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OVERCOMING THE ADVERSITY OF DIVERSITY: AN AUSTRALIAN STORY

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Abstract

The low participation rate of women in computing education and the computing industry is a phenomenon that has been recognised by many western countries. While much has been written on the underlying reasons for the low participation in such a growing and dynamic industry, the situation only seems to be worsening. This paper examines briefly a number of approaches taken by researchers in Australia to try and address the problem. One tertiary institution, Victoria University, has undertaken over a ten year period a sequence of projects, aimed at encouraging and supporting female students to study information technology and then make a successful transition from university to the workplace. The strategies and outcomes of the most recent project is the focus of this paper. This project concentrated on equipping graduating female students with skills and knowledge to enable them to participate on equal terms with their male counterparts in workgroups and project teams. An outcome from this work was the preparation and distribution of a resource book to graduating female students during 2002.

Keywords: Gender equity, glass ceiling, group dynamics, IS culture, IS curriculum, IS education, IS teams

Introduction

The land of computing is a frontier country, and, as in the development of most frontier territories, there are more men than women. Indeed, it appears that at all levels of learning about computers - in school, in higher education, in further education, in training, in adult education classes, and in independent learning - women tend to be strikingly under-represented (Gerver 1989, p483).

This is particularly true in Australia where in 2001 only 23.6% of people employed in IT occupations were women (Byrne and Staehr, 2003). There is a broad range of literature which has paid attention to the underlying reasons for this low participation of women, in such a growing and dynamic industry, but the position is clearly worsening. This is the situation not only in Australia (Byrne and Staehr, 2003) but also in many other countries (SIGCSE 2002; UNCTAD 2002).

There is also a large body of literature which highlights the reasons why it is imperative to have a diverse computing workforce and the need to increase the participation of women in computing careers, which is beyond the scope of this paper. These arguments are similar to those put forward in other male dominated disciplines such as science and engineering. Wulf (1998) sums them up as "A lot of people argue for diversity in terms of fairness. ... Others argue in terms of simple numerics: Male Caucasians will be the minority in the 21st century ... [and others are concerned that] in any creative profession, what comes out is a function of the life experiences of the people who do it. Finally, sans diversity, we limit the set of life experiences that are applied, and as a result, we pay an opportunity cost - a cost in products not built, in designs not considered, in constraints not understood, in processes not invented."

The Australian Environment

Women's participation in higher education in Australia has increased steadily over the last two decades. Maslen et al. (1994, p132) suggest that during this time 'the most spectacular change has been in the gender balance' of the tertiary student body. The first 130 years of Australian tertiary education saw women students outnumbered by men. In 1981 female students made up 45% of the student population, but by 2000, they comprised more than 55% (ABS, 2001).

The issue of the lack of women in computing courses in Australia emerged in the mid 1980s and was finally recognised by academics, industry and politicians in the early 1990s. Concern about girls and computing was first raised in Australian secondary schools around 1983-1984. Initial research (Symons 1984) showed that many of the factors identified surrounding girls and computing were similar to issues identified for other areas of the school curriculum, such as mathematics and physical education.

A comprehensive national study on women's participation in professionally accredited Tertiary Computer Science and Data Processing courses was undertaken in 1984 and 1985, involving 36 different university courses (Kay et al., 1986). Clear evidence of the low proportion of females in computer courses (25% - 33% of students in these courses were women) was found.

One of the earliest Australian studies of retention of students in tertiary computing investigated first year Computer Science students finding that at the end of the three year course, the male to female ratio had deteriorated from 2:1 to 3:1 (Porter and Pirie, 1986). Studies from the University of Tasmania (1992) revealed that, for every 100 male students entering a Computer Science course, 56 would graduate, whereas for every 100 female students entering, only 26 were likely to graduate (Gibson and Hartnett, 1993).

The enrolments by female students in Computer Science and Information Systems peaked at 27.2% during the early 1990s (Lang, 2003) and have since fallen to 24.1% in 2000 (DEST 2002).

Government Policy

The 1990 Australian Government report *A Fair Chance For All: National and Institutional Planning for Equity in Higher Education* listed objectives, targets and strategies to achieve equity in higher education for all groups in society. One outcome of this report was the Higher Education Equity Programme (HEEP) which provided financial support to Universities to encourage more women into male dominated courses.

Targets were established where by 1995 the proportion of women in engineering would be 15% and in other non-traditional courses, such as Computer Science and Information Systems, would be at least 40%. The number of women in postgraduate study was also targeted to rise relative to the percentage of women as undergraduates in each area (DEET 1990b).

The Commonwealth Government reaffirmed its commitment to these targets in 1993, with the release of the New National Agenda for Women 1993-2000. The government also actively encouraged all higher education institutions to provide appropriate support for women, particularly in the areas of Science, Technology and Engineering (Office of the Status of Women, 1993).

Strategies to Address the Gender Divide

During the past decade many initiatives and programs have been created in Australia to encourage women to commence, and successfully complete undergraduate computing courses. Initiatives ranged from mentor programs, to the production of videos, special classes for female students, curriculum changes to create a more inclusive curriculum, computing camps and so on. Many of these programs were supported by funding available through the HEEP program.

Work by Clayton et al. (1993) has provided a framework for this work that identified three stages where it was possible to influence female participation in computing courses and the computing profession. These were:

1. Pre-tertiary stage; where the focus was to encourage females to develop the necessary prerequisite skills and to enrol in computing courses,
2. Tertiary stage; where the focus was to decrease the attrition rates of female students,

3. Post-tertiary stage; where the aim was to equip females with the necessary skills and contacts to obtain positions in the computing profession (Clayton et al. 1993, p16).

Table 1 provides an overview of initiatives from both Australia and overseas, created to address each of these stages;

Table 1. Initiatives to Increase Participation Rates

Stage	Initiative	Example references
Pre-tertiary	Adopting different teaching methods	Bernstein (1990)
	Running Girls in Computing Days	Craig et al. (1997)
	Running Computer Camps	Ryan (1994)
	Providing accurate information	Jepson and Perl (2002); Martin and Staehr (1994)
	Creating teacher awareness	Clarke and Teague (1993)
	Profiling successful women	Clayton et al. (1994)
	Providing equal access	Jepson and Perl (2002)
	Creation of engaging videos	Clarke and Teague (1993)
	Improving the curriculum	Duplantis et al. (2002); Martin (1992)
	Tertiary	Providing bridging courses
Creating mentoring programs		McGrath Cohoon (2002); Sampson (1993)
Creating orientation sessions		Cartwright and Colville (1994)
Providing positive role models		Hemenway (1995); Pfleeger (1995)
Providing extra tutoring		Martin et al. (1996)
Post tertiary	Providing double degrees	Batson et al. (2002)
	Creating support communities	Gabbert and Meeker (2002)
	Generating an electronic mailing list	www.systems.org
	Providing workforce strategies	Scollary et al. (2003)

Which of these initiatives were successful? How can their success be measured?

If success is measured by the percentage of women in computing courses and graduation rates, across the nation, then these programs must be seen as a failure with a 2% decline of female students from 1989 to 2000 (see Table 2). Looking at the specific field of Information Systems (regarded by some as the ‘softer’ part of computing and therefore more likely to appeal to women) there has been a decline during the same time period of nearly 15%. Total enrolments by students in these discipline areas tripled from 1989 to 2000.

Table 2. All Students with User Specified Field of Study by Gender, 1989 - 2000 (DEST 2002)

User Specified Field of Study	1989				2000			
	Male		Female		Male		Female	
	N	%	N	%	N	%	N	%
Computer Science, Information Systems - General (not DP)	5,788	75%	1,936	25%	14,983	77%	4,445	23%
Computer Science	3,092	78%	875	22%	10,685	80%	2,694	20%
Information Systems	737	54%	626	46%	5,652	69%	2,599	31%
Computer Science, Information Systems - Other	636	75%	207	25%	2,359	68%	1,120	32%
Total	10,253	74%	3,644	26%	33,679	76%	10,858	24%
Total students	13,897				44,537			

Victoria University's Approach

New enrolments by female students in the Information Systems degree at Victoria University, Melbourne (VU) peaked at 39% in 1991 and has since dropped to the mid 30% range. At the same time more female students were withdrawing from the course than their male counterparts. Statistical analysis of student records data showed that in 1992, 10% of females withdrew compared with 2% of males. In 1993, 20% of females and 12% of males withdrew. To address these concerns over the last 10 years a number of programs were developed aiming to have a positive impact on enrolment numbers, retention rates and workplace transition for female students. These projects have in the main been funded through grants from the University's Equity and Social Justice Branch under the HEEP scheme. A brief description of these programs follows:

Pre-tertiary

- Girls in Computing Days for Year 10 students;
Annually from 1992-1997 a 'Girls into Computing day' to encourage girls to consider computing courses at the tertiary level was hosted. The aim was to expose girls to a variety of computer based activities, encouraging them to see the computing field as more than programming or word processing.
- Follow up study on long term results;
The girls who attended the '1992 Girls in computing day' were eligible for tertiary admission in 1995. Of the 81 girls, 36 were contacted and interviewed to ascertain the long-term effects of such a day (Craig and Fisher, 1996).
- Australian Computer Society Summer School;
The school has contributed staff each year to assist with this activity.
- Video 'Real Girls Use Computers';
This video was created with the assistance of girls from a local secondary school and distributed to other secondary schools within the state. The aim of the video was increasing the profile of computing career options to female students.
- Dissemination of accurate information to schools;
Information kits have been disseminated to schools and careers teachers in the region to ensure currency and accuracy. Up to date information was incorporated within yearly wall planners distributed to each final year secondary student in the local region. IS staff regularly visited school groups and participated in careers events (Craig et al. 1996).

Tertiary

- Mentoring;
Interviews with female Information Systems students indicated that many girls felt isolated, particularly in their first year of study, and found it hard to form friendship groups. It was this, coupled with their low retention rates, which led to a program called MicroNet that provided support to the female students via mentoring (Craig, 1998).
- Orientation program;
The transition to higher education was eased for students via a 'girls' only' orientation program run by the women of the school.
- Retention via curriculum and assessment design;
This study looked at the issue of retention via curriculum and assessment design (Fisher, 1995). The project established guidelines for the process of curriculum change to reward and recognise specific skills such as communication skills rather than only focusing on technical skills.

Post-Tertiary

- Women in Computing Conferences;
The inaugural women in computing symposium was held in Tasmania in 1992. These conferences, held approximately every two years since then, aim to maintain and build on the networks that allow women to come together and discuss issues specific to gender, the workforce and education. Victoria University hosted this conference in 1993.

- Networking opportunities have been created;
A group called 'Vic Wic' was created which comprises women who are 'in' computing; many are academics, some are professionals in industry and a few are students. The group meets informally every few months for dinner to enable networking, sharing of ideas and support. This group has been asked to become involved in evaluation of the resource booklet from the current project.

The Current Project

Women are underrepresented in management roles in IT (Byrne and Staehr, 2003). This issue is not unique to information technology - the glass ceiling has been noted and commented on in regards to participation of women generally in the senior ranks of business and the professions. Statistics from the first Australian Census of Women Executive Managers (Nov. 2002) found that 54% of Australia's top 200 companies still have no women in executive management positions, which is far greater than the 14% recorded in the last US census. The situation is worse for positions of governance. The first Australian Census of Women Board Directors (Nov. 2002), found women hold only 8.2% of board positions in the top 200 companies as listed on the Australian Stock Exchange, while the comparable US statistic is 12.4%.

Women in IT also face an equity issue in accessing the promotion opportunities of their male colleagues. They are more likely to be relegated to low status tasks, which utilise their nurturing roles. A vicious cycle develops in which they are given low status jobs, which then become stereotyped as low status because women are doing them. Partly the problem could be attributed to gender stereotyping in the community – women are expected to make coffee, organise catering, take notes at meetings, write user documentation, train and support users. Male colleagues appear more likely to be involved in 'responsible roles' such as programming, project management, negotiating and marketing.

During university life students are often required to complete assessment tasks in groups. In the early stages of this final research project the focus was on enhancing team dynamics by providing female students with proactive strategies to ensure that they competed on their merits with their peers and avoided relegation to low status roles within their work groups. Learning opportunities were provided within the final year of the degree to equip the girls with skills they could practice in their capstone project subject. It was hoped that this would help to break the cycle too often observed, where women usually elect to, or are appointed to, roles within the group that do not involve the major programming/management tasks. This often reinforces the view women have of what they feel they 'should' do rather than what they 'could' do. The concern was that when women completed their qualifications and joined the workforce they took with them the attitudes and approaches they have had reinforced over a number of years.

The initial aims of the project 'Enhancing Team Dynamics' were to increase:

- Access - by developing skills in relation to team work;
- Participation - in all areas of a project rather than having female students confined to traditional roles;
- Retention/success - ultimately in the work force but initially at university as this should improve women's confidence in performing these roles.

Scope and Methodology

The project:

- Involved undergraduate students and early career graduates in Information Systems;
- Identified traits from the literature and focus groups to be incorporated as part of a set of behaviors to be targeted by the project;
- Designed and conducted specific workshops;
- Monitored participating students.

The students engaged in this study were predominately drawn from the final year of the IS courses, where the gender breakdown, majority male, mirrored what is found within the workforce. Several early career graduates were also involved. Focus groups and related action research was used to gather material relevant to successful team participation, conflict resolution and business etiquette. Issues arose that though not related to team participation were of importance to a successful transition into the work

place. It was found that the strategies that one could adopt differed depending on whether the issue arose for new participants in the workforce or for those students who had completed a co-operative year (internship) and then become an employee in the same organisation after completing their studies.

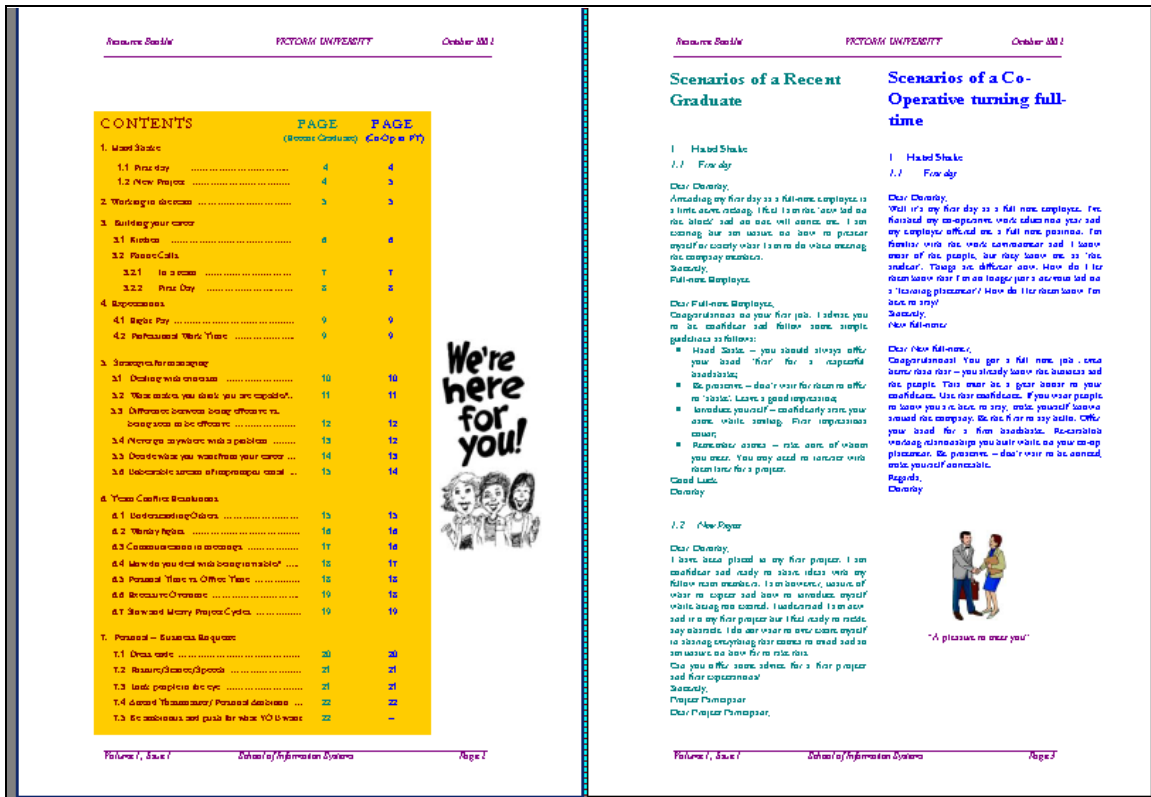


Figure 2. Sample pages from the Resource Booklet

The information collected from these activities was then categorised and summarised by two participants, one an early career graduate, the other a final year student who had joined the workforce after completing a cooperative education year. To disseminate the information to not just the women in the study but to other students as well, a resource booklet was created using the “Dorothy Dix” approach where a question was asked followed by a possible solution. The booklet was printed in A5 format for easy access. The scenarios were listed in 2 columns – the left hand column provided the recent graduate with insights on how to handle various situations while the right side looked at a similar situation from the point of view of the cooperative student who had become a full time employee (see figure 1).

Project Outcomes

- Students who participated now feel that they are better prepared to take a pro-active place in the workforce;
- A Resource Booklet that can be further refined and implemented by interested others;
- The Resource Booklet has been distributed to all the graduating women students in IS in October 2002, helping to equip them for effective workplace entry.

Discussion

Having now been once round the cycle of encouraging girls at school to enter IT courses, supporting them through their studies by mentoring, creating gender inclusive curriculum and providing proactive strategies to participate on their merits in project teams, in their studies and on entry to the workplace, it is timely to consider what should happen next. The task is by no means accomplished.

From the IS school at Victoria University's perspective, in 2002, the situation was mixed. The most active intervention strategies have been aimed at undergraduate students and it is pleasing to see 38% of the enrolled students are female. Of the 170 graduating students in 2002, 31% were female. At the postgraduate level however, only 19% of 146 graduating students were female, with a diminishing cohort of female students (16% of 367 students) enrolled in 2002. Few of the intervention programs mentioned have focused on post graduate students and clearly much work remains to be done in this area. Another area of concern is that recently the number of tenured women academics within the school has dropped from 8 to 1.5 and this will make it harder to provide role models for female students.

From a national perspective there has been a decline in the number of women in many computing courses. Recently in the 36 Australian Universities the total number of computing students was 24,283. Female students represented just 21.3%, down from 27.6% in 1991(Gibson and Hartnett, 1993). Female students graduating from computing degrees in 2001 not only found themselves in the minority but also found that they frequently earned less than their male counterparts (see Table 3). Clayton and Lynch (2002) report positive outcomes from work to redress the gender imbalance at Central Queensland University over the last 10 years. However they also sound a clear warning. Changing funding priorities in the Higher Education Equity Program (HEEP) from women in non-traditional areas to people with disabilities or non-English speaking backgrounds amongst others, will make funding opportunities for future intervention strategies even harder to obtain.

Table 3. Graduates from Computing Courses 2001 (Gradlink 2002)

2001	Male	Female
Bachelor	77.9%	22.1%
Salary (Aus\$)	\$40,000	\$40,000
Graduate Cert/Dip	66.2%	33.2%
Salary	\$50,000	\$45,000
Master Coursework	69.9%	29.9%
Salary	\$60,000	\$48,000
Master Research	82.5%	17.5%
Salary	\$61,200	\$56,000

To run the programs, described in this paper, has required a huge amount of effort, time and enthusiasm. In many instances it has significantly increased the workload of already stretched academics. Has it been worth it? Without a doubt the programs have had an impact on encouraging some girls to start, complete their courses successfully, and commence careers in computing. We know of girls who would not have done any of these things without the programs. One such student has even gone on to win a national scholarship for her work in the male dominated field. It would appear though that we have not been able to make large waves but have only created little ripples.

Where to now? The most immediate challenge is to provide women with strategies to gain and keep employment over the next three years at least, until the IT employment market has recovered. New strategies need to be found to provide female students already enrolled in our courses with role models as well as to continue to promote the IT discipline and future job market within the schools. Work also needs to be undertaken to encouraging female students to progress up the education pipeline to the postgraduate level. There is certainly a need to go round the cycle again, to address the same issues with the benefit of hindsight.

Conclusion

Over the last ten years a sequence of projects have been conducted at Victoria University to encourage and support female students to study information technology and make a successful transition from university to workplace. This paper has provided

an overview of the projects as a continuum and in considering outcomes it would appear that while we have made small gains, very little has changed for women in either education or the workforce over the intervening decade.

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