise the course in secondary schools. Not just to VCE students but to Year 10 as well. Explain contents of the course and life after Uni."*

Many women felt that girls should be better informed about the contents of the course and subsequent career opportunities in computing. They should also be shown that they can do whatever they want to do: *"I think young women need to be encouraged earlier on in the education system, given more options."* Women in postgraduate courses considered offering assistance in job placement to be an encouraging factor: *"Help women find jobs in the computing area."*

4.2   Problems in Computer Science

Asked why more women do not study Computer Science, one woman replied that it was because computing was still considered a 'male' job: *"Some women think it is a man's job."*

Many who echoed this opinion also pointed out that Computer Science was considered too 'technical' for a woman, and 'boring' in comparison to humanities or business courses: *"They think it is hard and boring... Also because they think it is a male dominated environment."*

They also commented on the lack of exposure to computers, especially at high school, lack of encouragement and options given: *"At school, a lot of students did not know how to use a computer."* One woman summed up the multiplicity of factors preventing females from studying Computer Science: *"Societal restraints and lack of encouragement."*

The domination of male students in laboratory classes did not present any problem to the female students, merely an annoyance at times: *"I find that some males 'muck around' but that is their problem."* Half of the respondents by far preferred working in a group: *"In a group. Teamwork is enjoyable."* Others were happy to work either in a group or alone: *"Either. Depends on the task."*

There was a strong consensus that gender was irrelevant. It was the characteristics of the group that mattered, although some stated that it was better to work in 'mixed' groups. All women preferred to work with productive, reliable and cooperative people: *"No preference based on gender - preference is based on personality and knowledge."*

When it came to leadership, the vast majority of respondents preferred someone who had the ability to lead, who was knowledgeable, well organised and a good communicator. Gender of the leader was not an issue: *"I prefer a leader who is intelligent, knowledgeable and has the driving character of a leader whether they are male or female."*

Almost all agreed that the examples and exercises used in lectures and laboratories, although challenging at times, were easy to understand, and real life examples were preferred: *"Yes. The more complicated ones were extensively explained."* Asked whether they expected to be as successful in their studies as their male colleagues, all the women replied with an emphatic 'yes': *"I expect to be more successful, I intend to put in more effort."*

A majority felt that a greater number of female students in the course would not have any major impact on their studies: *"It does not matter as long as there is a proper study environment."*

Several admitted that they would enjoy having more female friends in the classroom: *"It is nice to see more female faces around when you come to a lecture. However, it does not matter that much as you study for yourself."*

4.3   Social and cultural factors

Most respondents stated that they did not participate in any social activities at University, although some maintained friendships with other students. Those who did participate were members of the gymnasium.

Half of the respondents did not use the computer as a recreational activity. The other half surfed the Net on a regular basis and used e-mail.

Domestic duties and family responsibilities affected the study time of the majority of respondents. Even those who were single or did not have children felt the impact of domestic duties on their study time: *"Absolutely! And I do not even have a family."* Women from traditional backgrounds regarded their family responsibilities as particularly important and an integral part of their life: *"Priority has to be given to domestic duties and children's needs."*

All respondents aimed at becoming good professionals, and several wanted their jobs to be both interesting and enjoyable. Several women wanted a career in project management, and two aimed at getting 'to the top': *"To become an excellent system developer, highly-paid of course."*

4.4   Role models

The majority of respondents replied that the decision to study Computer Science was their own and was not directly influenced by any other person. Some followed the suggestions of their friends, partners and family members. Only two were influenced by their teachers.

An overwhelming majority of the respondents stated that it was important to have good lecturers regardless of gender: *"I think there should be a balance, but it is more important to have good lecturers regardless of gender."* Some women admitted, however, that in general they found female lecturers to be more approachable and would welcome more of them: *"Yes. I find female lecturers easier to approach than males."*

More than half of the respondents keep in touch with former female graduates, and those who do not, wish they had such contacts. They all agreed that it would be helpful to get career advice from former female graduates: *"Yes, to give me an idea of the 'real world' working condition."*

Some women noted that they would welcome advice from female graduates to whom they could relate well: *"Yes, and not just from outstanding students."*

The respondents were also keen on the idea to meet successful female professionals from industry for inspiration and motivation: *"Yes, because I too would like to reach my goals (be successful)."*Several women stressed

the need for career advice: *"It would give me more of an idea of what to expect after Uni."*

4.5   Workplace environment

Graduates who replied to the survey did not feel disadvantaged in their current jobs because of their gender. Asked for advice for current female students in Computer Science, they emphasised the importance of up-to-date knowledge and high level of expertise: *"Keep current! Know your stuff, not just Uni stuff but IT stuff."*

In their opinion, the Computer Science course provided an adequate career preparation for both female and male students: *"As in the course itself, I do not believe that females are at a disadvantage to males, therefore no changes should be made."* They felt, however, that more could be done in recruiting female students as well as helping them in preparation for job interviews: *"Perhaps an elective to prepare you for the interview, grooming for the workplace - appropriate clothing, office politics."*

5.   ANALYSIS

The *Equity in higher education* report [5], identifies access as the major barrier to female participation in non-traditional areas of study. Once the barriers to entry into these areas have been removed, female students have success and retention rates slightly superior to males. This message is clearly echoed in the results of our survey which found a group of dedicated, competent and confident female students who view the computer education environment as a gender neutral arena. Preferences and interests that have been identified with women in computing [9] are clearly evident, but there is no sense of overt gender discrimination. Questions of male dominance in the laboratory environment are seen as irrelevant, while competence and character, rather than gender, are the concerns associated with group formation and leadership selection.

An interesting aspect of the survey was the emphasis on career advice and job placement. The transition from higher education to work environment was an issue of vital concern to all respondents.

The survey highlights an emerging conception of the 'role model'. The traditional role model, epitomised by female mentors, has been replaced by a gender neutral, competence specific entity.

Entry remains the major issue mitigating against female participation in Computer Science. The barriers emerging from the survey have been well canvassed in the literature [2], [3]. The message, both within the secondary

schools and the community, has not yet been heard. A study of first choice preferences of Year 12 students underlines the current reality. In the Engineering and Computing fields of study less than 5 per cent of females applied for a course compared to over 25 per cent of males [6]. Barriers to participation in computer science courses appear to be located in areas other than the courses or the university environment.

6.   CONCLUSIONS

Participation of females in Computer Science is a particularly elusive issue. Computer Science would appear, on the surface, to offer one of the more attractive scenarios to potential female students - gender unbiased curriculum, attractive career path, and high salary scale. The success of past female graduates proves that females can, and have succeeded in this area. Why then are the trends in the opposite direction? This is a particularly important question since computing and computer competence is critical to ongoing developments of the 'information revolution.'

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