A REVIEW OF

"UNLOCKING THE CLUBHOUSE: WOMEN IN COMPUTING."

Jane Margolis and Allan Fisher

Margolis & Fisher's book "Unlocking the clubhouse: women in computing" is an important publication for anyone involved in computer science education. It has currency on several levels. Firstly the facts are clearly stated; the number of females enrolling in computer science at Carnegie Mellon University (CMU) has risen from 7% in 1995 to 42% in 2000. A remarkable achievement considering that most computer science degree courses struggle to get their female enrolment up to double figures. On the second level the book is valuable because it provides a pithy summary of the "web of influences and sequence of turning points" that combine to extinguish female interest in this discipline. Lastly, and most importantly, it provides a concise account of the interventions that were implemented at CMU to bring about such a marked increase in female enrolments, enabling other institutions to use this program as a blueprint to initiate local change.

CMU is a renowned university, and its School of Computer Science (SCS) regularly rates among the top three in the USA. It has a worldwide reputation for being at the centre of research and development in the computing field. Allan Fisher was Associate Dean for Undergraduate Education at CMU, Jane Margolis a visiting research scientist experienced in gender education. They combined to conduct a longitudinal qualitative study with 100 CMU male and female SCS students. Over a period of four years 230 interviews were conducted with the aim of classifying and demystifying the differential experiences and interactions that each gender has with computing.

The "magnetic attraction" that males have with computers, and machinery in general is acknowledged, and some earlier research used to deconstruct the reasons behind this. Of this study ¾ of the males fit the "magnetic attraction" mould, and only 1/4 of the females. Females neither look for nor want this all-consuming interest in computing. Sally, a first year student, recounted her first experience with computers:

> I was caught totally by surprise. I was in love with it. I played with it all day long. Its OS, as near as you can say, was Basic. So I learned Basic. And I had a lot of fun…. I mean, I didn't spend all my waking hours on it the way some budding hackers might have, but I really enjoyed just messing around" (p.18)

Males described themselves as having an "epiphany" like experience when they discovered computers and programming, usually at quite an early age and encouraged by a parent. Females, while liking working with computers, and the problem solving associated with programming are usually "turned on" later in life, at senior high school, often through the involvement in a programming class. The students entering the SCS at CMU are quite disparate in their programming knowledge and experience, ensuring that the females consistently feel like under-achievers, and unable to make

mistakes or question openly in class without being "continuously under suspicion because of their gender".

Margolis and Fisher's analysis of interviews extracted some disturbing facts about the student experience in the SCS. While males consistently feel proud, comfortable, within a group of like minds "dreaming in code", the experience for some females interviewed was:

> a descending spiral of eroding interest through the corrosive effects of lack of confidence, negative comparisons to peers, poor pedagogy, and biased environments (p.77)

Female students recounted being ridiculed and constantly challenged by the male students. The Technology Commission 2000 report from the American Association of University Women (AAUW) labelled computer science education as a "bastion of poor pedagogy". The negative effect of poor pedagogical practice erode self-efficacy in females, the greatest "at risk" group when teaching is poor. Combined with this was the lack of real world applications, particularly in programming classes. The interviews showed that females were attracted to contextual computing, applications with relevance in the wider world of business, medicine, music, or languages for example, and the abstract nature of teaching programming contributed to "extinguishing" interest in this field.

There was an attempt to predict what type of female would persist in the field and alternatively, if there were any way of predicting who would drop out. No clear cut answer was apparent, other than the females who stay "reject and find alternatives to the dominant culture of the field". It was noted that females from a non-western cultural background were more likely to persist, either because they do not hold the male hacker as their stereotype, or are driven by economic factors to a much greater degree than white middle-class American females.

All that is written is not negative however, while reading the first six chapters, the statistical evidence of an increase from 7% to 42% in female enrolments over a short 5 years is in the forefront. The final two chapters in the book are a blueprint of the interventions that were implemented to counteract or alleviate the negative factors working to deter females from choosing this field. These interventions were multi-pronged, aimed at poor pedagogies in secondary schools and university teaching, enhancing the curriculum to make it more relevant to females by using real world examples and projects, and the implementation of institutional changes in the degree course at CMU to enable four different entry points. There were also support networks established between female faculty, post-graduate students and under-graduates to allow females to develop a critical mass and not feel like they were strangers in their own course.

Secondary School interventions

CMU provided programs over the summer to prepare teachers to teach in the C++ language. This was in line with changes in the secondary school curriculum computer science exam in the USA and funding was provided by the National Science Foundation and the Program for Gender Equity. The program was designed in collaboration with key secondary school teachers, a gender equity specialist and CMU

staff. Senior high school was targeted because this study found that a greater percentage of females currently in computer science at CMU were attracted to the discipline through programming classes at secondary school (1/3rd of sample of females as opposed to 9% of males. The program enabled skills enhancement for teachers, strategies to improve their teaching of programming, as well as giving gender sensitive pedagogical advice.

Teachers attending were asked to research in their own district regarding the genders depicted in computing game advertisements, who purchases computers, who talks more in class, who is depicted in cartoons or textbooks, and whether there were any courses in gender equity in their local school districts. There was uniformity in the lists generated by teachers in the reasons they thought girls enroll or don't enroll in computing. The program shared the results of efficacy studies with the teachers, particularly boys attributing failure to external factors such as a too hard exam and success to their own ability, while girls tend to attribute failure to themselves, and success to external factors such as luck.

Teachers were provided with strategies to improve the gender balance in their computing classes such as:

- Deliberately focus on recruiting bright girls and recruit friendship circles.
- Use girls to recruit other girls.
- Recruit a high profile girl (on school committee, sports teams).
- Hold information sessions for counselors, teachers and parents to emphasize the importance of IT in all occupations.
- Get girls involved early, in the middle years of secondary school.
- Hold girl-focused events, clubs, and camps.
- Place “Want ads for computer jobs” in prominent positions on parents nights.

To deal with the preference of females for real world examples and applications in computing, they were encouraged to have a close look at the curriculum as well as provided with "A baker's dozen ways to enrich programming assignment”. Teachers were sent back to their schools with an action plan that committed them to spreading the word and encouraging cross-curricular computing in their schools.

Tertiary interventions

CMU computer science lecturers and teaching assistants were provided with gender equity education and training in gender inclusive classroom practices. A move was made to ensure the best teachers were used in the early courses of the degree. The preference for real world projects by females was observed, but there was difficulty in applying this early in the curriculum because multi-discipline projects often needed a sound base of core knowledge that is built in the first two years of a degree course. There was an attempt to design a discovery-based course with the aim of placing computer science in a real world context. A move was also made to involve students with non-profit groups in the community.

To counteract the differences in skill levels on entry, and negate the feeling that females have of not belonging because they don’t “dream in code”, pre-entry and summer programming classes were offered. Four different ways to enter the curriculum were established and it was emphasized that programming experience was

not a prerequisite. This meant adopting curricular changes and a more flexible degree structure. Students could enter at varying points more suited to their prior programming knowledge. "Immigration" courses where faculty presented their research projects to the undergraduates emphasised the contextual nature of computer science by providing examples of real world applications.

Acknowledging the under-representation of females, and with the aim to build a perception of a female community, female academic and student lunches were organised. Undergraduates were paired with seniors in the field to establish an informal mentoring network.

Recommendations and Pitfalls

The first point Margolis and Fisher make in recommendations for other institutions is to "pay ferocious attention to the quality of the student experience". No matter what amount of funding is available, the quality of student experience needs to be investigated and considered to ensure that gender inclusiveness and not exclusiveness is involved. Positive discrimination for women, assertiveness training, support groups and contextualizing the curriculum can all be implemented at the tertiary level. Building strong links with feeder secondary schools worked well for CMU but other universities may find this more difficult because of a lesser profile or a lack of external funding.

Margolis and Fisher have written a very readable book, applicable to all computer science educators at a senior secondary and tertiary level. The freshness of the language which is not weighted with jargon, but enlightened with metaphors of fire and religion, capture the experiences that males feel towards machinery, that females do not want to feel, but that should not be a pre-requisite for studying or working in this field.

The challenge at CMU is to implement systemic change. Will this program continue to produce this gender balance in enrolments, or is it driven by individual personalities and likely to fade now that both researchers are not actively involved in the School of Computer Science?

Implications for future research

- Are the experiences of female students at CMU different or similar to those of Australian students? Does the female experience differ across universities in Australia.
- An evaluation of home environments and educational backgrounds of females in computing. Is a pattern evident in their place in the family (first born, only child), whether they have brothers, and parents involved in the IT field in any capacity?
- Is the perception of Asian women as "persisters" correct (economic factors, family responsibility over-riding personal likes and dislikes)?
- Could the intervention strategies with secondary schools work in Australia? Apart from the funding aspect, there is no one pre-requisite computer science course of study in Australia, or a particular programming language recommended.

Reference:

Margolis, J & Fisher, A 2002, *Unlocking the Clubhouse: Women in Computing* The MIT Press Cambridge, Massachusetts.