Encouraging Female Students in Business Computing

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DECLARATION

It is hereby certified that:

1. The work is that of the candidate alone (except where due acknowledgment has been made) and has not been submitted previously, in whole or in part, in respect of any other academic award.

2. The content of the thesis is the result of work carried out since the official date of commencement of the program.

[redacted]
Annemieke Craig

20\12\96
Date

For Matthew and Katelyn

'Seek after knowledge - it's your future'

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SUMMARY

This thesis investigates women in computing; their success or otherwise. To establish the context for the study the inter-rèlationships between computing and young women are examined by an extended review of the relevant literature. The research for the thesis involves an illustrative case study of young women in an undergraduate Business Computing course. It explores the experiences of the students and the issues which impact on their success. Using a case study approach, qualitative and quantitative data is gathered on attrition rates and reasons for the attrition of female students in the course. In the second stage of the research, using an action research methodology, an intervention strategy is established to improve the experiences of the female students and, consequently to have an impact on retention rates. A peer mentor scheme is the mechanism chosen to provide additional assistance, overcome the isolation felt by many young women and to increase student self esteem. The role of the scheme is later broadened to raise student awareness of possible career outcomes of the course. Evaluation of the scheme indicates that it has been valuable for those who participated. Reasons for the scheme's success, such as being based on the experiences of this particular group of young women and refined over time to continue to meet their particular needs are discussed. Some of the difficulties in implementing the program in a way that includes all female students are analysed.

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GLOSSARY OF ACRONYMS

AAUW	American Association of University Women
ABS	Australian Bureau of Statistics
ACER	Australian Council for Educational Research
ACS	Australian Computer Society
AEC	Advanced Education Council
ASCPA	Australian Society of Certified Practising Accountants
CAE	College of Advanced Education
CRA	Computer Research Association
CTEC	Commonwealth Tertiary Education Commission
DEET	Department of Employment, Education and Training
HECS	Higher Education Contribution Scheme
HSC	High School Certificate
IT	Information Technology
IFIP	International Federation of Information Processing
IIETF	Information Industries Education and Training Foundation
MACWAG	Ministerial Advisory Committee on Women and Girls (Vic)
NBEET	National Board of Employment Education and Training
NSF	National Science Foundation
OECD	Organisation for Economic Co-operation and Development
TAFE	Technical and Further Education
TER	Tertiary Entrance Rank
VCE	Victorian Certificate of Education
Vic. Uni.	Victoria University of Technology
VTAC	Victorian Tertiary Admissions Centre

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).*

Australia has one of the most gender segmented workforces amongst OECD countries. More women are in the paid workforce today than ever before, but relatively few will achieve success, satisfaction, security or remuneration comparable to that achieved by their male colleagues. This results from a complex array of factors; entrenched attitudes and expectations, and the resulting lack of opportunities for higher education and, subsequently, employment and career advancement. Regrettably this is not only a loss for individual women, but also a loss to the society as a whole. Coincidentally, as the number of women in employment has risen, so have the job opportunities in the relatively new area of computing. However, few women are employed in this industry, and, many of those who are, are at the lower level of the hierarchy. The computing industry offers a wide variety of well-paid and influential positions. Not only are women missing out on these opportunities, but the industry is missing out on the talents of a significant proportion of the population.

To be qualified to work as a computer professional a university degree is usually required. Despite the fact that increasing numbers of girls are studying information technology subjects at high school, women are not enrolling in the related university courses in the same numbers as men. Encouraging more female students to take up computing courses is only a part solution. Once enrolled in the course it is important to ensure that women experience the same opportunities for success as the male students. Currently, this appears not to be the case, with many universities recording higher withdrawal rates for female students then for male students, and it is this area, the experiences of young women studying computing at university that this study will address.

While there is an enormous amount of literature which relates to the different attitudes, competence and use of computers by women and men, relatively little is based on empirical research. This study will, firstly, review the existing literature and, secondly, research the experiences of female students in an undergraduate Business Computing course. It will explore the experiences that these women have in the course and attempt to identify the factors which influence their attitude to computing, and the course itself. It will then investigate how a higher retention rate for female students can be fostered by implementing an intervention program to address the factors that are of concern to the young women. By contributing to improving outcomes for young women the study seeks to provide the basis for such women to gain entry to professional employment in the computer industry.

Chapter 1 is the first of two chapters comprising an extended review of the literature. It considers the current state of gender segregation in the workforce and its impact on women. The growth of the computer industry and the disproportionate spread of women in this industry are discussed. The history of computing as a discipline is traced to enable the breadth of computing studies to be explained and the three discipline areas of Computer Science Engineering, Computer Science and Information Systems defined. The increased participation of women in tertiary education is investigated and the current enrolments of young women in computing courses explored.

Chapter 2 reviews the literature on the complex range of issues which interact to produce the under-representation of female students in computing courses. These issues are grouped into three categories; those factors relating to the *Computing Discipline* and the *Profession,* those factors relating to the *Institution* and, lastly, those factors which relate to the *Individual.* Strategies that have been suggested to address these issues are then reviewed for both the pre-tertiary and tertiary levels.

Chapter 3 explains the research context and the methodology used in undertaking the study. The research problem is described as well as the justification for the research. The case study approach is detailed as well as the instruments used in the exploratory, descriptive and explanatory components of the study. Each of the data collection methods are explained and the limitations of the methodology noted.

Chapter 4 begins to describe the illustrative case. The experiences of the young women in the undergraduate Business Computing course of one Australian University are examined. The same categories which were used to group the issues from the literature are used to categorise the themes which emerged from the data. The final section in this chapter compares the findings from this study with findings reported in the literature.

Chapter 5 concludes the illustrative case by describing an intervention strategy adopted to improve the retention rate of female students in the course. The evolution of the intervention program over a three year period is described. The evaluation of the program considers both the experiences of the participating young women and their retention rate in comparison with students not participating in the intervention strategy.

Finally, **chapter 6** of the thesis reflects on the whole study highlighting pertinent issues that have arisen and pointing to future areas for research.

CHAPTER 1 -

WOMEN, WORK AND COMPUTING

1.1 Women And The Workforce

Women's participation in the Australian workforce has been increasing since the mid 1960s. In 1966 only 36.3% of all females were in the paid workforce (Murdoch & Starford 1989, p50). In less than thirty years, women's participation[1] in the labour market has risen sharply to 53.9% (Australian Bureau of Statistics 1995, p5). Over the same time period, men's participation has decreased from 84% to 73.8%. In July 1995, there were 4.7 million men employed compared with 3.6 million women[2] (Australian Bureau of Statistics 1995, p5) thus males accounted for 57%, and females 43%, of the total labour force. According to Gunderson (1989, p46) the increase in the number of women now at work for pay is the single most important development in the labour market over the last 40 years. Yet, despite this increase, men and women's experiences of the workforce are substantially different. Women are more likely to be working on a part-time basis (Women's Bureau 1995, p12) with less security and fewer economic benefits (DEET 1988a, p1).

Australia's workforce is heavily gender segregated. Selby Smith (1980; as cited in Werneke 1985) found that over 85% of women in the paid workforce were concentrated in 18 of 61 occupations listed by the Australian Bureau of Statistics (ABS). Furthermore, Department of Labour figures from Victoria indicate that occupational segregation increased during the 1980s (Lyall & Hawkins 1993, p1). According to OECD surveys (DEET 1988a, p40) gender segregation today is more pronounced in Australia than in most other advanced industrialised countries. The gains in female employment can be explained by the congregation of women in industries and occupations which have grown most quickly, typically those in the service sector (DEET 1988a, p40). Whilst women make up 43% of the total paid workforce 76% of these women work in the lower levels of the employment hierarchy in industries such as:

- Wholesale and retail trade
- Community services
- Finance, property and business services
- Recreational, personal and other services

More than half of all employed women are found in just two occupational groups: 25% are sales assistants or personal service workers; and 29% are clerks (ABS 1995, p46).

[1] The participation rate for any group is the labour force expressed as a percentage of the civilian population for the same group (ABS July 1993, p v).

[2] Estimate of all employed persons (full-time and part-time).

The range of occupations in which women traditionally work has been very narrow, but a multitude of evidence suggests that women are broadening the kind of vocations in which they work, and that this broadening is slowly accelerating. In 1911, of the women who worked for wages, 84% were employed in female dominated occupations - that is a workforce in which women are present in a higher proportion than they are in the labour force as a whole (Whitfield 1987, p389). This had only marginally changed to 82% in 1971 (Whitfield 1987, p389) and by 1991 to 73% (ABS 1991,p2). Salvano (1993) concludes that a 2% change had occurred over sixty years, which was followed by a 9% change in just twenty years. While this is an improving situation, it is still remarkably slow, and, even in those occupations where females are in greater numbers, women are still typically clustered at the lower ends of employment hierarchies (NBEET 1992, p98).

One concern about the gender segregation of the Australian workforce is that the occupations and industries in which women are predominantly located are generally low-paying (Whitfield 1987, p.390). Even though the principle of 'equal pay for work of equal value' is a feature of the Australian labour market, there is still substantial inequity in pay between men and women in all occupations (DEET 1990a, p.4). A woman, on average, earns 83% of the full-time male wage, and in terms of total earnings, women earn 65% of the total of men's wages (Dawkins 1991, p.17). As Stangle (1992) observes, this segregation has social and equity implications as well as implications for the Australian economy:

> *Women who comprise 51% of Australia's population, are not able to contribute their talents and skills equitably nor do they share equitably in the financial rewards or decision-making power (p3).*

At the *Dismantling the Divide* conference, the then Minister for Employment, Education and Training, the Honourable John Dawkins in 1991, suggested that achieving economic equality for women will be one of the more complex issues to confront us in the coming decade. Surely, this is most serious as Australians stand to lose so much (socially, economically and personally) by not fully utilising the abilities of over half the population.

1.2 The Growth Of The Computer Industry

Concurrently with this slow rise of women in the workforce, there has been a growth of new employment opportunities in new technology industries, such as the computer industry. Yet, there are relatively few women working in these areas and of those that have ventured into these fields many have accepted lesser roles.

In 1956 the universities of Melbourne, Sydney and NSW introduced courses training students in the programming and application of computers. Australia's first computer for commercial purposes was used in 1958 at the Government's Bureau of Census and Statistics (Tatnall 1993, p167). By 1992 the industry had developed so rapidly that more than 264,400 people were employed in selected Information Technology related occupations in Australia (IIETF 1993, p9). Within this time frame, computers and computer work had become stereotyped as more appropriate for males (Game & Pringle 1984).

Women tended to be highly represented in the less skilled, less sophisticated areas of data entry and computer operation, while men made up the majority of the higher level, higher status, higher paid computer workforce (Anderson, 1985; Davis, 1986; Werneke 1985, p401). 'As they mature, all professions develop divisions and divides and, as in most other mature professions, women in computing seem content with lesser roles' (Moffat 1994, p149). In 1992 females comprised only 20% of computing professionals (IIETF 1993, p11). Game and Pringle (1984, p81) suggest that unskilled data entry work, which is mainly done by women, is frequently regarded as clerical rather than proper computer work and is often not considered part of the same industry. They contend that this exclusion can obscure the role of women in the structure and organisation of computer work (Game & Pringle 1984, p82). Promotional opportunities certainly appear to have been limited for women as only 0.25% of Australian computer professionals who earn an annual salary in excess of $100,000 are female (Moffat 1994, p150).

The disproportionate spread of women in the computer industry is not unique to Australia. In the United States, computers have been in industry since 1946 and in schools since 1980, but although relatively new, the industry is not open on equal terms to both men and women (Banks & Ackerman 1990; Foster 1991,p1; Ware & Stuck 1985; Wilder, Mackie & Cooper 1985). In 1990, 36% of computer programmers, 87% of data entry clerks and 66% of computer operators were female (Henwood 1993, p33) with women outnumbering men as *users* by two to one (Moses 1994, p102). Henwood (1993) suggests that in the USA, there are signs that lower level computer jobs are becoming increasingly feminised. In Canada the situation is similar with women over-represented in data entry positions, but figuring poorly in computer programming and systems analyst positions (Bernhard, 1991, p81; van Brussel 1992). The computing labour market is also segregated by gender in Sweden (Mortberg 1994, p374) and the United Kingdom, where Steve Shirley, who successfully pioneered teleworking for women programmers in the 1960s (Moffat 1994, p150), reports that, during 1987 only 2% of managers in the computer industry were women, but females made up 95% of workers in the less skilled area of data entry (Shirley 1991, p8). Amongst programmers, women represented 12% at the top level and 25% at the lower ranks of the coders (Edgar-Nevill 1991, p303). The low proportion of women in Information Technology management positions is seen as particularly problematic (Chivers & McPerson 1994, p82). Singapore, on the other hand, does not have this problem in their Information Technology work force. In 1987, 58% of application/analyst programmers and 52% of systems analyst/designers were women (Uden 1991, p388).

The under-representation of women in the computing profession in Australia does not seem to be improving and, in fact, may even be deteriorating. Women made up 20.8% of the computing management and professional categories in 1986 and 24.3% in 1989 (Rimmer & Rimmer, 1994, p12), but this trend has actually reversed with only 20% of computing professionals being women in 1992 (IIETF 1993, p11). Rimmer et al (1994, p13) point out that, if the annual growth between 1986 and 1989 had been sustained, it would still have taken until 2009 before there was equality between the number of men and women working as computing professionals. Rimmer et al (1994, p12), however, do report that women's share of data process machine operators' jobs has fallen from 79.4% in 1986 to 77.7% in 1989 and this over a time period where there has been considerable growth in employment in these positions. By 1992 women's share had fallen further to 75.9 % (IIETF 1993, p11).

Technological advancement has also brought about many other changes to the job market which, when considered together, have reduced many of the traditional employment opportunities for women. Stenographers, for example, are currently expected to perform a larger range of tasks than ever before, while office workers and managers now undertake substantial keyboard work (DEET 1991, p31) with the traditional skills of a typist; speed accuracy and neatness, becoming largely redundant (Gerver 1989, p492). Many of the traditional areas of work for women are being de-skilled or becoming non-existent (Reimann 1986). In addition, information technology has had an enormous impact on occupations traditionally held by women, such as telephone operators, clerical workers and lower level management (Appelbaum 1993, p77).

1.3 Computing - The Future

To possess a minimum amount of knowledge about computers is becoming more and more important for all members of society. As Lockheed comments (1985, p116) most future jobs will involve some form of computer use. Even outside the computer industry there are many jobs which require an understanding of general computer use or knowledge of a particular aspect of computer use (Commonwealth Schools Commission 1985a; Crawford 1990, p21; O'Leary & Williams 1989, p4). It is unimaginable today in what ways 'tomorrow's adults will need to be technologically literate as citizens and technologically skilled as workers' (Sanders 1990, p183). Likewise Lawrence (1984, p1) suggests that access to information and skills will be linked to an understanding of computers and, ultimately, people's position in society will depend upon this. In a similar vein Hawkins (1985, p166) argues that in the future knowledge about computers will be a source of power. Lips (1991, p166) concludes that in an era when sophisticated Information Technology is increasingly used in the workplace, women will become 'increasingly segregated if they do not master some aspects of this technology'.

In its report 'Australia's Workforce in the Year 2001' the Australian government argues that on average the jobs of the future are expected to be highly skilled:

> *On the whole the workforce will become more 'clever'. Above average growth is expected for occupations with above average skill levels (particularly for those with the highest skill levels). Apart from a few occupations, such as sales assistants, lowly skilled occupations are expected to grow at below average rates (DEET 1991, p5).*

The danger is that these highly-skilled jobs may not be available to women because they do not have the necessary expertise or training. Although the recession in the early 1990's slowed the demand for computer professionals (DEET et al 1992, Vol 1 p9) they are expected to have very good prospects in the workforce of the future with a 59.4 % projected employment growth between 1991-2001 (DEET 1991, p22). According to the '1995 Skilled Vacancy Survey' also published by DEET, advertised vacancies for computer professionals increased by 82% during 1994. Recruitment agencies are currently being forced to search for qualified people from overseas to fill positions (Mitchell 1995, p1). However, Greenbaum (1994, p23) is more cautious about the future of computing professionals. She observes that jobs are becoming more temporary in nature with the increasing reliance of employers on a temporary and part-time workforce. In the US computer programmer positions declined by 27,000 in the early 90's and there was a greater reliance on short term contractors (with lower wages and job security). Greenbaum warns that the very positions that women are being encouraged to consider have begun to be 'temporized'[3].

It has been widely recognised that if women are to find an equal place in the future workforce, it is necessary that women broaden their occupational choice and not limit themselves to a small range of careers (Fowler et al 1990, Morgan 1986, Plaister 1984, Reimann 1987, Women's Employment Branch 1990). The type and level of education a person obtains has a major influence on that person's future career possibilities. Access to higher education 'opens the door to economic security, better jobs, and positions of power in Australia' (Maslen & Slattery 1994, p142). Differences in education and training between men and women lead to different career paths and can limit the opportunities available to women (DEET 1992, p19). In fact, if woman do not keep up, the divisions will be greater than ever.

A career in the computing profession would allow a woman the opportunity of a high level career, and the industry itself, which is shaping so much of the future of society, would also benefit from the widest possible pool of expertise. If women are to take advantage of new employment possibilities being created as a result of technical change and the growth of IT occupations, then more women need to be encouraged to undertake, and successfully complete, computing courses. Yet in 1991 the Australian national average proportion of female enrolments in higher education computing courses was 27.6% (Gibson & Hartnett 1993, p22). Teague and Clarke (1993, p5) argue that this low level of enrolment in computer education means that many women are being deprived of good career prospects which are also financially rewarding. Dale Spender (1995, p18) suggests that women need to get involved with computers not only 'for the wealth [and] the power' but also for 'the pleasure of it all'.

Governments and leaders of the computer industry fear that a shortage of qualified labour in the future will restrict the industry's development and have advocated that women should be as closely involved as men at all levels in future development for their own personal advancement and the true representation of the interests of all sections of the community. In the USA (Heller & Martin 1994, p8; Pearl et al 1990, p48) and many West European societies (van Zoonen 1992, p13) the aims of government and industry to encourage more women into the computing profession came about as a result of the prediction that a critical labour shortage is likely to occur early in the next century due to changing demographic trends. New technologies bring about changes that have the potential to

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3 A term coined by Greenbaum (1994, p14) to signify the changes occurring to many jobs; jobs are becoming temporary in nature with more workers being forced into freelance and casual positions with fewer chances of promotion or increased wages.

affect all society and 'would be most likely to achieve maximum benefit if each significant section of society was represented in the planning decisions' (Ryan 1994, p548). An improvement in the current situation will not only benefit women, but may also contribute to Australia's potential for sustained economic growth (Dawkins 1991, p17). Women need to be actively involved in all levels of the new technologies that have such immense potential for social change.

1.4 Computing As A Discipline

Given that computer use is expanding in every facet of society, the increased demand for computer professionals, while not guaranteed, is likely. 'Women who exclude themselves from learning about and using computers risk experiencing even greater vulnerability in a world that is increasingly dependent on the power of computers and telecommunications' (Gerver 1989, p494). The means for women to avoid this vulnerability, and to be involved, must be through education.

Computer studies are relatively new as an academic discipline, just as computers themselves are new. Developing a new academic discipline raises various questions (Dain 1991, p219) such as:

- what should be included as subject matter?
- how should the topics be taught?
- which aspects are suitable research projects?
- where will the discipline fit in the academic world?

Computer courses in Australia were introduced at several universities in the late 1950s. By 1985, every generalist college of advanced education (CAE) and university had an established computer department (Sale 1994, p152). Even so, there were less than 80 undergraduate courses of a computing nature in 1985, but this number had more than doubled to 170 in 1991 (DEET et al 1992, Vol 1 p8). The computing courses offered at tertiary level covered a wide range of curriculum areas. The teaching of university computing courses initially occurred in the faculties of Engineering, Science or Business (Tatnall 1993, p4) and has since spread into other faculties with titles such as Commerce, Mathematics and Computing, Information Technology, or Informatics. Computing was disguised under a range of names and curriculum areas; while some computing was labelled as Mathematics, other computing was not (Sale 1994, p153). For example

> *...courses with names such as Information Science, Information Processing, Numerical Methods, Computer Science, Data Processing, Automatic Data Processing, Electronic Data Processing, Business Data Processing, Commercial Data Processing, Business Computing, Information Systems and Computing, all either currently exist, or have existed in the past (Tatnall 1993, p15).*

Grundy (1994, p25) suggests that although many university prospectuses commonly call computing a science, this is actually a misnomer as computing makes no attempt to explain the world, which is what science is all about.

The two main approaches to the teaching of university computing today are those of Business Computing and Computer Science (Tatnall 1994, p1). According to Mitchell (1995, p1) Professor Juliff, Head of Management Information Systems at Deakin University - Burwood in Victoria, reported that currently at Australian universities there are more Business Computing degree courses offered than Computer Science degree courses. Business Computing is also known as Information Systems (Tatnall 1994, p1). The structure and content of Business Computing courses differs between universities however subject material such as systems analysis, systems design, database and programming are common to all (Shackleton, forthcoming). Tatnall (1995, p2) has found that 'no other curriculum area has developed so quickly...and courses in Business Computing are also unusual in the degree to which they depend on technology for their very existence'.

Several patterns are evident in the approaches each of the universities has adopted for the provision of Information Technology education that often reflect the previous history of the institution and its current mission (DEET et al 1992, Vol 1 p7). For example, some of the

> *...pre 1987 universities have developed more strongly the computer science and engineering options, with a slower rate of development of information systems specialities. Former CAEs which lacked an engineering base tended to concentrate initially on business data processing, within commerce departments, with a later move to information systems. Former institutes of technology have been relatively active across the full spectrum of IT. Courses from the last two groups are more vocationally oriented and may include industry experience (DEET et al Vol 1 p7).*

DEET introduced a Field Of Study Classification in the 1980s 'to assist in the interpretation of data about Australian higher education courses' (CTEC 1986, p1). It listed ten broad fields of study including Business and Science. Within Business, a field entitled Business Data Processing was defined. Science included:

1. Computer Science, Information Systems - General (not Business Data Processing)
2. Computer Science
3. Information Systems.

After a study into the computing discipline the Commonwealth Government released the *Report of the Discipline Review of Computing Studies and Information Sciences Education* (DEET et al 1992). The report recommended that the term *Information Technology* be used as the generic term encompassing activity from computer engineering to telecommunications, business systems and other applications (Vol 1, p1). The report also suggested that within Information Technology, three separate discipline areas can be broadly defined: Computer Systems Engineering, Computer Science and Information Systems (Vol 1, p6).

Computer Systems Engineering courses, which are usually delivered by Faculties of Engineering, have an emphasis on engineering as opposed to computing, and consequently are deemed to be outside of the scope of this study.

Shanks, Rouse and Arnott (1993, p2) describe Information Systems as being the effective use of Information Technology by both people and organisations. They argue that since it is a relatively new discipline within tertiary education there is still debate as to its nature and purpose. Shanks et al (1993, p3) have identified that within the study of Information Systems 'human factors are at least as important as technical factors and it is this focus which distinguishes Information Systems from Systems Engineering'. Information Systems can also start to be distinguished from other parts of the Information Technology discipline by its association with a broad group of subjects and methodologies (Shackleton, forthcoming). An extract from the Australian Computer Society's submission to DEET (Figure 1.1) tries to show the boundaries between the three various curriculum areas, however, it is at once apparent that there is a great deal of overlap between them. The interests of three professional bodies, the Australian Computer Society, the Australian Society of Certified Practising Accountants and the Institution of Engineers - Australia, (indicated below figure 1.1) reflect the extent to which computing has permeated into other discipline areas.

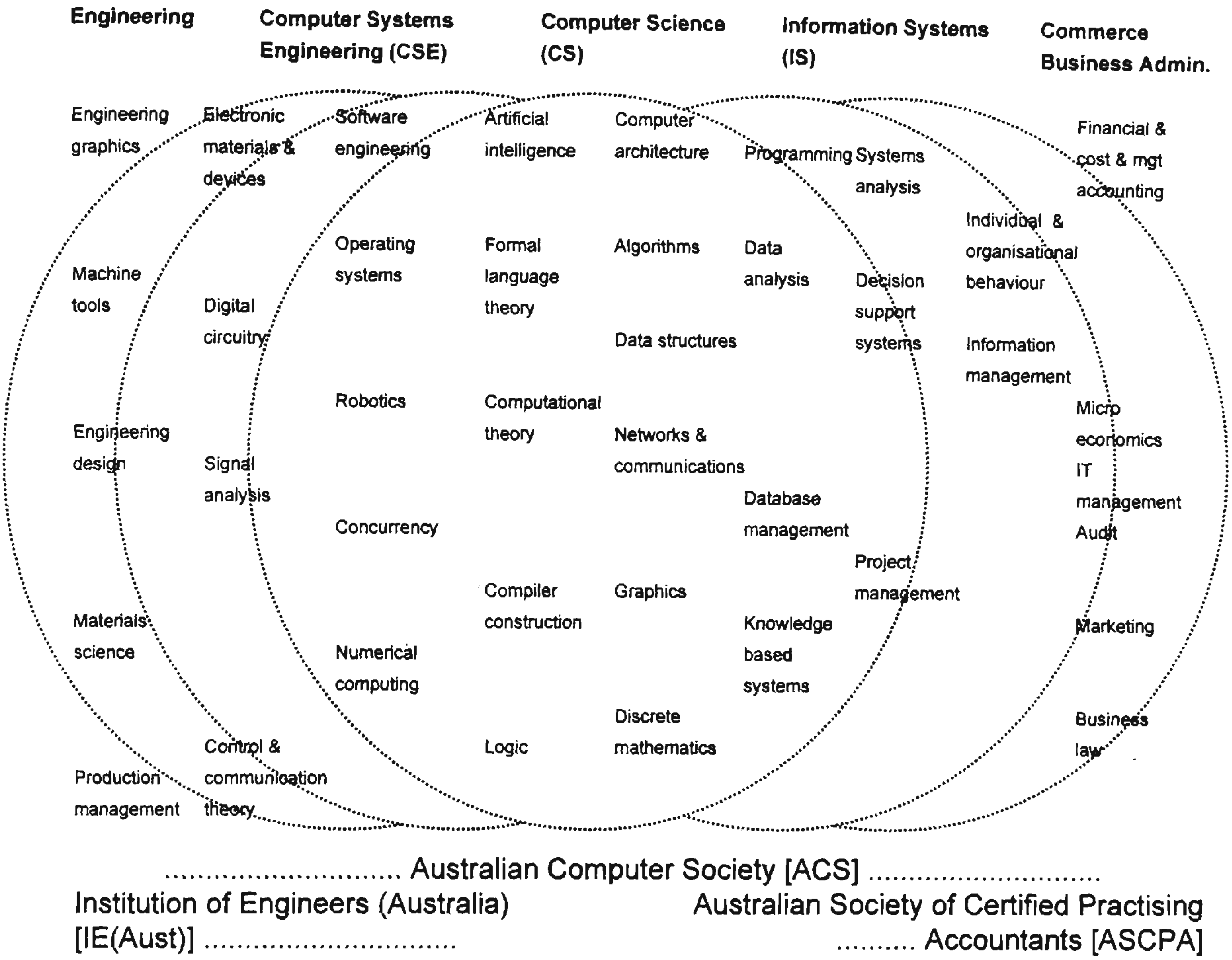

Figure 1.1: Scope of the Computing Studies and Information Science Disciplines

NB: The topic areas are indicative only and are not exhaustive. The orientation dimension, comprising basic research, applied research, product development and application areas (such as commerce, industry, government, libraries, land information and health) is orthogonal to this disciplinary dimension.
Software engineering is included as a subject area rather than a discipline.

Source: DEET et al 1992, Figure 2.2

Although Information Systems curricula overlaps with elements of Computer Science and Computer Science Engineering courses, there are important differences in the nature of the work performed, the types of systems developed and managed, and the application of the technology (Longenecker et al 1995, p9). Information Systems is a discipline which is oriented towards business or commerce; it involves matching information systems requirements to an organisation's objectives. In contrast; Computer Science concentrates on algorithmic processes and system software. Software Engineering incorporates the principles of large-scale software systems whereas Information Systems usually deals with smaller organisations (Shackleton, forthcoming). As a consequence, Information Systems courses are

> *...designed to prepare or develop further the abilities of students to analyse information needs, functions, operations, procedures, physical systems and technical problems of an organisation to establish the feasibility of, and develop procedures for, automatically processing data by use of computers and communications network (DEET et al 1992, Vol 2 p16).*

Figure 1.2 assists in contrasting the three areas of Information Technology. Moving along the horizontal axis ('hard' to 'soft') represents a shift from hardware-oriented, to more human involvement, in the development of applications.

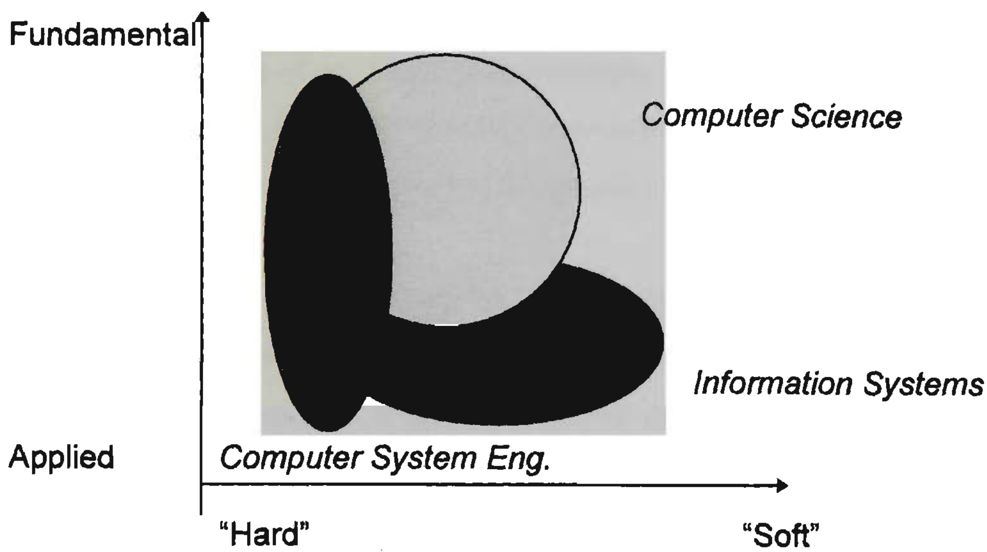

Figure 1.2: Information Technology - Principal Subject Clusters

Source: DEET et al 1992: Figure 2.1

For the context of this thesis *Information Systems* will be defined, using the definition from the discipline review report, as a general term used to

> *...denote all operations and procedures involved in the design and implementation of an information processing system. The term implies the integration of computer based components and manual operations to enable data to be collected, organised, saved, managed and retrieved as useful information (DEET et al 1992, Vol 2 p 16).*

Information Systems as a field of academic study will be defined using Tatnall's definition (1994, p4) as 'curricula designed primarily to educate people in the efficient and effective application of computer hardware, software and systems to the solution of business and organisational problems'.

Different skills are required by students studying in the different areas within Information Technology. Kay et al (1986, p2) suggest that those courses with a heavy Information Systems or Data Processing emphasis deal with the application of computers, especially in the business area, and they typically stress communication and broad problem solving skills. In contrast, Computer Science oriented courses tend to concentrate on the technical and mathematical aspects of the discipline.

A recent American study (Betts 1993) lists the top job titles for women qualified in the area of Information Systems as LAN Manager, PC Help Desk, PC Specialist, Systems Analyst, Programmer/Analyst, Technical Services Manager, Computer Operator and Database Administrator. While some estimates suggest that in Information System departments throughout America, an average of one out of three employees is a woman (Fryer 1994, p34) a study conducted by Computerworld of 1,383 Information Systems professionals in the US, found that 18% were female, while they constituted 45% of the general work force (Betts 1993, p68).

In reviewing the literature, a number of studies have not specified which discipline area within Information Technology they are referring to. Where it is known, a study will be clearly linked to either Computer Science, or Information Systems (Business Computing). However, course names are often not a reliable guide to their content as 'degrees which include the words Information Technology, Information Systems, Computer Science etc. in their titles, vary considerably' (DEET et al 1992, Vol 1 p31). Where a study uses different terminology, but it is clear that in terms of content it is dealing with Computer Science or Business Computing it too will be considered. As Tatnall (1993, p12) indicates, the situation is 'rather more complex than a simple dichotomy of Computer Science versus Business Computing would suggest, as courses in computing form a continuum between these extremes'. The broader term *tertiary computing* will be used to refer to all non-Computer Systems Engineering oriented computing courses.

1.5 Women and Tertiary Education

The 1980s and early 1990s saw a period of enormous change in the Australian education system. High school retention[4] rates more than doubled during the 1980s, increasing from 34.5% in 1980 (Australian Bureau of Statistics 1992b) to 76.6 % in 1993 (Ainley et al 1994, p39). Changing community expectations, a depressed teenage labour market and government policies encouraging students to complete their secondary education were all interacting and contributing factors (Williams et al 1993a, p15). The result was an increased number of people eligible to enter higher education.

In 1974 higher education fees had been abolished for students attending Australian universities and CAEs (Abbott-Chapman et al 1991, p32). The Commonwealth Government's commitment to increased participation resulted in an increased number of places available for students at the tertiary level. In 1955 students enrolled in Australian universities totalled a mere 30,792 (Maslen 1995, p5). In 1983 there were 348,500 students enrolled and this has soared to a staggering 622,048 in 1995 (Maslen 1995, p5) resulting in education 'for the masses rather than the elite' (Maslen et al 1994). The two-tiered system which distinguished between the more applied and teaching-oriented colleges and the traditional universities was abandoned (Williams et al 1993b, pxiii). Seventy-six tertiary institutions were amalgamated into less than forty large, multi-campus, multi-purpose universities (Maslen et al 1994, p3). To help alleviate the cost to the taxpayer of the growth in tertiary education places, an annual administration fee was charged for the first time in 1987 ($250, increasing to $263 in 1988) but this was replaced in 1989 with the introduction of the Higher Education Contribution Charge (HECS). Since 1989 all higher education students have been expected to pay approximately 20% of the costs of their tuition[5] (Williams et al 1993b, p4) either up front each semester, or repayable when a student's taxable income is about equal to the average weekly wage.

In 1988 the Australian Government issued *The National Agenda for Women* which outlined objectives for the development and implementation of its strategy for women for the remainder of the century. The Agenda....

[4] Retention rates are a measure of the percentage of a cohort of students who remain at school for subsequent years of schooling. It does not take into account the mobility in or out of a particular school as it is only a measure of net change (Wyatt 1988, p4).

[5] Approximately $2500 for a year of full time study in 1995.

> *...promotes the importance of education as a key to future choice, the means by which women may raise their level of competitiveness in all segments of the labour force, improving their chance of gaining economic independence and enhance the overall quality of their lives. The Agenda also notes that as larger numbers of women extend their education into the fields of science, technology, business and economics, there will be corresponding benefits for the economy and society as a whole (Office of the Status of Women 1991, p22).*

Access to tertiary education is a major factor which for many Australians determines their personal and career development (Castelman & Poole 1990, p1). A study of the Victorian labour force in 1992 found that males and females who had completed a post secondary qualification had lower unemployment rates than those without such a qualification. The unemployment rate for women with post school qualifications was 8.5% and for those without post school qualifications 14.4% (DEET 1992, p18). A survey of human resource responses to a changing workforce and business environment by the Business Council of Australia (1992, p7) concluded that employers prefer to employ experienced workers, followed by university graduates or recent apprentices and that job opportunities are more limited for people who have lower educational levels. The number of full-time jobs available for unskilled workers, especially younger workers is declining (DEET 1991, p75).

Women's participation in higher education 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 tertiary education in Australia saw women students outnumbered by men (Maslen et al 1994, p147). Whereas female students made up only 45% of the student population in 1981 they comprised more than 55% in 1993 (Maslen et al 1994, p132). Maslen et al conclude 'that a curious and profound social change is taking place among the sexes in Australia about the value of higher education'. Williams et al (1993b, p32) suggest that norms about gender roles in society are changing slowly and that this is partly due to the government's policy of increasing participation of women in education in the 'interests of both equity and human capital formation'.

The year in which female enrolments first exceeded male enrolments is unclear. While Cobbin (1995, p6) reports 1988, DEET (1990a, p7) claims 1989 whereas Maslen et al (1994, p132) and Richards (1995, p12) suggest that the last time more males commenced university than females was 1986. While some of this confusion may be due to calculations associated with the transfer of nursing to universities (beginning in 1985), the amalgamation of CAEs and universities, the definition of tertiary education (whether this includes TAFE and technical colleges) and the differing methods of calculation (completions, commencements, total enrolments) there is no doubt that women in recent years have comprised more than 50% of the commencing enrolments. Birrell, Dobson, Rapson and Smith (1995, p46) report that in 1994, 54.7% of the commencing student population were women. At the undergraduate level the proportion of women amongst commencing students was 56%. Only five of Australia's 38+ universities had enrolments where women did not exceed men. These include Victoria University of Technology where only 48.2% of commencing undergraduate students were female (Birrell et al 1995, p47).

Although female enrolments in non-traditional courses have risen (Data Matters 1995, p2; DEET 1990a , p99) women still do not participate equally in all fields of study. The concentration of females remains mainly in the arts/humanities, health and education fields (Cobbin 1995, p8; DEET 1988b, p21; 1990b, p28; Dobson 1995, p7; Maslen et al 1994, p148). As a DEET report in 1992 states 'Gender segregation in the secondary and tertiary education curricula leads to the gender segmentation of the labour market which is so influential in limiting women's pay and career opportunities' (p19). One of the goals of the *Australian Women's Employment Strategy* (DEET 1988a) which seeks to ensure that women are employed to their full potential, is to improve women's access and participation in employment, education and training and consequently to reduce this gender segregation in higher education and elsewhere. This was the first time that national goals for improving women's employment opportunities had been established in Australia.

In 1990 the DEET initiative *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. This was the Government's response to Dawkin's White Paper (July 1988) in which the Government had given a commitment to the 'development of a more equitable higher education system with improved opportunities and outcomes for all Australians' (DEET 1990b, p53). Women were one of the major target groups. As a consequence of the imbalance between the disciplines national objectives were set to improve the spread of women across the various courses. Emphasis was placed on two areas:

1. Research and higher degrees.
2. Non-traditional courses - courses where females have generally been significantly under-represented. These include the areas of engineering, business studies, economics and science (DEET 1990b, p27).

Non-traditional is defined as a minor field of study with less than 40% female representation (Cobbin, Poiner & Temple, 1995, p1). In 1991 the nation-wide average of female enrolments in higher education undergraduate computing courses was 27.6% (Gibson et al 1993, p22). Consequently computing is one such 'non-traditional' area.

Targets were established where by 1995 the proportion of women in engineering would be 15% and in other non-traditional courses 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, p27). Future funding allocations to the higher education institutions would depend on progress made towards achieving these equity goals (DEET 1990a, p4). The Commonwealth Government reaffirmed its commitment to these targets in 1993, with the release of the *New National Agenda for Women 1993-2000.* It 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, p26).

While Dobson (1995) agrees that women dominate the traditional fields, he has recently put forward the argument that except for the engineering field, women can no longer be considered disadvantaged with regard to access to non-traditional fields. He reports that in 1994, 44% of commencing business students and 41% of commencing science students were female. Computing courses are likely to be within both of these broad fields. However, Dobson fails to address the fact that from the figures he provides it is not possible to know what the proportion of women is for Computing courses nor other non-traditional minor fields. Taking a figure for such broad fields could actually hide areas where women dominate and women are under-represented. The Finn report (Australian Education Council Review 1991, p137) has identified that while gender itself is not an indicator of disadvantage in higher education 'there are equity issues associated with gender which remain to be addressed by the education system'. The report goes on to suggest that there is a possible connection between the increasing number of women in higher education and the disproportionately low participation of young women in apprenticeships[6].

Birrell et al (1995), suggest that the emphasis on encouraging females into technological fields is actually misguided. He maintains that women are no longer disadvantaged in regard to access to higher education and that females are, in fact, out performing males in many aspects of their education:

> *Young women appear to have made quite sensible career choice decisions, given their relative success in finding professional work. They may be better anticipating the way our economy is moving as regards job opportunities than some educational leaders. Perhaps more men ought to be encouraged to enter service oriented professions (Birrell et al 1995, p53).*

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[6] Fewer than 10% of all apprenticeship positions are held by females and most of these are hairdressers (Australian Education Council Review 1991, p31). The report also indicates that apprenticeship opportunities have increased 70% in the past 25 years (p85).

It has long been argued, however, that the present growth in the service sector is likely to be short-lived due to the effect of new technologies (Jones 1983), so that ultimately women may be disadvantaged if they do not consider employment in other areas.

Cobbin (1995) strongly argues that there are many ways in which women are still disadvantaged in higher education. Apart from the clustering of women in particular fields of study, research shows that women are less likely to be represented amongst higher levels of study[7] such as Masters degrees or doctorates. Within the ranks of academic staff, women are likely to be clustered in lower level positions such as tutors. One third of all computer science departments in the US have no women academic staff (Leveson 1989) and Etzkowitz et al (1992) report that not only are women poorly represented in most computer departments, but that all the traditional norms of the academic system make it difficult for women to obtain promotions. In most Australian higher education institutes women are also particularly under-represented among all levels of senior management (Jones & Castle 1989, p8).

1.6 Women and Computing Education

The Commonwealth Tertiary Education Commission (CTEC) conducted a review of research on the participation of women in tertiary education (Powles, 1987) and its report for 1985-87 noted that the numbers of women enrolling in tertiary education had increased significantly. However, 'severe gender imbalances have persisted in those fields of study which are, to an ever increasing extent, underpinning a society in the process of rapid social and technological change' (Powles 1987, p1).

While the literature indicates that female students are under-represented in tertiary computing in Australia (Campus Review 1996, p23; Cobbin et al 1995; DEET 1990b, p65; Gibson et al 1993; Kay et al 1986; Maslen 1996; Ryan 1994, p548; Sampson 1993), the statistics at times can be confusing. A study by Cobbin, Poiner and Temple (1995, p4) on women in tertiary computing reported female participation rates of mid to high 30s within Business Data Processing and 20% to 30% for the major field of Computer Science/Information Systems. However, this analysis was based on the DEET Field Of Study Classification System which has not been altered since its introduction in the 1980s and which was found to be inadequate. With the rapid change in curriculum content this classification system:

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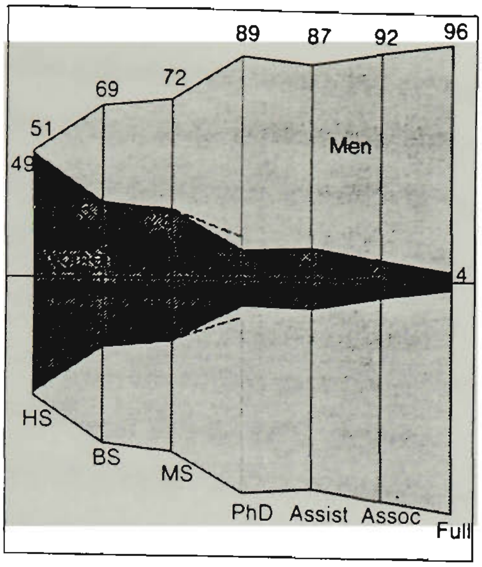
7 See for example Maslen et al (1994, p149) who report that in 1993, of the postgraduates who completed a PhD, 70 % were male and 60 % of those who completed a Masters degree where male.

> *...is significantly out of step with current courses. In its present form it is unsuitable for monitoring or comparing institutional performance in general as well as in relation to women in non-traditional study fields (Cobbin et al 1995, p1).*

Even DEET admits that its 'definitions of the terms used in data collection lack consistency and do not accord well with common usage' (DEET et al 1992 Vol 1, p31). With the rapid growth of computer courses, their appearance under a variety of names and within different faculties, and an outdated classification system, official government statistics of tertiary courses may not provide unequivocal data on student enrolment in computing courses.

Across Australia there appears to be considerable variation in enrolments in computing courses between the states and by institution. In 1990, for example, for Information Systems courses, female enrolments were reported as high as 52% in Victoria and as low as 27% in Western Australia. For Computer Science, the highest recorded enrolment was in South Australia with an enrolment of 26% females and the lowest was in the Australian Capital Territory with a female enrolment of 14% (DEET 1993 - see Table 1.1). Not only are there significantly fewer women in nearly all higher education undergraduate computing courses, but a greater percentage of males than females expect to continue their computing studies beyond the undergraduate level (Clarke & Chambers, 1987).

Educators in many Western countries are concerned about the low participation of female students in computing. In the UK the number of female students enrolling in computer studies fell from 24% in 1980 to 10% in 1987 (Dain 1991, p218) with a slight improvement to 13% in 1989 (Lovegrove & Hall 1991, p34). In the USA female participation at the undergraduate level in computing science is 36% and at the doctoral level 13%, yet it was as high as 50% at the high school level (O'Rourke 1993). O'Rourke's pipeline graph (Figure 1.3) shows that the higher the educational level required, the harder it is to retain women, with only 4% at the full computer science professorial level.



The data up to master's degrees is taken from the National Science Foundation's Jan. 1992 report, Women and Minorities in Science and Engineering: An Update. The remaining data is from the 1991-92 CRA Taulbee Survey. The two databases are not entirely compatible. The NSF data is for 1989, whereas the CRA Taulbee data is from 1991-92. NSF includes information sciences departments, and the CRA survey includes Canadian universities. At their point of overlap, the NSF data shows the Ph.D. percentage at 17%, which is shown as dashes in the figure (O'Rourke 1993).

Figure 1.3: Statistics on Women in Computer Science

In other parts of the world, however, female students participate in more equitable numbers in the computing discipline. For example, there is no shortage of female students enrolled in computing courses in Singapore. More than 50% of the undergraduates from computer courses in 1980 were female (Uden 1991, p388), though it is noted that this enrolment pattern does not spread into other technical courses such as engineering. In Malaysia, Computer Science courses are popular with students regardless of gender (Kamsah & Ahmed 1994, p753). In 1993, at one of Malaysia's six universities, women even comprised 88.7% of the total student enrolment in computer science. In Bulgaria, although the new technologies are not as wide spread as in other parts of the world, computing also seems to be more gender neutral (Durndell, 1991b). Durndell reports that women certainly dominate the Engineering profession and the government is now restricting female enrolments into engineering courses to 50% in order to stop the domination of women in this area. Why does computing appeal more to women in one culture than from another? Cross cultural comparisons seem to indicate that the problem of women and computing is not sex-related but dependant on cultural and societal influences. Durndell (1991b) suggests that in Bulgaria it is the existence of a core secondary school curriculum which prevents young women from opting out of scientific and technological subjects and courses.

In Australia the gender imbalance in computing courses is not confined to the tertiary level. At the secondary level in Victoria some form of batch programming was made possible as early as the mid-1970s through the use of a PDP-8 at Burwood High school and a Wang at Box Hill High

School. Then in 1978 schools also gained access to a travelling roadshow which was equipped with an Apple II and a tape drive (Pirie 1994, p160). Formal computing study in Victoria, at the secondary school level began in 1981 with the introduction in the final year of schooling of HSC Computer Science (Tatnall 1993, p13). In 1981 candidates for this subject were fairly evenly balanced between the genders. In 1982 slightly more boys took the subject. By 1983 girls were less than half of the enrolments and in 1984 they represented less than one third (Firken 1984, p27). Firken identified three themes which contributed to this situation:

1. Computers were often introduced via maths/science departments where traditionally girls feel less comfortable and where there are fewer female role models[8].
2. Computers were seen as a male domain as they were associated with high technology.
3. Computer classroom culture was seen to be a problem.

The rapid growth in secondary computing can be seen by the fact that by the end of the decade some form of compulsory computer awareness unit, and optional computer studies, was available at all Australian secondary schools (Pirie 1994, p166).

There is also evidence in Australia, the USA and the UK of differences in computer use outside of the classroom. The Melbourne PC User group, one of the largest user groups in the country, reports a female membership of less than 8% (Finlay 1994). Boys are twice as likely as girls to be members of computer clubs (Queensland Teachers Union 1986). It is more common to find boys at computer camps in the USA than girls (Chen 1986, p266) and boys use computers in extra-curricular activities more frequently than girls (Lockheed 1985, p117). Video games, which are regarded as the *quick-and-dirty* entry point into the world of computers, are pre-dominantly bought for boys (Moses 1994, p101) and in video arcades girls tend to be the onlookers (Kiesler, Sproull & Eccles 1985, p455; Wilder et al 1985, p215). About one third of American homes have a computer, but most of these are purchased and used by males (Kantrowitz 1994, p50) and in Australia too, boys report more frequent home use of computers than girls (Crawford, Groundwater-Smith & Millan 1990 p48). However, as Hattie and Fitzgerald (1987, p8) note, at primary school level there is little difference between boys and girls in their attitude towards computers or in their usage. Anderson (1994, cited in Kantrowitz 1994, p51) argues that boys and girls are equally interested in computers until the fifth grade when sex-role identification takes over. In an Australian study on adolescents and the media, the younger students (12 year olds) made the most use of computers, while the older students (17 year olds) used computers the least (Sachs 1991, p18). Unfortunately, there was no breakdown of gender given in this study. However, Hattie and Fitzgerald (1987) conducted a meta-analysis of 19 research studies and

8 This relates to the way students are inclined to copy the behaviour of someone who they admire or with whom they can identify (Lawrence 1984, p10).

concluded that older female students become less frequent users of computers than their male peers, and, that differences in attitude toward computers become marked as the students progress through adolescence.

Researchers concerned with equity issues have also identified inequalities in computer access for students relating to social class and race/ethnicity. However, as Sutton (1991, p477) has identified, very few studies have been able to simultaneously examine gender, social class and race/ethnicity due to the difficulties associated with the research design. This thesis will primarily focus on gender research but will consider studies where gender overlaps with social class and/or race/ethnicity.

In tertiary computing there is evidence to suggest that there are fewer women enrolled in Computer Science courses than Information Systems courses. Table 1.1 shows the percentage of female students in Computer studies in 1990:

Table 1.1: Percentage of Female Computer Students by State 1990

	Computer/Sci Info Systems	Computer Science	Information Systems	Other Computer Science
NSW	32.05	23.99	48.04	-
VIC	27.90	22.32	52.26	25.48
QLD	17.78	20.20	27.70	26.04
WA	25.19	18.18	27.08	-
SA	21.66	26.12	-	-
TAS	20.28	-	-	-
NT	18.3	-	-	30.0
ACT	27.96	13.79	22.7	-
AUST	28.05	22.98	46.25	25.66

Source: DEET as report in Sampson(1993, p112)

Cobbin Poiner and Temple (1995, p4) put the enrolment rates for women in Computer Science and Information Systems between 20% and 30%, but indicate that it was noticeable that the rates of each category (completions, commencements, total enrolments) were lower for Computer Science than Computer Science/Information Systems - general and for Computer

Science/Information Systems - other. They suggest that the tendency for Computer Science courses to have lower female enrolments was connected to the involvement of an Electrical/Electronic Engineering content and/or departments. A similar trend has been commented on in Mathematics:

> *The linking of lower participation for women in Computer Science was also noted in the field Mathematics - General, where there was a pattern of higher participation rates for women in programs that were variants of Bachelor of Mathematics degrees and lower rates in courses oriented to Computer Science (Cobbin et al 1995, p6).*

In fact, Computer Science showed a decrease in female enrolments over the five year study period, and was the only non-traditional field to do so (1995, p5). A similar decline in Computer Science enrolments has been noted in the UK and the USA (Foster 1991, p2; Frenkel 1990, p35; Gruman 1990, p87; Lovegrove & Hall 1991).

Clarke, Silcock and Teague (1993) used Victorian secondary education enrolments to suggest that the low proportion of women is actually restricted to Computer Science, rather than computing in general.

> *Slightly more than half of the students enrolled in the 1991 Victorian Year 11 Information Technology units were girls. In the following year only 26% of the Year 12 Information Systems class was girls, but in the Information Processing and Management subject the proportion was 56%, and in Information Technology in Society it was 67% (Clarke, Silcock & Teague 1993, p1).*

The *Information Processing and Management* subject involves the use of software packages, the *Information Technology in Society* subject focuses on the social issues related to technology and the *Information Systems* subject covers Computer Science curriculum (Clarke & Teague 1994, p2). This illustrates the confusion of nomenclature. While the percentage of female students enrolled in VCE *Information Systems* has halved since 1992, there has also been a decrease in the percentage of female students in all the other computer subjects studied at VCE level (see Appendix 1). Taking a slightly different look at Victorian Year 12 computing classes the total number of students who undertook computing studies increased fourfold between 1990 and 1993 (Ainley et al 1994, p54). In 1993, as Ainley (1994, p54) reports, one student in five studied *Information Processing and Management* (20.3% of all male students and 20.2% of females). Relatively few males and females studied *Information Systems* (5.4% and 1.4%) or *Information Technology in Society* (0.6% and 1.0%).

Mitchell (1993, p35) and Ward (1991, p15) suggest that girls see Information Systems/Business Computing as the 'softer' option to Computer Science. While it may be perceived to be the easier option in nearly all institutions students require a higher TER (Tertiary Entrance Rank) score for entry into Business Computing than for entry into Computer Science (DEET et al 1992, Vol 1, p31). Hasan and Kapram (1994a, p4) argue that it is the *application* of the technology to business problems that attracts women to choose Information Systems in preference to Computer Science. Hasan and Kapram (1994b, p51) also suggest that there are perceptions that there are more flexible working conditions in this field and that Information Systems graduates are more employable than Computer Science graduates.

A number of studies conducted in the USA found that there is a difference in the type of computer use between the genders. In a survey of Californian high schools (Linn 1985 as cited in Tittle 1986, p1164), girls comprised 42% of enrolments in computing classes. However the area of participation varied; 86% of enrolments were in word processing courses and 37% of programming students were female. Becker and Sterling (1987) also found girls to be over-represented in the area of word-processing only (as cited in Sutton 1991, p482).

Concern about girls and computing was first raised in Australian secondary schools around 1983-1984. Initial research (Symons 1984, p5) 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. Symons(1984) cited scarcity of positive role models, the lack of confidence of girls, curriculum materials which were not gender inclusive and the degree of active participation in classroom activities by girls as prime examples. One of the earliest Australian studies of tertiary computing was conducted by Porter and Pirie (1986) which investigated first year Computer Science students at Wollongong University. At the commencement of the course only one third of the students were female. Porter et al. found an alarming rate of attrition of around 60% of all enrolments. Having categorised students into part-time, full-time, male and female they found that it was the full-time female student (generally straight from high school) who was least likely to successfully complete the course. At the end of the three year course, the male to female ratio had deteriorated even more, from 2 : 1 to 3 : 1. Yet part-time female students did not withdraw from the course with the same frequency as the full-time female student. It was suggested that although computing was not a pre-requisite for the course, students found that having prior computing experience was a distinct advantage. This could account for the performance of the part-time females who could be gaining computing experience at work. Alternatively, these students may have had access to contacts or networks outside the University which could have helped them.

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 courses offered at universities and CAEs (Kay, Collings, Lublin, Poiner, Prosser, Bishop and Watson 1986). Evidence of the low proportion of females in computer courses (25% - 33% of the students in these courses were women) was found. Female students were slightly less likely to pass in the first units of their course than the males and more likely to withdraw in their first months of studying. A relatively high proportion of women discontinued their studies (women outnumbered men in withdrawing from their course by 3 to 2). The investigation found

> *...that there are particular problems for women in the very early stages of the courses and that some aspects of teaching method, curriculum and course emphasis and orientation relate to better outcomes for women in these early stages of the course (Kay et al 1986, p1).*

Women were found to have enrolled in higher proportions in Information Systems or Data Processing courses than in courses with a heavy emphasis on Computer Science. A lower proportion of female students enrolled in courses that placed high emphasis on mathematical skills (Kay et al 1986). Since Computer Science courses place greater importance on mathematics this combination of findings is consistent.

Studies from the University of Tasmania in 1992 revealed that, for every 100 male students entering a Computer Science course, 56 would graduate. In comparison, of every 100 female students entering, 26 are likely to graduate.

> *The difference in retention rates for women and men can probably be attributed to poorer performance of female students in a relatively small number of key first year units. This suggests that the barriers to successful completion of a computing degree by women students may be relatively few and identifiable (Gibson et al 1993, p32).*

The retention rate of female students in computing was as low as 11% at La Trobe University-Bendigo after two years of study. At the end of 1993, of the 19 girls who enrolled in 1992, only 2 girls remained in the course (Staehr & Martin, 1995). In contrast, a study at another Australian university found that 40% of the students in the Information Systems degree were female with no evidence of different attrition rates between the male and female students (Hasan & Kapram 1994b, p51).

Once enrolled in computing subjects women appear to achieve higher results on average than men. A recent study of more than 10,000 students who enrolled for the first time at the University of Wollongong between 1990 and 1993 found that the female students performed at a higher standard than the male students (Lewis 1994, p20). In the non-traditional fields of Engineering, Informatics and Science, female students also consistently achieved better results than males. A study by

Clarke and Chambers (1989) differs in its finding regarding achievement of students in first level units. Women enrolled in a compulsory computing unit gained comparable results to their male colleagues and this was despite initial differences in attitudes, previous computing experience and in the students' anticipated academic results. As other research has concluded the lower participation of female students in computing courses cannot be explained by differences in ability (Jacklin 1989, p127; Kiesler et al 1985; Lawrence 1984, p2; Linn & Hyde 1989). Bem (1981) argues that while everyone is born with a given biological sex, the consequences are socially enforced and perpetuated from that moment on. After reviewing studies from other Australian universities Lewis (1994, p67) has recommended that the government and universities should 'expand their efforts to encourage women into non-traditional fields of study'.

In the study conducted by Kay et al (1986) it was observed that women who did survive the early stages, and went on to complete their final year of study achieved as well as, if not better than men. Female students made up about one quarter of the graduating classes. The central findings of this study were:

- *Women's participation seems to be largely determined either before their entry to tertiary institutions or in the first few months in the courses.*
- *Intervention would seem more likely to succeed if it is structured and closely related to the course of study and if it occurs either immediately before or very early in the first year (Kay et al 1986, p0).*

Studies in other English speaking countries show some similarities, although important differences are also evident. In the USA, Campbell and McCabe (1984, p1109) found a 61% persistence rate for male students in Computer Science but only 39% for females and more recent research indicates that there continues to be a significantly higher dropout rate among female students than among their male counterparts (Martin 1992a, p7). In New Zealand the absolute number of women in computing courses is falling and large numbers of women are dropping out (Toybee, 1992; cited in Selby & Ryba, 1994). In South Africa the situation appears to differ[9]. Although the percentage of female undergraduate Computer Science students is small, the persistence rates, and pass rates, for men and women are similar (Galpin & Sanders 1993).

[9] There has been very little research in South Africa on gender-equity and computing. Galpin and Sanders (1993) studied the students at the University of Witwatersrand over 7 years and they suggest that their results may reflect the situation in other computer science departments in South Africa.

1.7 Summary

Within the last forty years there have been enormous changes to Australia's workforce. Many more women participate in the paid labour market today, yet they are still congregated in a small number of industries. At the same time we have seen the birth of a new employment opportunity: Information Technology. However, women have quickly become under-represented in computer education and the industry. The statistical evidence shows there is no equality. This does matter and is of concern 'not simply because of the occupational and educational rights of one half of the population, but also because of what that half can bring to the total of human knowledge' (Birke 1986, p185).

Tertiary Education is the path to a computing career for many future computing professionals. Not only is there a lower level of enrolment by females in tertiary computing but consistently across studies, it has been identified that there is a greater rate of attrition of female students compared with their male counterparts. The situation may be worse in Computer Science than in Information Systems/Business Computing. It also appears that problems for female students entering computer courses occur most frequently in the early stages of their studies. Yet, those women who remain in tertiary computing courses appear to achieve good results. To move towards a better gender balance in the world of computing, women need to be encouraged not only to commence, but also to successfully complete a computing qualification.

CHAPTER 2 -

REDRESSING THE IMBALANCE

2.1 Historical Developments

Women have made significant contributions throughout the development of computing although this generally goes unrecognised. In fact, the very first computer programmer was a woman. In the mid 1800s, Augusta Ada Byron, Countess of Lovelace, worked with Charles Babbage on his mechanical computing machines by providing the conceptual programming ideas (Senjen & Guthrey 1996, p15). The first programs for the ENIAC[10] were written by Adele Goldstine in the 1940s (Lockheed 1985, p117) and Grace Hopper was a pioneer in the development of the programming language COBOL[11], the first programming language which used English words rather than mathematical symbols (Meredith 1993). Women did make valuable contributions in the development of the earliest computers including designing and programming the machines. However, as a number of feminist researchers point out (Cronin & Kelly 1992, p106; Curry-Jansen 1989; Wajcman 1993, p29), many of the contributions made by women to technological endeavour have been left out of computer history.

As a result of World War II, and the war effort, many of the early programmers were women. During the war, when the computer revolution really took off, women were encouraged to work in many non-traditional areas. Women were regarded as very suitable for programming since 'programming requires a lot of patience, persistence and a capacity for detail and those are the traits that many girls have' (Seligsohn 1967 as cited in Gurer 1995, p18). However, Battel (1994, p399) suggests that this was temporary, and just as quickly, women were encouraged out of these areas. According to Gurer (1995, p48), however, it was not until later years that computing became less than ideal for females. Gurer suggests that this transformation was partly due to the adoption of male hierarchical business structures as computing businesses grew. Society in 1930s through to the 1950s also defined gender roles for women as family caretakers and men as financial providers (Gurer 1995, p53). Middle class working women were expected to be nurses or school-teachers and not to be working in scientific or technological fields. With so few

[10] The first fully working electronic computer was the Electronic Numerical Integrator And Calculator. It occupied 1,500 square feet of space and was first turned on in February of 1946 (O'Leary and Williams 1989, p574).

[11] An acronym for COMMON BUSINESS ORIENTED LANGUAGE, a programming language developed specifically for business applications.

women in the field, the computing discipline has, consequently, evolved with male values and male practices (Hasan & Kapram 1994b, p48).

Men and women are subtly encouraged to go into different areas of computing. Game and Pringle (1983) suggest that the early field of computing had a mathematics or scientific image and that this restricted women's entry, notwithstanding that a survey in 1963 concluded that only 45% of all programmers actually had such a background. As they comment; 'It is as if the image is there purely to keep women away' (Game & Pringle 1983, p4). The computer represented power and control and it was assumed that women although capable of feeding the data in, would not be able to understand the workings of such complex machines. Game and Pringle argue that there is nothing inherent about any job which makes it better suited to men or women, but that the distinction between men and women's work will remain as 'gender is not just about difference but about power' (1983, p16). Programming, for instance, was initially assigned to women as it was viewed of low importance (Kraft 1979; as cited in Kiesler et al 1985, p459) but when it began to be 'considered intellectual, creative and demanding work it also stopped being women's work' (Wajcman 1990, p8). Segal and Jennings (1988, p79) suggest that women are encouraged into the 'soft' areas of computing - applications, human-computer interface etc; while men are in communications, architecture and programming. They argue that 'women's' areas are devalued by the 'real' computer experts. Cockburn (1985) contends that women are alienated from technology as society has constructed technology as male domain, where men control technology and use it to dominate others. It is women who therefore use the word processors that men design, and women who use the machines on the factory floor which men fix (Grundy 1994, p24). It seems reasonable to surmise that women will actively choose to absent themselves from such a male domain and no amount of opportunities or encouragement will change this while the environment remains unchanged.

Research which centred on the effect of *new technologies* on women's jobs started in the early 1980s with a whole body of literature developing which explores the relationship between women and technology. Henwood (1993) has identified two different approaches to the development of a gender perspective on Information Technology.

- The *women in* technology approach focuses on the 'exclusion of females from computer work, with change expected to come about via equal access to education and employment' and
- The women in *technology* approach which explores 'the nature of technological work, its development over time and its articulation with changing gender relations' (Henwood 1993, p31).

These different approaches have also been identified in the literature on women and science (Wajcman 1993, p23). Wajcman and others (eg: Cockburn 1985; Fox-Keller 1986; Grundy 1994) suggest that the *women in* technology approach has limited potential; assuming as it does that given the right encouragement and opportunities girls will gladly become scientists, computing professionals or engineers and engage in the present work practices of these fields. This approach

> *...locates the problem in women (their socialisation, their aspirations and values) and does not ask the broader questions of whether and in what way science and its institutions could be reshaped to accommodate women. The equal opportunity recommendations, moreover, ask women to exchange major aspects of their gender identity for a masculine version without prescribing a similar "degender" process for men (Wajcman 1993, p23).*

The *women in* technology approach simply tries to involve more women, whereas the second approach has a broader focus on the nature of technological work. It aims to alter the masculine practices of these occupations so that women could enter into such work without any loss of identity or integrity (Grundy, 1994). Women should not be required to 'play the game' or accept working conditions such as ten hour days, frequent weekend work or travel, in order to fit into the computer culture (Dain 1991, p223). Wajcman (1990, p10) advocates that what is needed is a transformation in the nature of paid and unpaid work, as well as looking at the impact women can have on technology and technology on women.

Henwood (1993, p5) also advocates a wariness of the 'add women and stir' approach and argues for frameworks which address the many ways in which technology and gender interact. Henwood suggests that access to skills is not enough to secure a permanent place for women in the technological workplace and that the *source* of the inequality needs to be addressed (1993, p45). Battel (1994, p404), on the other hand, does not deny the relevance of this argument but adopts a more pragmatic view point: The difficulties surrounding women and technology involve wider social questions than computer courses alone can hope to solve. Therefore, the means, the know-how to 'break through the barriers which make the computer as a machine meaningless' to women must be made available to them. Grundy (1994, p29) acknowledges that in spite of the superficiality of the add-more-women approach it must, nevertheless, be implemented as it is a precondition to the 'emasculation' of computing. Moses (1993, p11) suggests that the focus of this debate should not be whether the current under-representation of women in computing was a male conspiracy (and in Moses's opinion this is not the case), but rather about how all teachers of computing, be they male or female, can improve the teaching/learning environment.

Concern for the under-achievement of women in computing has been expressed by three different groups; educators, computing professionals and social science researchers (Huff et al 1992, p19; Harding, 1986). Their explanations and strategies for change tend to differ, yet all agree that the gender inequality *does* matter.

2.2 Barriers To Successful Female Computing Education

A major focus of studies of women and computing courses have looked at the complex range of issues which could be interacting to produce the under-representation of females in computing courses. Although there are overlaps and interactions between many of these issues, they can be loosely grouped into one of three categories:

1. Factors relating to the *Computing Discipline* and the *Profession*
2. Factors relating to the *Institution* (pre-tertiary or tertiary)
3. Factors relating to the *Individual* (including family background)

2.2.1 Factors relating to the *Computing Discipline* and the *Profession*

RELATIVE COMPLEXITY

In my parents' lounge room after Christmas dinner
I am talking to my brother the computer programmer.
He is explaining to me the principles of cyberspace.
"It is only relatively complex," he says finally, peeling the icing off his fruitcake,
"It is mainly a system of binaries, permutations of zero and one.
So the data may be stored as, say, zero, zero, one, one, one, zero, zero, one."

My mother sighs.
She is next to us, half-listening.
She is knitting a fair-isle sweater.
"I'll never understand how you get your brain around it, " she says.
"It's beyond me'" she says, and turns half her attention back
to her fair-isle pattern: Purl purl plain, plain plain plain purl purl.

Cate Kennedy (as cited in Senjen & Guthrey 1996, p13).

Many women underestimate their ability to master complex procedures and many men reinforce this misconception. Generations of women have been able to knit complicated patterns -yet the skills involved in mastering the intricacies of this work are often unrecognised and undervalued. The language involved is peculiar to the craft work and understood in context, yet, the language of computers seems to many women beyond comprehension.

Computing is not the only profession in which women are under-represented, but studies looking at what, if anything, is different about computing have identified cultural factors that are 'significant contributors to women's special experience with computers' (Pearl et al 1990, p49; see also Kramer & Lehman, 1990). Dain (1991, p219) and Martin (1992a) argue that the image of the computer culture is not one to which women are drawn. One element of the computer world is its own language, or jargon, which can be alienating (Gornall 1994, p738; Selby & Ryba 1994) for those unfamiliar with the terminology.

There are many examples of how language within the computer culture works to exclude women:

- Some frequently-used terms contain words which have negative connotations in contexts outside of their new computer meaning: terminal, divide-and-conquer, abort, hacking[12] (Dain, 1991) and can be quite alienating.
- The impact of violence in the language and the violence in hacking is rejected by females (Turkle, 1988, p44), and Grundy (1994, p27) suggests that this violence must influence female students as they start to learn about the subject.
- Words alluding to engineering and its associated paraphernalia (for example 'software engineering', 'tool boxes', 'workbenches', 'business re-engineering') have also become common in computer work (Grundy 1994, p26), yet traditionally, women have been absent from the engineering profession.

Kiesler et al (1985) contend that to become effective in using computers requires not only technical knowledge of computers as machines but also social knowledge of the computer culture.

The media presents an image of computing which would not make it appealing to many women. The popular press regularly run articles about the 'information superhighway' and its possibilities as a distribution system for pornography (Gornall 1994, p738). The Internet is described as being full of bomb-making recipes and 'unscrupulous multi-national companies'(Senjen & Guthrey 1996, p ix). Newspapers and magazines frequently contain articles about computer-controlled weapons (Dain 1991, p219), computer widows and computer addiction (Turkle 1984, p13). The popular image of compulsive programmers or computer junkies is 'of bright young men of dishevelled appearance' (Gerver 1989, p485), who are described as antisocial and obsessive, spending much of the day and night working alone with a computer (Turkle 1984, p206). This image of the computer

[12] Keller (1991, p66) has identified that the term *hacker* originally meant a "hack programmer" who was someone who could turn out a lot of clever program code very quickly but who was unconcerned about its quality. 'Latterly the term hacker has come to mean someone interested in penetrating computer systems, usually by means of a data communications network, using fair means or foul, simply to snoop or, more sinisterly to compromise the integrity of the software or data they find'. This process is known as hacking.

world is more consistent with male adolescent culture than with feminine goals and values (Kiesler et al 1985) and is hardly likely to be attractive to female non-computer users.

The overwhelming impression made by computer magazines and advertisements is of a 'single-gendered world of computers' (Gerver 1989, p482). Numerous studies of illustrations in computer publications (Culley 1988; Hattie & Fitzgerald 1987, p21; Ware & Stuck 1985) suggests that women and men are portrayed differently. Ware and Stuck (1985) observed that only 31% of the pictures and photographs included women and that the roles played by these women were more likely to be passive (such as showing women handling input and output) than active. Women were also

> *... over-represented as clerical workers and sex objects, while men were over-represented as managers, experts, and repair technicians.... In mixed-sex illustrations, men were most often shown in the position of authority. Only women were shown rejecting the computer (Ware & Stuck 1985, p205).*

Researchers argue that media images play a critical role in shaping social attitudes to computing (Michaelson 1994, p708), and become part of a woman's conception of herself (Butler & Paisley 1980; cited in Ware & Stuck 1985) and so it is of concern that many females are not seeing positive visual images of women and computers. In the eleven years since the Ware and Stuck study, little appears to have changed. Heller, Brade and Branz (1994) report that in their similar study considerably more men than women are depicted in computer images. Women were also seldom shown in positions of power and 55% of images showed no people at all, 'running counter to the notion that computers are for people' (Heller, Brade & Branz 1994, p1).

Computer magazines are designed to overwhelmingly appeal to a male readership (Gerver 1989, p485). Gerver (1989) has identified that not only are the illustrations showing a man's world and that some advertisements border on being offensive to women, but the articles are written mainly by men who assume that their audience is male. The computer magazine giant Ziff-Davis[13] currently attracts only a 20% female readership although, of course, they would prefer a larger female readership (Moses 1994, p103). Women who do not find these magazines appealing are currently denied access to essential information found in these publications.

In reality, the computer is a general purpose tool useful for a wide range of applications, such as word processing, spreadsheets, graphics and music, yet the way it tends to be presented focuses on its technical features and attributes in a way that may lessen the interests of girls. Although girls tend to be more interested in using the computer as a tool than boys (Lockheed 1985, p120), many

[13] Publishers of PC Magazine, Computer Shopper, PC Week and others.

girls associate computers with technology where the machine itself is the focus, rather than its usefulness as a problem solving tool (Wajcman 1990, p9). However,

> *...at a practical level, there is no more need to understand the technical features of a computer to use one as a tool than there is to understand the mechanical features of a car to gain a driving licence (Clarke 1990a, p59).*

Where girls fail to find sufficient evidence of the validity of the computer as a tool that meets people's needs, they are likely to quickly lose interest (Gerver 1989, p489). Hasan and Kapram (1994b, p48) note that girls have a preference for dealing with people rather than with a machine and, in contrast, that boys have been shown to prefer interaction with the neutral machine which will help them 'conquer the universe' rather than dealing with people. While boys will solve the problem for the sheer challenge of it, many girls need to see the relevance of the problem to everyday life (Clarke 1989a, p21).

Technology is also identified with masculinity as part of the socialisation process (Battel 1994, p399; Chivers & McPerson 1994, p82). Toy shops clearly separate boy's and girl's toys, with anything of a technical nature being defined as a boy's toy. Computers are seen as machines, and therefore masculine, so the computer becomes a boy's toy. Yet, while many women reject technology because of this association with masculinity (conferring status and power and manliness), others are attracted to it for that very reason (Henwood 1993, p44). Cohen and Lockheed (1986) and Clarke (1992, p80) have found that it is not so much the presence of males and the masculine image that keeps the girls away, but rather the absence of other females with whom to share their experiences.

One way to become familiar with computer technology is to use a computer for recreational game playing. In their study "Poolhalls, Chips and Wargames" Kiesler, Sproull and Eccles (1985) have identified a relationship between recreational computer game playing and serious computing. Disturbingly, many of the computer games available are unappealing to young females. Computer games tend to have names which show a 'preponderance of games oriented around wars, battles, crimes, and destruction, as well as the traditionally male-oriented sports and hobbies' (Kiesler et al 1985, p456). The motivational factors such as 'shoot and kill', competition, rapid and violent actions and loud noises also appeal more to the boys (Hattie & Fitzgerald 1987, p19; Lockheed 1985, p120). Girls are repelled by the violence of these type of games (Gerver 1989, p489; Morse 1995, p17) and consequently computer games are of greater interest to boys than girls and give boys some computing experience while turning girls away. Educational software, through its similar design, is also more likely to be appealing to male students (Clarke 1985b, p88) who consequently find interaction with this software more rewarding than female students (Clarke 1990a, p58). Huff and Cooper (1987) suggest that this is due to the expectations and stereotypes of the designers of the software who write educational software for children but with only boys in mind. Some specially-designed 'girl' software has been moderately successful in promoting positive and active problem solving skills appealing to females, such as 'Jenny of the Prairie' (Sutton 1991, p485) and Tetris (Hasan et al 1994b, p49), while some has only reinforced familiar stereotypes by focusing on dating, shopping or housework (Sutton 1991, p485). Problems of bias in software are not easy to overcome as even gender conscious female designers have produced gender-stereotypes within their software (Huff et al 1992, p21). Kiesler et al (1985) concluded that computing itself is not inherently uninteresting or difficult for girls, but computer games, educational software and curriculum have been designed using a male paradigm.

There is a lack of knowledge about the nature of many professional careers, including computing, among students still at secondary school. Some students may not be aware, or may have erroneous ideas, about what a computing professional actually does in his/her work. Clarke and Teague (c.1993, p10) suggest that this situation is worse in computing than for other professional areas since computing suffers from the overexposure in the media of particular sections such as word processing/clerical work and hacking/programming. Newton and Haslam (1991, p67) suggest that girls are discouraged from enrolling in computing courses by their previous experience of computers as well as their perceptions of what a computing career involves. Dooley (1992) has found that some students think that a computer career requires sitting at a computer doing data entry all day long and argue that:

> *Perceptions of the career that is available on the completion of the course influences the final decision that is made when choosing a tertiary course. If an individual does not have a prior knowledge of the course, then they can not form these perceptions, and therefore, have nothing to be attracted to.... (Dooley 1992, as cited in Clayton et al 1993, p18).*

Another study found that while professionals working in the field saw computing as a 'people-oriented' job, secondary students perceived it as a 'technical, programming' one (Clarke & Teague 1993a). Kramer and Lehman (1990, p166) observed that few students have the 'breadth of knowledge about computer applications and career options that might allow them to imagine how to use the computer in ways most suited to their individual abilities, interests, and values'. In Australia, for example, DEET distribute an annual job guide to most Year 10 students to help students select the right career path. Amongst the hundreds of job descriptions there are only five computer-related occupations listed; computer operator, programmer, systems analyst, computer engineer and computer service technician (DEET 1996). Another factor which deters some women from pursuing a computing course is the actual title of the degree. While Grundy (1992) found that many course titles are misleading, a study by Cox and Dickinson (1992) suggest that women find some names of courses 'evocative of the male associations of engineering and hardware' (see also

Brosnan 1992). Whereas men find 'software engineering' highly appealing, for example, the effect of the 'engineering' term was off-putting for women in this study (Cox & Dickinson 1992).

2.2.2 Factors relating to the *Institution*

Evidence from a range of studies indicate gender-related differences in participation and success in computer subjects and courses in both school and post-school education. In July 1990 there were 10,007 schools in Australia (75% were government schools and 25% Catholic or other independent schools) (Australian Bureau of Statistics, Jan 1991) and only a few schools under each system are segregated by gender. Educational alternatives after secondary schooling include Traineeships, Private Colleges, Apprenticeships, TAFE and University education. At all levels it appears that factors in the institutional environment affect outcomes for female students. Indeed, tertiary institutions vary in the extent to which they attract women into their courses. Having attracted them into the course, the extent to which different institutions retain these women also varies. Willis (1991, p43) concludes that it must be factors within the individual course which influence female retention.

Studies undertaken in the school sector suggest that the institutional environment can affect the apparently gendered nature of computing. In single-sex secondary schools, girls have more positive attitudes to computing (Aman 1992; Clarke 1985a, 1986) and there is a high level of participation in computing activities (Culley 1988, p7). This enthusiasm appears to result from a range of factors: greater access to computers (Clarke 1991), more female role models (Clarke 1985b, p89; Freundlich 1989), sex-typing of computing as a female activity (Clarke 1985a) rather than a male activity as occurs in mixed schools (Clarke 1985b, p87), and a perception of a curriculum tailored specifically for girls (Clarke 1985a; 1986). Culley (1988) came to the conclusion that since social influences are likely to be similar for girls attending co-educational or single-sex schools, then the processes involved in the organisation of teaching with, and about computers, in a mixed setting must be significant. Jones et al (1993) suggest that it is actually the diversity of computer experiences that is critical. It may be 'preferable to provide a range of different opportunities to learn about the use of computers than to focus on the development skills in one or two specific applications' (Jones et al 1993, p11).

Computers are considered by many people as being something mathematical and/or technical. The introduction of computers into education via maths or science departments (Tittle 1986, p 1165), the housing of computers in these departments (Culley 1988, p4), the mathematical or science backgrounds of teachers of computing (Hattie & Fitzgerald 1987, p16; Pirie 1994, p155) and the prerequisite of maths for many tertiary computing courses (Dain 1991, p220) has led to this association of maths and computing. Women tend to have a poorer knowledge of mathematics which worries them as there is a whole body of mathematical knowledge (as distinct from skills) which is required in computing and 'parts of Computer Science are essentially mathematical' (Kay et al 1989, p517). Mathematics has traditionally been regarded as a male domain (Henney 1986, p5) and considered unnecessary for females to pursue (Moss 1982, p1). Female students report more maths anxiety than male students (Klein 1992, p52) and the subsequent avoidance of maths by girls is well documented (see for example Ainely et al 1994 p180; Firken 1984; Lawrence 1984, p2; Willis 1989). While computers are not inherently mathematical, since the main purpose for computers is the manipulation of information, these negative attitudes may be transferred to computing (Clarke 1985a, p833) so much so that female students have chosen to avoid computing subjects which include more mathematics (Kay et al, 1986). Programming, too, is associated with maths as mathematics is also frequently a prerequisite for programming courses (Lockheed 1985, p119) and, like mathematics, programming requires 'problem solving skills and the formal manipulation of abstract symbols'(Kay et al 1989, p516). Many girls assume that computer work requires not only high levels of mathematical knowledge but also an understanding of the technical features of a computer and that the work itself is often solitary (Clarke 1992). Consequently, a strong emphasis on the technical and hardware aspects of computing within computing courses, may also unnecessarily alienate girls. However, Hattie and Fitzgerald (1987, p18), while acknowledging this association of computers with maths, argue that there is little evidence that girls do not use computers due to an association with mathematics.

A unique feature of computing courses is the necessity to complete much of the course requirements in a computer laboratory. Most computer work involves communicating with other people and the manipulation of information (Clarke 1992, p72), yet the design of many computer rooms (or laboratories) in educational institutions discourages talking and collaboration between students. The placement of the computers on desks, in rows, and the allocation of one student per computer (NSW Department of Education 1984, p6) does not promote a sense of community and assumes that students work in isolation. This NSW Education Department report goes on to suggest that while boys enjoy working alone and tinkering, many girls prefer a 'talking-through' stage to which such an environment does not lend itself. For all students computers on the desktop may also obstruct a student's view of the teacher and any teaching aids being used. Female tertiary students also encounter the issues of physical safety in relation to computer laboratories (Pearl et al 1990, p49). Students must often be at the computer laboratory after dark to complete their work. While all students require safe access 'such access is even more essential for women' and if this is not provided it may reduce the working hours for female students to less than those available to male students (Pearl et al 1990, p50).

Many students find that computing courses and, particularly, programming subjects can be more time consuming than other subjects. This is highlighted when other class members boast about the many hours spent fine-tuning an assignment solution (Frenkel 1990, p44). A heavy workload and time commitment would exacerbate any stress felt by students caused by any limited access to computing equipment (Kay et al 1989, p522).

Timetabling practices may also discourage females from selecting computing subjects. In secondary schools the timetabling of computing against subjects which are traditionally popular with girls decreases the likelihood that girls will choose computing (Culley 1988, p5). A lack of awareness by administrators at tertiary institutions that female students may prefer to avoid evening classes may also 'prevent' female students from participating in computing classes (Clarke 1992, p81). Women with young children may have difficulty attending classes outside of school hours or during primary or secondary school holidays (Ramshaw, Patience & Archibald 1994, p106) without access to adequate childcare (NBEET 1992, p99). This, however, is not restricted to women in computing courses, but applies to many women who are studying irrespective of their chosen discipline.

Within schools the impression may be given that computing is more appropriate for males. The vast majority of computing teachers are male (Booker, Lovegrove & Hall, 1991) both at secondary and tertiary levels. Even in other subjects where the computer is used as a tool, the teacher is more likely to be male (Culley 1988, p5). With many students developing their ideas of suitable female and male behaviour partly from their observation of their teachers, certain subjects can become labelled as male or female (Lawrence 1984, p10).

Students are not always treated equitably in schools. Teachers spend disproportionately more time with the boys (AAUW 1992, p68; Spender 1989, p54) regardless of the sex of the teacher (Lawrence 1984, p7). While teachers may provide verbal answers to questions asked by boys, in response to questions asked by girls they tend to take over the keyboard and complete the task (Clarke 1992, p77). This serves not only to undermine the girl's self-esteem, but does not enable the girl to learn from the answer provided. Teachers may unconsciously promote gender stereotyping by the allocating of technical tasks to the boys, while, for example, girls may be asked to complete the associated documentation (Lawrence 1984, p12). Female students may also feel that computing is not applicable for them if the course material is uninteresting or is not gender inclusive[14]. If the examples and explanations used within text books or teacher instruction relate to mechanical, mathematical or scientific areas, girls will often find them meaningless (Lawrence 1984, p13). In mixed-schools boys also often dominate computer activities (Booker, Lovegrove & Hall 1991, p1) and by their attitude and by subtle harassment can discourage the girls from computing (Gerver 1989, p487). Girls find many of these situations discouraging and, consequently, are often unwilling to fight for the right to use the scarce resources.

Introductory computer units at secondary and tertiary level may be alienating for girls if it is assumed they have a particular background which, in fact, they do not have (Clarke 1992, p77). At a tertiary level Harrison (1994, p5) has found that women may be encouraged to chose a particular computing course by the lack of prerequisites believing the course will start from first principles. If this is then found not to be the case they experience difficulty coping, which ultimately may lead to course withdrawal.

The different learning styles adopted by males and females in a computing environment may also cause a problem. 'Girls are reluctant to sit down and experiment ..... while boys, in comparison, are keen to show their mastery over the new technology' (Lovegrove & Hall 1991, p36) and show little concern for the consequences of incorrect actions. Boys are often happy to tinker, whereas girls seek external justification and relevance for the tasks which need to be performed (Clarke 1992, p79). Other factors which may also contribute are the way the course is presented and the way that girls learn. Courses which consist of lectures and assignments which are then completed in unstructured, unscheduled environments promote individualism. Yet, according to Hattie et al (1987, p22) and Dain (1992) girls prefer to work in groups. Many girls seem

> *... to prefer learning in a co-operative rather than competitive setting, working collaboratively rather than on their own, and they appreciate being able to discuss concepts and solutions to problems with other people...Many students will not benefit as much from working with a computer by themselves as they would if a group were given a problem to solve using the computer (Lawrence 1984, p13).*

It has been suggested that group work can increase students' understanding of the subject matter and interest in the subject itself as well as resembling more the working environment where most graduates go (Marshall 1992, p60). Being forced to work individually, as boys prefer, may be discouraging to girls.

The environment in which a person uses software has been found to be a factor which influences performance. Novice female computer users performed less well and reported higher levels of

[14] This term was coined by Jean Blackburn to suggest curriculum that by its content language and methods gives equal validity to students of either sex and their experiences (Lawrence 1984, p13).

stress when completing a task in the presence of another person. Novice male computer users on the other hand reported less stress and performed better with an audience (Huff et al 1992, p21). Student expectations played a role with those expecting success performing better in public and those who anticipated failure performing worse in front of an audience.

Programming is an integral component of almost all computer courses, but as a number of studies have indicated (Harrison 1994; Paay et al 1993; Shackleton & Craig 1993) female students generally do not perform well in procedurally-based programming classes. Female students have expressed the

> *...overwhelming impact that the lack of prior knowledge of procedural languages has had on them in respect of succeeding in programming classes. The female students find it demoralising and detrimental to their progress when placed in a group that includes male students who are confident in what they do (Smith & Kelly 1994, p111).*

Hasan and Kapram (1994a) tested commencing tertiary programming students for cognitive skills related to the complete programming process[15]. They found a slight correlation of verbal abilities with females and spatial abilities with males, results which are consistent with accepted theories of gender difference (Maccoby & Jacklin 1974). This suggests that women may rely on verbal strategies to solve problems, whereas men may rely on spatial strategies. Teachers of computer programming often assume that students use a spatial strategy (Hasan & Kapram 1994a) and, consequently, 'current methods of teaching computer programming may better suit students with a typical male set of cognitive skills' (Hasan & Kapram 1994b, p50). Two Massachusetts Institute of Technology (MIT) scientists, Turkle and Papert (1990, p118), suggest that there are *at least* two different approaches to solving programming problems: a 'formal' style commonly used by men and an 'adhoc' style more frequently used by women. They maintain that although both styles are equally valid, the computer culture is biased toward a 'formal' style (particularly top down design and hierarchical decomposition) and if girls are forced to conform to this method they may become computer reticent.

A lack of positive role models, models perceived as enthusiastic and competent, whether in real life or in the media (Clarke 1986), is a contributing factor to the development of different attitudes of girls to computing. Teachers provide very strong role models for many of their students and through students' observation of these role models, ideas of gender-suitable behaviour are derived (Lawrence 1984, p10). Clarke (1986, p47) suggests that children learn that computers are sex-typed through their observation of role models. When most computing teachers are men this conveys the notion that computers are appropriate for males not females (Clarke, Sillock & Teague, 1993; Firkin

[15] Hasan and Kapram (1994a) suggest that much of the research on programming covers only the coding and testing phasis whereas their study included problem comprehension and analysis, program design, coding and testing.

1984, p24). However, a female role model does not guarantee an improved attitude to computing, as Sanders and Galpin (1994) have identified. In their investigation, a higher percentage of female family role models was found among females who choose not to study computer science. Sanders and Galpin tentatively suggest that these role models had a negative influence because the computer work undertaken was considered menial or boring. Emms and Kirkup (1992, p161) question the value of role modelling as they found that role models are not active in helping women overcome structural barriers. Lack of role models and mentors, however, has been identified as leading to feelings of isolation when there are few other female colleagues with whom to work and socialise (Freundlich 1989).

Not only do many female undergraduate students in computing experience a lack of role models and feelings of isolation, they also frequently do not have the same social support structure that the male students have (Martin 1992b, p240; Smith & Kelly 1994, p110). Successful male students have identified the informal study groups which they form where they can easily consult with each other as a significant factor in their success in tertiary studies (Harrison 1994, p5). Byrne (1993) suggests that the 'critical mass' threshold is 30% for any group within a given population. If the number of female students enrolled in a computing course is below this level, then rather than being seen as part of the whole, the female students are seen as atypical, abnormal and exceptional. The lack of a critical mass of women in many computing courses means it may be more difficult for female students to develop such supportive groups and effective networking opportunities. Harrison (1994, p2) suggests that women who do not get this peer support are less likely to be able to overcome other barriers such as difficulties with the transition from secondary education to tertiary education. This transition may involve living away from home for the first time and coming to grips with different work practices expected at university level from those encouraged in the senior years of secondary education (such as the submission of preliminary drafts of work). Harrington (1990) also identified forming supportive relationships as well as being able to get help from others as essential factors for persistence of women in computing courses.

2.2.3 Factors relating to the *Individual*

The increased retention of students to Year 12 throughout Australia is bringing entry to university within reach of large numbers of students who come from families where the experience of higher education is previously unknown (Abbott-Chapman et al 1991, p1). Williams et al (1993b) cite considerable research which indicates that

> *...differences in family wealth, social status and parental educational attainment's are all linked to differences in educational participation, and educational outcomes more generally, in the next generation (p32).*

Parents are a source of advice and encouragement for their children. As each parent's educational background varies, so too will their knowledge of education and the encouragement and advice that they can provide (Williams et al 1993b, p42). Students who have a parent with a post-secondary qualification are much more likely to enrol in tertiary education. This is due to the fact that graduates of universities are in the best position to know of the benefits of a university education and to 'ensure their children also enjoy the benefits' (Maslen et al 1994, p142). For reasons of 'preferences' and values and economic factors disproportionately fewer students from blue-collar backgrounds go on to complete Year 12 (Williams et al 1987 as cited in Abbott-Chapman et al 1991, p31).

Parental attitudes will influence the subject choice and career direction of their children (Coleman 1991, p98; Powles 1987, p3) as will the beliefs and attitudes of teachers. Studies in America show that

> *...performance of girls in computer literacy and computer science is lower than that of boys and that this is related to attitudes of parents, teachers and peers and the perception of the students of their future career (Voogt 1987).*

Different expectations by parents of their daughters' and sons' abilities and interests will influence the children's beliefs regarding their own interest and abilities (Clarke 1992, p78). A general belief among many teachers, parents and students is that girls are no good at computing (Clarke 1992, p72; Lawrence 1984, p12; Sanders 1990, p182) and that the area is inappropriate for girls (Hawkins 1985, p 168). Henny (1986, p 5) suggests that parents encourage their daughters to consider community service careers whilst encouraging their sons to pursue technical careers. Davis (1986, p4) and Clarke (1992, p80) also suggest that girls are often encouraged into traditional areas by their fathers, male teachers and male career advisers and steered away from courses which are considered scientific. A recent DEET commissioned study on students' attitudes to post-compulsory education has found, however, that a student's secondary school (and this includes the careers adviser, school generally, and the teachers) is the most frequent source of information for 76% of girls and 68% of boys about university courses (ANOP 1994, p13). A study by Culley (1988) highlighted the problem that information material being provided by secondary schools on computing careers portrayed stereotypic images.

It is also a common belief that boys have some inborn ability for working with computers which girls do not have (Clarke 1990b, p53; Kiesler et al 1985, p459; Moses 1992, p155). This belief is an extension of the myth that boys have a greater innate mathematical capacity than girls and that mathematical and computing ability are related. Research demonstrates (Clarke & Chambers 1989; Gerver 1989, p487; Jacklin 1989, p127; Linn & Hyde 1989) that it is not an innate ability to cope with the demands of the discipline that is creating the imbalances, but rather societal issues, such as maths anxiety, gender-stereotyped beliefs in parents, and the value of maths to the individual student. 'Although gender issues have been central to the study of intellectual abilities in the past, they should no longer have this emphasis, given the current findings of a lack of gender differences' (Jacklin 1989 p131).

A lack of academic perseverance by female students in computing and in other areas has been linked with attribution theory which suggests that 'while girls are more likely to attribute success to luck, boys are likely to attribute their success to ability' (AAUW 1992, p70). Hawkins (1985, p168) indicates that male and female students consequently interpret their success or failure differently. Female students lost confidence more quickly than male students if there was little or no feedback on their performance. This was, however, not as important during social tasks as individual ones. Female students also exhibit lower self esteem than male students even when they achieve better results (Western & Carpenter as cited in Powles 1987, p13). Successful male students claim more ability, and less luck, as a reason for their success (Deaux 1984, p106). Female students, however, are more likely to attribute their success to outside sources such as good teaching or help from friends, then to their ability (Clarke & Chambers, 1987). Lack of ability is more likely to be cited by women for their failures while men are more likely to look for other reasons. Consequently, males and females use the information provided by their success or failure differently. Clarke (1990a, p58) argues that males use the information to modify and develop more appropriate strategies while female students gain little positive reinforcement from any success, with a failure resulting in a lowering of their self-image. Similarly, a suggestion put forward by Igbaria and Baroudi (1995, p110) for the limited advancement prospects of women in the information systems industry is that the successful performance of a female employee is less likely to be attributed to ability and effort compared to the successful performance of a male employee. However, a woman's unsuccessful performance is attributed to low ability and a man's to bad luck. There is also the suggestion in the literature that women students express the contradictory attitudes that though women can succeed, they themselves can not; 'women can, but I can't' (Collis, 1985) or 'women can but I don't want to' (Durndell, 1991a). While many women think that they should have the right to do anything, they personally choose not to.

Gender differences in attitudes to computers may be the result of many factors, however, Sutton (1991, p490) suggests that differences in computer experiences are a major cause. As previously discussed there is a large amount of research which indicates that boys are gaining more computing experience than girls. Boys are more likely to have access to a computer, attend computer camps and extra-curricular activities, belong to a computer club, play computer games and read computer magazines. Male values and activities are often treated as the norm (Clarke 1992, p77).

'Differences in experience lead to differences in opportunities to gain further experiences' (Clarke 1992, p74). Girls may not be interested in all computer activities, however, if girls are given the opportunity to gain *relevant* computing experience, sex differences in attitude and achievement disappear (Chen 1986; Clarke & Chambers 1989; Culley 1988). Bernstein (1991) recommends improving the *initial* experience that girls have in computing courses as this is critical to how comfortable they feel with computers and in turn, this influences what they will accomplish in the future.

Language background may be a contributing factor in educational attainment although the evidence for this is inconclusive. In a study of Wollongong University students (Lewis 1994) 25% of commencing students were found to speak a language other than English at home. It was suggested that these students were at a disadvantage with their results being, on average, 3.2 marks below those of students who speak English at home. Further investigation found that there is a differential impact on school leavers and non-school leavers; with speaking English at home being insignificant for school leavers but significant for non-school leavers. Being born overseas had little impact on the expected performance of students[16].

The type of school attended may also be a factor. In the Wollongong study mentioned in the preceding paragraph an analysis of the type of school which a student attended before university showed students from government co-educational schools do slightly better than students from Catholic and other private schools (Lewis 1994,p59). However, Williams et al (1993b p99) point out that in 1989 more than 70% of students graduating from independent secondary schools progressed to tertiary education compared with less than 40% from government schools. This was attributed to three factors; the advantaged social origins of students in independent schools; the higher levels of family support they receive and aspects of the schools themselves.

There is evidence to indicate that girl's confidence and self-esteem are eroded as they progress through their secondary education (AAUW 1992, p12; Commonwealth Schools Commission 1985b). Lack of confidence is a factor in the reluctance of some women to seek help from lecturers or to ask questions during class. Harrison (1994, p4) indicates that the reason some female students do not ask questions is that they are not confident that they understand 'enough to ask intelligent ones'. Harrington (1990) argues that women's minority status actually makes them feel uncomfortable asking questions in class.

[16] This study was concerned with DEET-funded students only and excluded international full-fee paying students (Lewis, 1994, p22).

Chamber and Clarke (1986) define disadvantaged groups in education with regard to gender, school ability, those from lower socio-economic sections of society and ethnic background. They found for girls who belonged to more than one of these groups there was a cumulative effect of disadvantage. Abbott-Chapman et al (1991) suggest that there are many different types of disadvantage:

> *The aboriginal student who has never had a positive educational experience; the student who is hampered by lack of financial means and low socio-economic status, the rurally isolated student who suffers the social and personal dislocation of moving from a close-knit, traditional community, the young migrant from a non-English speaking background, and the bright girl pressured into early leaving by an unsupportive family background - all these are suffering different sorts of disadvantage (p34).*

Edwards (1992) reported that colored women experience all of the same gender problems as white girls but to a greater degree. The effects of disadvantage (being poor, a member of a minority group and female) were found to be cumulative. A lower socio-economic status is also more likely to have a negative influence on a female student's self-esteem, lowering their perceptions of their own ability and, consequently, their aspirations (Western & Carpenter as cited in Powles 1987, p13).

While some of the factors discussed are unique to computing some of these obstacles are also shared by women in other non-traditional areas and also, but to a lesser degree, by all women who are in education and/or the paid workforce (Pearl et al 1990, p50). Pearl et al go on to list difficulties with self-esteem, lack of mentoring and role models, discrimination and the problems associated with balancing family responsibilities with a career, as common problems for many women.

2.2.4 Summary

There is a large body of literature which documents how and why female students are generally less interested in pursuing computer studies than male students. The factors suggested for this include the linking of computers with mathematics and science, different learning styles, low self-esteem, the male orientation of computer games and educational software, a lack of role models and support networks and inadequate computer education and careers information. Due to the presentation of computers in software, the media, the classroom and the image of the culture associated with computers, computers are perceived as a male domain by many female students. Spertus (1991) observes that generally people are not consciously trying to discourage women away from computing, however,

...people's behaviour is often subconsciously influenced by stereotypes that they may not even realise they have. Additionally, when companies direct technical games and products at men, their intention is not to perpetuate stereotypes but to target the largest existing audience. That some women feel uncomfortable in mostly male environments is not primarily a result of men trying to make them feel unwelcome but of dynamics resulting directly from the male majority and societal sex-based differences in behaviour. While perhaps it is comforting to know that no conspiracy exists against female computer scientists, it also means that the problem is harder to fight (p75).

2.3 Strategies For Successful Female Computing Education

How the obstacles facing women are overcome depends in part upon the explanations offered for women's exclusion. For example; if exclusion depends on some feature of men and women's biology then there is little that can be done (Birke 1986, p191). In contrast, Battel (1994, p400) argues that women can only make successful challenges into non-traditional areas if they are given the tools, knowledge, skills, confidence and resources to do so, and that this is the role of education. The challenge according to Martin (1992b, p244) is to identify programs which attract females to computing and to 'cultivate sustaining support systems for them' once they have entered into computing courses. Newton et al (1991, p73) suggest a first step is to market a new image of computing, showing its human side and demonstrating the variety of applications of computers.

Factors producing the under-representation of females in computing courses which relate to the *Computing Discipline* and the *Individual* are largely beyond the scope of academic institutions. However, at an institutional level there have been numerous strategies suggested to address the range of issues contributing to the lack of females graduating from such courses. Work by Clayton et al (1993) has provided a framework which identifies where it is possible for institutions to influence the participation by females in computing courses and the computing profession. These are:

1. Pre-tertiary stage — where the focus is to encourage females to develop the necessary prerequisite skills and to enrol in computing courses,
2. Tertiary stage — where the focus needs to be to decrease the attrition rates for female students,
3. Post-tertiary stage — where the aim is to equip females with the necessary skills and contacts to obtain positions in the computing profession (Clayton et al 1993,p16).

2.3.1 The Pre-Tertiary Stage

To develop and encourage girls interest in computing is not a simple task. For every teacher who insists that girls become familiar with computers, female students are receiving the message from television, the media, families, friends and even the computer arcades, that computers are *really* for males. These influences are all very strong in the lives of young women and men. Sanders (1990, p186) raises the question that 'Educators who resist these influences need a great deal of support, but where are they to find it?'.

As some of the problems faced by female computing students at tertiary level may begin at an earlier stage there seems to be a need for closer liaison between secondary schooling and tertiary institutions. The following strategies are listed without discussion, not because they are not important, but because they are not directly the focus of this study. Nevertheless, the responsibilities of a tertiary institution could well include helping better prepare students for a successful academic computing career by working to enhance the quality of the computing experience at pre-tertiary level.

Strategies that may decrease some of the barriers associated with girls and computing at the pre-tertiary stage could include:

- Teachers, students and parents could be made aware of the importance of planning for a future career for both boys and girls (Clarke 1992, p78; Razz 1993).
- All students could be made aware of the changing work place and the increasing role of computers within it (Symons 1984, p6; Ward 1985, p 4).
- Accurate information regarding the range of computing careers should be disseminated (Clarke & Teague 1993a; Clayton et al 1994a; Lovegrove & Hall 1991; Martin & Staehr 1994) and should highlight the aspects of computing which involve interaction with people (Howell 1993). Clayton et al (1994a) have incorporated profiles of female students and female computing professionals into resource packs for schools to show the wide range of occupational choices available in computing for women.
- It has been suggested that increased access to computers by girls during secondary schooling could be accomplished through
    - ⇒ making computing a compulsory subject (Kushan 1995; Sanders 1990, p186)
    - ⇒ running single-sex classes (Clarke 1985a)
    - ⇒ organising mother and daughter fun-nights (Macrae, 1986).
    - ⇒ the careful supervision of mixed computing activities (Gribbin 1984,p17)

⇒ allowing students to borrow overnight school computers (Clarke 1992, p75) and

⇒ offering a supportive environment (Clarke 1992, p75; Lawrence 1984, p16).

- Software needs to be developed which will be appealing to both girls and boys (Pearl et al 1990, p55; Klawe & Leveson 1995, p30).

- Teachers may need

  ⇒ to be made more aware of the gender imbalance (Clayton et al 1993) to become *concerned* about it (Sanders 1990, p182)

  ⇒ to develop awareness of the ways in which the boys come to dominate computing classes (Clarke 1992, p77; Culley 1988, p8) and subtly harass girls (Lawrence 1984, p11) and

  ⇒ to develop classroom management strategies to ensure equality of access to facilities, class discussion and teacher time (Culley 1988, p8).

- In the school classroom

  ⇒ the link between mathematics and computing could be removed (Culley 1988, p7; Lawrence 1984, p16)

  ⇒ timetabling of school elective subjects could be such that stereotypic choices are not encouraged (Lawrence 1984, p15)

  ⇒ the focus could be shifted from the computer as the object of the study to one where the computer is a useful tool (Clarke 1990a, p62; Hawkins 1985, p 178)

  ⇒ different teaching methods may need to be used which are compatible with different learning styles (Bernstein 1990; Booker, Lovegrove & Hall, 1991)

  ⇒ the impression that computing is a male domain should be avoided (Lawrence 1984, p9)

  ⇒ 'occupational' role models could be used in visiting programmes and in seminars (Brown 1991), and

  ⇒ gender inclusive language and examples could be used (Lawrence 1984, p13).

- Universities can contribute by

  ⇒ running 'taster' days, workshops, short courses and open days (Craig et al 1995a, p195; Dain 1991, p223; NBEET 1994, p37)

  ⇒ organising 'outreach' programs such as the sending of information and publications, visits to schools by academic staff and contact with secondary teachers and counsellors (Abbott-Chapman 1991, p143; Martin & Staehr, 1994; Baum 1990, p49)

  ⇒ providing a residential girls' computer camp or summer school (NBEET 1994, p37; Ryan 1994; Sampson 1993, p75; Schulz-Zander 1990, p198) and

⇒ university staff could participate in school run career sessions (Martin & Staehr, 1994) or with non-traditional units of work.

An important element of pre-tertiary computer education is the ability to instil confidence and competence in all children (Kiesler et al 1985, p460) and positive role models could contribute to this. Increasing the number of women teachers of computing who are competent and confident in their computer use (Kushan 1995; NSW Department of Education 1984, p10) would not only provide role models but also mentoring opportunities (Booker, Lovegrove & Hall, 1991; Clarke 1992, p80). Martin (1992a, p6) concludes that improved curriculum, educational software and teacher training are also needed to help address many of the factors which contribute to an under-representation of female students in computing courses.

If a combination of these strategies were employed in schools, then this may help to expose and attract girls to computing. More girls may then be encouraged to apply for entrance into a university computing course. However, before actively encouraging more females to ensol in courses which will lead to a computing degree it is important to ensure that female students will have the same chance of success as their male counterparts. Making a computer course accessible is not enough. Each student should have a reasonable opportunity to complete the course successfully (Abbott-Chapman et al 1991, p1; Advanced Education Council 1986). As the research discussed in earlier sections shows, female students appear to be more likely to withdraw from tertiary computing courses than male students and it is this greater withdrawal rate that is of particular concern. What can be done to stop this from happening? As Howell (1993, p4) observes, once women become undergraduate students factors such as their previous computing experience and past achievement cannot be changed. In fact, these women have already overcome many of the barriers to computing by being prepared to commence a computing course. Power et al (1987, p43) suggest that specific arrangements and programmes may be needed to provide a reasonable chance of success for these students. Consequently, this research project will focus on possible strategies for the tertiary stage, as identified by Clayton et al (1993, p16).

2.3.2 The Tertiary Stage

Withdrawal rates of students entering first year tertiary studies vary according to course and institution. A study undertaken by Monash University (1996, p3) indicates that in each cohort of students a 'sizeable proportion drop out or flunk out'. Attrition research (Noel et al 1987; Tinto 1987; Upcraft & Gardner 1990) shows that not just in computing courses but in many courses it is the first year of a course where the highest withdrawal rate occurs. Power et al (1987, px) suggest that as many as one student in three will either withdraw or fail during their first year. Professor

Tinto has suggested that in the USA 52% of all undergraduate students 'drop out' of tertiary study (Gender Matters 1996, p2). It has been argued that

> *...fostering student success in the freshman year is the most significant intervention an institution can make in the name of student persistence. More than any other, the freshman year presents attrition hazards that institutions must counter (Levitz & Noel 1990, p65).*

Tinto (1987, p42) reports that many 'students are uncertain of their long-term educational or occupational goal' when they commence their studies. There are many reasons why students do not complete their tertiary studies and Power et al (1987, p41) observe that discontinuance does not necessarily mean that no benefit has been obtained by the student from their time at the tertiary institution or that their objectives have not been met. The study undertaken by Power et al (1987) found problems can be minimised in the first year of tertiary study by the provision of adequate information and academic, attitudinal and social preparation of the student. The study also found that high course commitment and motivation are particularly important for success in first year higher education.

While it seems to be inevitable that a proportion of students in the computing discipline will leave before graduation it is the higher rate of leaving of female students compared with male students that is of particular concern to this study.

Strategies

Strategies adopted at varying institutions to increase female participation and retention, in non-traditional courses, at undergraduate level include -

- provision of positive role models
- bridging course to help females develop skills and acquire knowledge to overcome disadvantage (Blaber 1984; Clayton et al 1994b; Teague et al 1996)
- orientation programs
- mentoring/peer support schemes

However, little documentation of any evaluation of the relative success of these strategies has been able to be sourced.

Hemenway (1995, p60) and Pfleeger et al (1995) have identified that positive role models are 'essential for women's advancement'. Emms (1992, p98) argues that until there is a critical mass of prominent women in computing they 'will not be effective in altering the perception of women in this field'. Emms suggests that a more active way forward is the concept of mentoring. Roberts (1995, p3) suggests that there needs to be an increase in the number of women at all levels and particularly one step ahead who can encourage, explain, clarify and support those in the level below.

This would enable women to act as both mentors and mentees, thereby receiving knowledge and support from someone further along and passing knowledge and encouragement to someone following on.

While the concept of mentoring has been traced as far back as Greek mythology (Clulow 1995, p1), it has been used increasingly in recent years as a retention and enrichment strategy for undergraduate education (Jacobi 1991, p505). Mentoring is a technique which can be used to help girls who embark on a computing career to overcome lack of peer support while it also promotes networking (Gruman 1990, p88; Sampson 1993, p35). The mentors help to orientate the new students by sharing with them ways of surviving and learning at university. Formal mentoring programs assign the mentors to the students as opposed to those where the mentor-mentee relationship is formed through free choice or natural pairing (Jacobi 1991, p512). Commencing female students can be matched up with a more experienced student, as in peer mentoring, or with a teacher or adviser. Mentors may need to be male if there are not enough senior female students or teachers available and then matching may be preferable in small groups (Paay et al 1993). Mentoring can also be done by a professional woman from industry and while this may make the difference to enable a mentee to remain in a non-traditional area (Sampson 1993, p35), Leveson (1989) has expressed concern that often the mentors assume this role above their normal work and family obligations, since the work involved as a mentor is not usually rewarded by employers. Noe (1988) has identified a number of issues to be considered with cross-gender mentoring including the lack of access to information networks, tokenism, and stereotyping.

An alternative scheme suggested by Cartwright and Colville (1994, p3) is to involve all commencing computing students, both male and female, as mentees. This strategy developed from their previous research which had found that the female computing students did not want a support scheme set up exclusively for the girls. Other researchers (see for example Kay et al, 1986) have acknowledged that such strategies used to benefit females could actually help all of the students. One of the activities trialed in the mentor program organised by Cartwright et al (1994) was a 'treasure hunt' during Orientation week. Students had to discover the location of lecture room, computer labs and staff offices and also met all the academic staff personally. While many positive results were found from this scheme on the negative side 'none of the female students believed that they have gained any real benefits from the mentor scheme' (Cartwright et al 1994, p6). Only four out of the twenty-five first year students were female and these female students had initially joined different mentor groups. While some of these groups had female mentors all of the girls still felt isolated. Recommendations for the following year include the creation of a women in computing group just for female students (Cartwright et al 1995, p6).

Clulow (1995, p3) observes that peer mentoring has considerable advantages for undergraduate students. 'Peers are more readily available ...and greater opportunity for communication may make mutual support and collaboration easier to achieve'. In comparing peer mentoring with the more traditional role of the mentor relationship, Kram and Isabella (1985, p129) point out that 'mentoring involves a one-way helping dynamic while peer relationships involve a two-way exchange'. According to Johnson (1990) the key to mentoring commencing students is *caring*. Many first year students 'need someone who cares and who can help them through the academic maze and confusing process of becoming mature and achieving academic success' (Johnson 1990, p127). This can be especially so for female students studying in a non-traditional area. Teague et al (1996, p168) caution that it is necessary to ensure that young women involved in a mentor scheme are not made to feel that 'they are inferior and require special assistance'. This situation can be avoided by creating a scheme which does more than just offer academic assistance or by including any student who has limited prior computing knowledge.

To provide support at the post-tertiary level for those women already in the industry, a women's network can be set up to meet on a regular basis (James 1992, p2). This would provide a forum for the transfer of ideas and experiences and enable women to provide each other with mutual support. The Australasian Women in Computing network began in 1992 to provide women in academia and industry with similar peer to peer networking and uses irregular conferences to share ideas on encouraging girls into tertiary computing and the computing profession. The all-female nature of such support groups is often critical for their success (Biddiss et al 1992, p3). A variation of these ideas has been the creation in 1987 of an electronic mailing list called 'Systers'[17] (Frenkel 1990, p36) which aims to overcome the sense of isolation among women in the computing industry. The list provides a forum for women, wherever they may be in the world, to discuss the problems and joys of their work and to provide networking and mentoring.

To encourage persistence in computing the learning environment must be altered to promote success for all students and, at the same time, to reinforce how computers are useful for everybody in their future lives (Hattie et al 1987, p24). A learning environment where it is possible to feel comfortable and to have a sense of belonging to a community will allow girls to take risks and make mistakes rather than a competitive situation (Gruman 1990, p89) which many girls find threatening. Frenkel (1990, p44) suggests that since students perform better in private, ways should be found to

[17] Professional women in computer science can join this network by sending email to systers-request@decwrl.dec.com.

help all students work without an audience when they chose to do so. Arch and Cummins (1989, p253) argue that women need to be required to use the machines and then they will 'attribute competence to themselves' and this will lead to success.

Many tertiary students, particularly at night, depend on safe access to computing facilities at the university to complete their work (Dain 1992, p10; Pearl et al 1990, p50). Creation of women-friendly laboratories with 24 hour access would enable women to feel comfortable and safe. Desirable safety measures could include electronic door locks controlled by a card reader, video camera surveillance, the presence of a security officer to escort students to their car, or a security shuttle to the nearest public transport. A 'friendly' laboratory would include ergonomic chairs and tables with plenty of elbow room for books and printouts, instructions and manuals within easy reach and be bright and pleasant (Moses 1993, p8) with friendly posters or plants to improve the sterile atmosphere which is present in many labs (Kiesler et al 1985, p457; Yewlett 1992, p217). A comfortable working temperature, good ventilation and, particularly for those students working late at night, a coffee machine and bathrooms nearby. A friendly laboratory assistant who is easily accessible and helpful would be a tremendous addition. Such a laboratory would not only offer a safe and pleasant working environment for all, but also enable greater access to the computers for many female students.

At University level the timetabling of computer classes between 9.30 and 3.30 would help cater for women returners with school-age children (Scollary 1992, p9). Ramshaw et al (1994, p105) even suggest tempting mature women into a computing course by allowing them to undertake a single subject at a time. These women require the information and confidence to initially apply for a course, and then, support and encouragement at all stages (Ramshaw et al 1994, p105).

A recent Australian study by Hasan and Kapram (1994a) suggests that educators need to determine better ways of teaching computer programming. They suggest that new programming students should be tested for their verbal and spatial abilities and where these are lacking, they should be provided with extra training. Hasan et al (1994b, p51) observed that assessment of programming assignments should also place sufficient weight on producing the most 'appropriate system for the user', which is often where female students excel. Cox (1992, p81) suggests that it is essential that the first programming experience be enjoyable as this will enable women to feel in control of the computer and not vice versa. Allowing students to adopt Turkle's 'soft' programming style (Turkle, 1984) which allows for a more interactive method of writing programs (writing some code, trying it out, modifying it) may meet this need. Smith and Kelly (1994) are investigating the feasibility of introducing programming to students via visual programming. They argue that the

...visual approach offers a common reference point for teaching students the correct techniques in programming on an equitable basis. Additionally the new strategy provides an avenue for females to overcome learning difficulties encountered in programming classes (Smith & Kelly 1994, p106).

A pilot program undertaken at La Trobe University-Bendigo has allocated commencing female students for their first programming unit, into tutorial groups, so that 50% of the group were female (Martin & Staehr, 1994). Senior female students were employed to act as demonstrators for these groups and to increase the staff-student ratio. Their role was to assist any student requiring help, but they had been briefed to attend to female students first if a male and female student simultaneously requested help. Fortnightly meetings were also held between the students, senior students and program leaders to discuss progress and problems. Evaluation of this program indicated that the first year students felt the program was effective and contributed to their on-going participation and success in the course. This was reflected in the results at the end of the first year of the project with Staehr and Martin (1995) reporting that retention rates rose significantly from 37% in 1993 to 50% in 1994.

Besides changing the programming component and making programming examples more relevant and interesting (Marshall 1992, p59), other course content changes could include the inclusion of social and ethical issues. Dain (1992, p7) suggests 'putting computer science in its social context and informing students about the social obligations of their future profession'. Cronin and Kelly (1992, p111) also add that the historical contributions of women need to be highlighted within computer courses as well as the accomplishments of current women in technology. Designing the curriculum to be exciting and accessible would also benefit students and, particularly, women (Roberts, 1995).

Ramshaw et al (1994, p107) suggest that to design a course for women is actually easy, but to be successful aspects such as 'information, support, guidance and confidence building and encouragement' are essential. These aspects need to be provided from the first thoughts of possibly applying for a course until graduation. Ramshaw believes that this may well depend on a few enthusiastic and dedicated individuals who want to provide and promote opportunities for women in computing (1994, p 107).

2.4 Conclusion

Research spanning just over a decade has suggested many barriers which can account for the low participation rate of women in computing education and, consequently, the computing profession. Equally, many strategies to overcome these barriers have been suggested and implemented. However, as Turkle (1984, p18) indicates, studying the world of computers is like studying a moving target. The fundamental nature of Information Technology is based on continuous change and this is certainly evident in the dramatic expansion over the last decade in the uses of computers in all sectors of society (Aman 1992, p33).

Computer education within the Australian school system has changed from being almost non-existent to being incorporated into every school curriculum in the space of ten years. Vast sums of money have been invested in hardware and software as well as on the professional development of teachers, though some would argue that many teachers and careers advisers are not computer-literate enough and that there must be ongoing professional development (Harris M. 1993, p38; Hawkins 1985; Pirie 1994, p168). Better student-computer ratios now exist and changes have taken place in the teaching and curriculum content as computers and computer subjects continue to evolve. Sutton (1991, p481) describes how at first teachers used computers for drill and practice exercises, then, predominantly for programming and how the emphasis is now shifting to using a computer as a tool which is integrated throughout the curriculum. The increasing use of software packages like word processors, databases and graphics tools is also decreasing the association of computers with mathematics (Sutton 1991, p495) and Hasan et al (1994b, p48) suggest that the growth of the Human Computer Interaction area is increasing the focus on the 'people' aspect of computing. Pirie (1994, p167) reports that instead of having to rely on inadequate software, teachers in Australia can use more than two thousand reviews to help them identify appropriate packages. There certainly appears greater awareness of some of the issues of gender and computing by many teachers. New policy documents contain statements on the importance of addressing principles of inclusiveness in the development of teaching and learning programs. The Curriculum and Standards Framework - Technology[18] (Board of Studies 1995, p5), for example, 'has been designed to include the aspirations and experiences of *all* students' and advocates that schools provide an environment in which both boys and girls can fully participate. Female students are

[18] There are eight Victorian Curriculum and Standards Framework documents which provide the basis for curriculum planning in key learning areas for schooling from prep to year 10. Computer education has been subsumed as Information Technology in the key area of Technology (Pirie 1994, p168). The Technology document indicates the major areas of learning (Materials, Information, Systems) which are to be covered and describes the expected outcomes to be achieved by students (Board of Studies, 1995).

being encouraged to consider a variety of non-traditional careers and there are now alternative career entry paths to computing other than Computer Science (Hasan & Kapram 1994b, p48).

Children now grow up with computers and frequently come into contact with them, not only at school, but also in shopping centres, libraries and the home. However, the fact that computers are becoming increasingly common place does not ensure that all groups in society participate equally with computer technology for, as Pearl et al (1990, p49) suggest, even the first 'computer artefacts that children encounter are not gender neutral'. Nevertheless, while some inroads appear to have been made, the problem of girls and computing is a complex one which has not yet disappeared nor is it amenable to simple solutions.

There is little doubt that there has been a growing awareness within educational institutions of the need to provide equal access to success in non-traditional areas, including computing. This literature review has highlighted a range of explanations for the present imbalances, has provided a justification for the necessity for its redressing, and has provided ideas and strategies which could, and have been, implemented. Due to the ever-changing nature of technology itself, it would be simplistic to expect that the problems have remained the same over time and that the strategies that have worked in the past will be the same ones producing results in the future. Sutton (1991, p494) argues that it is now necessary to understand the complexities of the problem more fully and, therefore, to be able to devise appropriate and effective intervention strategies.

CHAPTER 3 - RESEARCH RATIONALE AND METHODOLOGY

Research involves the processes of 'inquiry, investigation, examination and experimentation' (Sekaran 1992, p4). In engaging in these processes it is important for the researcher to make their approach explicit. Consequently, this chapter will firstly describe the context of the research setting under investigation for this particular study. Secondly, the research problem is identified followed by a detailed discussion on the methods and tools used to undertake the research, giving consideration to the advantages and limitations of each of these methods. The third component of this chapter will describe details of the data collected throughout the study.

3.1 The Research Context

The research site Victoria University of Technology (Vic. Uni.) came into existence with the merger of the Western Institute and Footscray Institute of Technology on 1 July 1991. This created Victoria's fifth University which had campuses at five locations; Footscray, the City, and the western suburbs campuses of St Albans, Melton and Werribee. Since the formation of the University a campus at Sunbury has also been purchased and developed.

The majority of the students at Vic. Uni. are from non-English speaking and/or low socio-economic backgrounds. Many students come from local communities who, prior to the establishment of Victoria University of Technology, had been denied easy and equitable access to a university education. The students are often the first member of their families to go to higher education and they do not, therefore, come to the University with a background or culture that includes experience of tertiary education.

The Department of Business Computing in the Faculty of Business was formed in 1992 with the merger of the Computing Department and computing staff from Applied Economics from the two former institutions. It was recognised that the new department's strength and focus were on the emerging discipline of Information Systems. Yet the name of Information Systems was not chosen for the department as it was felt that the local communities were not technologically aware of what this discipline represented and consequently the name of Business Computing was adopted to reflect the new department's activities (Scollary 1995, p1). The courses offered by the previous departments required rationalising and it was 1994 before the identical undergraduate degree was offered at the two larger campuses of Footscray and St Albans. Melton and Werribee were viewed as feeder campuses and only the first year of the Business Computing degree program has been offered at these smaller outer-campuses. The Sunbury and the City campuses do not offer this undergraduate degree.

Although the merger to become a University occurred in 1991 it was not until recently that the University was working effectively as one entity. Due to the inaccessibility of data in the early post-merger period from the Footscray campus this thesis will concentrate on the experiences of female Business Computing students at the original Western Institute campuses of St Albans, Melton and Werribee.

At Vic. Uni. enrolments by female students in Business Computing at the three western campuses peaked at 39%[19] in 1991 (Table 3.1). It decreased to 33% in 1993. While the intake of female students into the common business year has improved steadily, the proportion of women enrolling into the Business Computing Degree is below the DEET target rate of 40% and declining. To raise the number of female students in the Business Computing degree members of the department have been pro-active and have attempted to raise female awareness of the course by creating a video called *Real Girls use Computers*, providing an annual Girls in Computing day, presenting talks to secondary schools and organising the 1993 Women in Computing Conference.

Table 3.1: Female undergraduate students 1991-1993

	1991	1992	1993
Common Year (Year 1)	45%	49%	50%
Business Computing (Year 2+3)	39%	37%	33%

Not only was the number of young women in the course low but alarmingly more female students were also withdrawing from the course than male students. Statistical analysis of student record data showed that in 1992, 9.5% of females withdrew from the course compared with 1.9% of males. In 1993, 20% of females and 12% of males withdrew (see Table 3.2). Combined, these results are statistically significant[20]. These students were in their second or third year of their course. In comparison, while the withdrawal rates were high in the common business year, there was comparatively little difference between the male and female withdrawals; in 1993 20% of males and 23% of females withdrew. What was it about the second and third years of the course which led to

[19] Prior to 1994 all first year business students were enrolled in a common year and they did not nominate which specialty within business they wished to study until the beginning of the second year at which time they were 'assigned' to a department. Consequently these figures do not include first year students. From 1994 onwards students entered directly into the first year of the course of their choosing, while still completing a common core of business subjects. Departments were now able to identify their first year students.

[20] There is enough data to justify a normal approximation: $Z = 2.034 > Z_{0.05} = 1.645$; Therefore accept H_a: $P_f > P_m$

the relatively higher withdrawal rate of the female students? Was it the emphasis on *computing* rather than *business* which contributed to this situation? This discrepancy between the withdrawal rates of male and female students in the computing course was considered to warrant investigation.

Table 3.2: Student withdrawals 1992 - 1993[21]

Year	Level	Students M	Students F	Students Total	Withdrawals M	Withdrawals F	Withdrawals Total	Percentage Withdrawals Male	Percentage Withdrawals Female	Percentage Withdrawals Total
1992	2	61	35	96	2	4	6	3.28%	11.43%	6.25%
	3	43	28	71	0	2	2	0.00%	7.14%	2.82%
	Total	104	63	167	2	6	8	1.92%	9.52%	4.79%
1993	2	74	42	116	13	10	23	17.57%	23.81%	19.83%
	3	66	28	94	4	4	8	6.06%	14.29%	8.51%
	Total	140	70	210	17	14	31	12.14%	20.00%	14.76%
Overall	2	135	77	212	15	14	29	11.11%	18.18%	13.68%
	3	109	56	165	4	6	10	3.67%	10.71%	6.06%
	Total	244	133	377	19	20	39	7.79%	15.04%	10.34%

The University is committed to equity plans which take into account national objectives, targets and strategies. The Access and Equity Policy adopted by the University, states that all groups in society should have the opportunity to participate successfully in tertiary education (Victoria University of Technology 1993, p17). Monitoring and assessing progress of equity groups is a priority by the Social Justice and Equity department. Consequently, the failure of many female students to successfully complete the computing course was identified as a concern that needed to be addressed. The aim of this research project was to identify possible reasons for the gender imbalance and then implement strategies which would begin to redress the situation.

At Vic. Uni. currently three of the five faculties offer undergraduate computing degrees. The Business Computing degree is offered by the Department of Business Computing within the Faculty of Business. The Department of Computer and Mathematical Sciences under the umbrella of the Science Faculty offers a Mathematics and Computer Science degree, while an Electrical Engineering degree can be earned from the Faculty of Engineering. The Business Computing degree has undergone many changes since its beginnings in 1987. The course generally aims to teach skills to analyse the development of computer systems and applications which accommodate

[21] Unable to acquire 1991 enrolments broken down to level. Figures as at September 1993 provided by Greg Young, Victoria University of Technology, Melton, Campus Statistician.

the information needs of users in a business context. Students combine their computing studies with business subjects - Accounting, Economics, Law, Management, Marketing, Business Statistics - allowing students to complete a broad range of business-focussed minors or major alongside their computing major. The computing subjects deal with the application of computers compared with the technical and mathematical content of the Computer Science course. Computer Science students tend to combine their studies with mathematics and other science-related subjects.

Apart from a satisfactory VCE pass there is no specific subject prerequisite for Business Computing, whereas Computer Science requires a Mathematics subject (VTAC 1995). Based on extensive research into maths avoidance (see, for example, Ainely et al 1994, Firken 1984, Lawrence 1984, Willis 1989), it is reasonable to hypothesise that such a Business Computing course should be more accessible and less threatening to female students. It could be argued that some women who enrol in the Vic. Uni. - Bachelor of Business Computing course elect to do so because it is perceived to be a computing course without the heavy mathematics component. Many of the obstacles faced by secondary female students and documented in the secondary sector (refer 2.2) can also be assumed to no longer apply:

- attitude to computing should be positive (or why choose it)
- no timetable clashes in the first year at least
- there is a computer for each student to use during class time
- there are role models

While only 6 out of 32 academic staff (19%) are female, they hold the influential and high profile positions of Head of Department and two senior lecturers, one of whom is responsible for the co-ordination of the undergraduate degree. Despite these factors the female withdrawal rate from the rather more practical and application-related Bachelor of Business Computing course was at a significantly higher rate than that for the male students (Table 3.2).

It is assumed that in this research context there is no difference in ability between the genders and that this is not a factor for the lower level of participation, or the greater withdrawal rates, of young women in Business Computing. Apart from research cited earlier (refer 1.6), statistics from Vic. Uni. support this view. Selection processes based on school results are not gender-based and focus on selecting the best qualified of those wishing to enter the course. Subject pass rates indicate an equivalent level of progress in the course for male and female students. Students in 1991, in the Business Computing course, had a subject pass rate of 76% for the female students and 75% for the male students. In 1992 female students had a subject pass rate of 75% in their studies as did 75% of the males (Appendix 2).

3.2 The Research Methodology

3.2.1 The Research Problem

The purpose of this study is to identify the reasons behind the attrition rate of female students in the undergraduate Business Computing degree course at Victoria University of Technology. Based on this data, an intervention program will be developed and implemented to increase the successful participation of women in the course.

The study aims:

- To gather qualitative and quantitative data on attrition rates and reasons for the attrition of female students in Business Computing at Victoria University of Technology.
- To develop a strategy to decrease the attrition rates.
- To trial the strategy and evaluate its effectiveness.

The gender-related nature of the problem requires that these processes have to be handled carefully. Spertus (1991) highlights the sensitivity of the issue:

> *Unfortunately, many attempts to encourage women in male-dominated fields at least partially backfire. Specifically, special treatment can imply, in a number of ways, that women cannot compete with men. Also, programs implemented to ensure equal opportunity often get misrepresented as having lower standards for selected groups. Additionally, consciousness-raising can lead to hypersensitivity.... (p49).*

For example, many writers have commented on the differences between male and female computer use and attitude, which led Hattie and Fitzgerald (1987, p4) to suggest that these opinions may actually lead 'to negative attitudes on the part of females and the subsequent avoidance of technology'. Consequently, it was necessary that all the possible effects of any strategies adopted, were carefully considered, to ensure this project's success.

3.2.2 Justification For This Research

This study focuses on the experiences of women in undergraduate Business Computing in an Australia university and begins to fill a gap in this area of research. While there is an enormous amount of literature which relates to gender differences in attitude, competence and use of computers, Hattie (1990) argues that very few articles actually report *research* on these topics. Of the one thousand articles reviewed by Hattie and Fitzgerald (1987) only nineteen reported research and the rest were statements of opinion which discussed 'the differences between males and females; all arguing that females are disadvantaged with respect to computer use' (Hattie 1990, p414). Hattie (1990, p414) has found that where computers and education are concerned there 'is too much advocacy and not enough research'. Howell (1993, p2) suggests that a lot of previous research in this area has also relied solely on the use of questionnaires as their only mechanism for data collection and this has been inadequate to assess the complex social constructs associated with this problem. Howell (1993, p7) recommends that additional research is required to obtain not only a more complete picture of why women do not persist with computing studies but also to find a way to improve intervention programs.

Not only is there a lack of empirical research but the limited studies undertaken have been primarily concerned with one form of Information Technology: Computer Science. While the statistics for women and Computer Science education are particularly alarming (see Appendix 1 for just one example) very little attention has been given in the literature to the situation of women in Business Computing / Information Systems education. This is not only the situation in Australia but in overseas countries such as the USA and the UK. This research seeks to identify the factors that influence young women to withdraw from a Business Computing course.

3.2.3 The Research Questions

The four main research questions are:

1. What are the experiences of female students in Business Computing?
2. What factors influenced their attitude to computing and the course more generally?
3. How do these factors relate to the discipline, institution and individual categories highlighted in the literature?
4. Can an intervention strategy based on student experiences be effective in enhancing the educational experience?

3.2.4 The Research Instruments

In investigating the research questions a range of strategies for the research and a range of methods for the data collection were adopted. This research was undertaken using a case study approach. The case study was achieved using the following methods:

- Initial questionnaire and focus group interviews (Exploratory)
- Individual interviews and detailed questionnaire (Descriptive)
- Progress reports, questionnaire and group interviews (Intervention/Explanatory)

A case study is a research technique that allows intensive investigation of a particular situation which is especially important if a subject is complex. Case studies provide an opportunity to look at the relevant issues in depth and allow for a range of methodologies; particularly qualitative methods. They also allow the quantification of some of the observations that are being recorded. Babbie (1995, p281) defines a case study as a 'comprehensive description and explanation of the many components of a given social situation' which is especially appropriate to the study of those topics 'for which attitudes and behaviours can best be understood within their natural setting'. Each case has within it a set of inter-relationships and it also interacts with the external world (Edward & Talbot 1995, p45). Frequently, a case study will rely on multiple sources of evidence such as documentation, archival records, interviews, surveys and observation. Yin (1994, p92) argues that an investigator is able to address 'a broader range of historical, attitudinal, and behaviour issues' when a range of sources of evidence are used within the case study. Kaplan and Duchon (1988, p582) observe that using different methods 'can also lead to new insights and modes of analysis that are unlikely to occur if one method is used alone'. Wadsworth (1984, p41) explains that a case study can use 'a variety of techniques (interview, questionnaire, observation) to assemble a range of information about a single *case*' whether that be a single person or a group. A case study can have as its subject individuals, families, communities, social groups, organisations, institutions, life histories, or even work teams (Hakim 1987, p61). In this study the chosen case is the female students in one particular course at one tertiary institution in the period of 1993 - 1996.

A wide range of factors can be surmised to potentially influence and ultimately determine whether or not female students complete their undergraduate studies in Business Computing. The case study approach was appropriate for this research as it enabled the total female Business Computing enrolment at one university to be investigated in depth. Female students and the inter-relationships with their peers, their teachers, their chosen study disciplines, their physical environment and a complexity of social attitudes have been able to be comprehensively analysed.

The first part of the research is exploratory enabling what Zikmund (1991, p32) describes as obtaining a better understanding 'of the dimensions of the problem'. Exploratory studies are important for obtaining a good comprehension of the topic. Sekaran (1992, p95) suggests that qualitative studies using observational techniques or interviewing as a means of gathering data are exploratory in nature. An initial questionnaire followed up by focus group interviews were used to explore the themes identified from the literature. Qualitative analysis of the data collected revealed a number of issues that would be further investigated by individual interviews and a detailed questionnaire.

The second dimension of the study was based on the previous understanding of the nature of the research problem and can be regarded as descriptive (Zikmund 1991, p33). Zikmund suggests that the major purpose of descriptive research is to answer the '*who, what, when, where* and *how* questions'. Qualitative research provides the answers to these questions and is 'rich in description of people, places and conversation, and not easily handled by statistical procedures' (Bogdan & Biklen 1992, p2). Researchers using qualitative techniques 'try to find out more than just *what is*, they also find out *why* it is' (Tesch 1990, p85). In contrast, quantitative research provides answers to the *how many* question. After studying ninety research papers in the area of gender differences and computing, Statistician Robin Kay (as cited in Frenkel 1990, p 42) suggests that this area is in a pre-paradigm period of development. Kay recommends that qualitative methods are needed to explain *why* males and females differ in their behaviour. Howell (1993, p6), in her comprehensive review of the existing body of literature on women and Computer Science, notes that descriptive qualitative research is needed to describe the factors that shape the computer culture and its impact on students. Consequently, this part of the research was accomplished via individual interviews with female students to find out what the experiences of the young women in Business Computing actually were and the data from the interviews was analysed using a qualitative approach.

Support for the qualitative approach to research is tempered by an appreciation of both qualitative and quantitative approaches. Miles and Huberman (1994, p40) argue that the quantitative-qualitative argument is unproductive. They suggest that words and numbers are *both* needed if the world is to be understood. Support comes from Christians and Carey (1989, p357) who argue that 'qualitative studies do not rule out arithmetic'. An analysis by Howe (1985, 1988) shows that the two methods are actually 'inextricably intertwined' and Gherardi and Turner (1987) suggest that the issue is really of knowing when it is useful to count and when it is difficult or inappropriate to count (as cited in Miles & Huberman 1994, p40). It is argued that it is appropriate to use predominantly qualitative but also quantitative methods, for this component of the research, whilst triangulating material gathered from the interviews (which is of a qualitative nature) to numerical data (quantitative) from the questionnaire of the entire cohort of students.

The last component of the research was of an explanatory nature. An intervention program was developed, and refined, to provide a positive impact on the young women's experiences. Action research was used for this section of the study, with data collected in the form of written progress reports, a questionnaire and group interviews. Action research is a means by which an understanding of the 'complexity of real experience' is used to 'strive for concrete improvements' (Kemmis & McTaggart 1988, p7). It involves a spiral of 'planning, acting, observing, reflecting then re-planning, further action and so on' (Bigum et al, 1987, p9). This enables the researcher to not only add to theoretical knowledge but to put this knowledge into useful action (Shanks et al 1993, p11). Burns (1990, p253) notes that action research is situational with the focus being on a specific problem in a defined context. More than one method of data collection was used for the action research so as to gather adequate information and provide opportunities for reflection and refinement of the intervention program (Edwards & Talbot 1994, p57).

In summary, this project combines a case study approach with mostly qualitative and some quantitative methodologies. Figure 3.1 illustrates the relationship between the different methods used to accomplish this research.

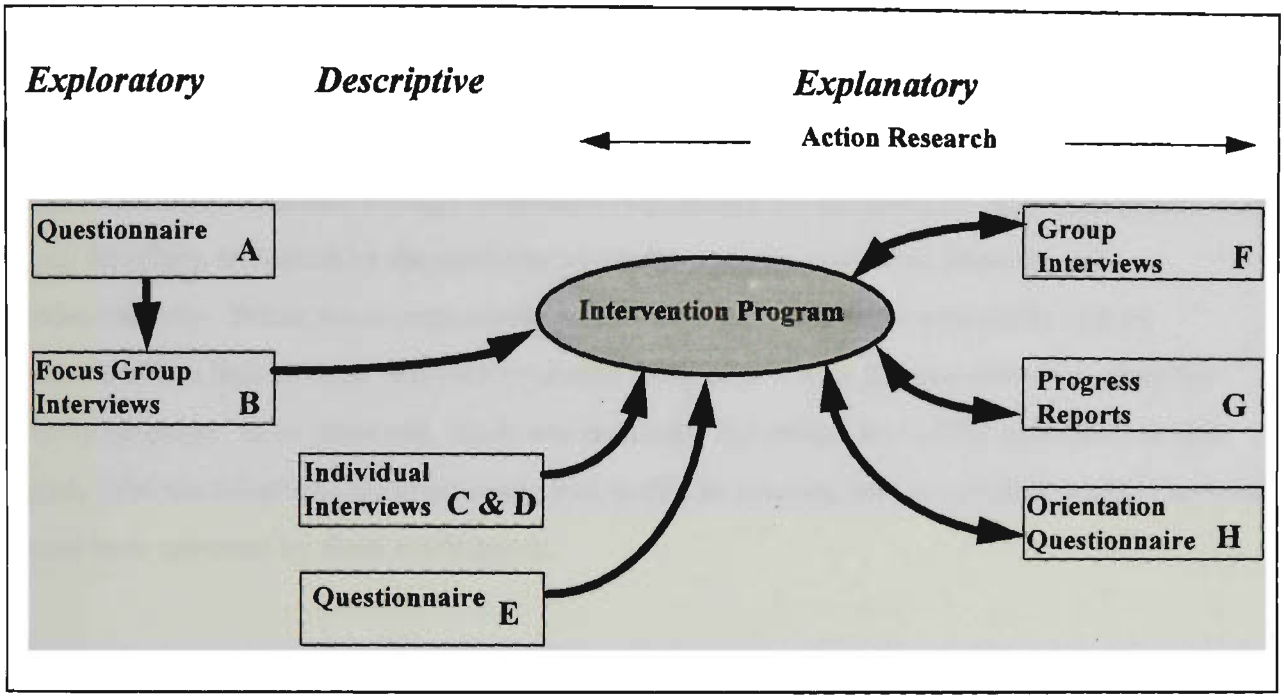


Figure 3.1: Data Collected

3.2.5 Limitations Of The Methodology

There are limitations in any research design and the following issues are noted with regard to the case study approach and the data collection tools used for this study. Firstly, a weakness of the case study approach is that its application 'is usually restricted to a single event/organisation, and [there is a] difficulty in acquiring similar data from a statistically meaningful number of similar organisations' (Galliers 1992, p154). Ultimately, the researcher executing a case study typically seeks insights that will have a more generalised applicability beyond the single case under study, but the case study itself cannot assure this (Babbie 1995, p302).

Another of the difficulties for a researcher who adopts the case study approach is that there is no standard procedure to follow. While this enables the researcher to be flexible and probe more deeply below the surface, the success of the case study will depend on the alertness, creativity, intelligence and motivation of the individual performing the case analysis (Singh, 1996). As Kirk and Miller (1990, p21) point out 'in the case of qualitative observations the issue of validity is not a matter of methodological hair splitting about the fifth decimal point, but a question of whether the researcher sees what he or she thinks he or she sees'. A researcher may become so involved in the case study that objective analysis of the data becomes difficult.

The role of an action researcher is to associate themselves with the research as well as trying to identify theoretical outcomes. The researcher's biases are made public just by undertaking the research and, consequently, the researcher's very presence will have an affect on the subject that they are researching (Galliers 1992, p157; Edwards & Talbot 1994, p45). The responsibility therefore rests with the researcher to be ethical in carrying out the research.

The information obtained through interviews requires the co-operation of the person interviewed and, therefore, is limited by the extent to which the students responded honestly and independently. While some respondents might feel uneasy about the anonymity of their responses in a face-to-face interview (Sekaran 1992, p197), such an interview does allow for 'body language' to be observed. As it was necessary to conduct four of the interviews in this study over the telephone the interviewer was unable to read any visual cues that might otherwise have been apparent by these participants.

Well designed questionnaires (including the wording, appearance and consideration of how the variables will be categorised) are necessary to minimise biases (Sekaran 1992, p197) and to ensure the data collected is not superficial. The researcher must take care to gather information that really matters and not just a large amount of data in a short period of time. Following up the non-returned questionnaires can also be time consuming and this needs to be allowed for in the research plan (Edwards et al 1994, p37). Finally, it is also possible that some of the interviewees and respondents to the questionnaires may not have comprehend the questions asked in the sense intended by the researcher.

3.2.6 Ethical Issues

This research project was designed and undertaken within the guidelines described in Victoria University of Technology's publication Code of Conduct for Research (Victoria University of Technology, 1993) and the project proposal was approved by Victoria University's Ethics committee. During the course of the research the ethical questions of informed consent and confidentiality were treated in such a manner as to safeguard all participants. When questionnaires were distributed it was made clear that completion was optional and confidential. Potential interviewees were approached, given an explanation of the nature of the research and asked if they consented to be interviewed. Students who did not consent were not interviewed. The sample of students used was a convenience sample (by willingness to be interviewed and proximity to the researcher). All interviewees who were interviewed in person were given a letter explaining the nature of the research and were asked for their written consent (Appendix 3). The interviewees' permission was sought to tape the interviews, so that every detail could be recorded and later transcribed. For those interviews which were carried out over the phone verbal consent was obtained from the students concerned. Statements from the interviewees were summarised under appropriate categories to facilitate an analysis for patterns in responses and opinions. Specific students and staff are not identified in the write up of this project. Pseudonyms are used for students contributing to the project in presenting the findings.

3.3 Details Of The Data Collection

The following data was collected in order to carry out the research:

Table 3.3: Data Sets

	Data Set
Exploratory Phase	
• Initial questionnaire 1993 Semester 2 programming class (N= 37)	A
• Follow up focus group interviews (N = 11)	B
Descriptive Phase	
• Individual interviews with continuing students (N = 14)	C
• Individual interviews with discontinued students (N = 6)	D
• Bachelor of Business Computing questionnaire 1995 (N = 123)	E
Intervention/Explanatory Phase	
• Group interviews with Intervention program students	F
• Progress reports from Intervention program students	G
• Intervention program orientation day questionnaires	H

Over time there has been an evolution in the focus as data has been gathered and, as a result some topics may not have emerged in all of the different Data Sets. The multicultural nature of the students enrolling in the Business Computing degree at Victoria University is evident from all sources (A*, C, D, E):

Table 3.4: Student Profile

Data Set	A * (N=37)	C (N=14)	D (N=6)	E (N=123)	Total (N=180)
% female	40%	100%	100%	48%	52%
% born in Australia	70%	50%	83%	84%	78%
% that had at least one parent born overseas	N/A	93%	50%	75%	N/A
% spoke another language	46%	86%	17%	65%	61%
% first in their families to go to university	N/A	43%	30%	50%	N/A

*Data Set A, a group of 37 students, has a subset of 11 female students who make up Data Set B

Nineteen different languages were spoken by the students, however, only one male student from Data Set A indicated that the majority of his schooling was in a language other than English. The most commonly spoken languages, apart from English, were Vietnamese, Italian and Greek. Each of the individual data sets, including data collection methods and samples, are described below.

3.3.1 Data Set A: Exploratory questionnaire - 1993

During Semester 2 1993, the subject Programming Techniques was offered at all 3 campuses to first year students. This subject was compulsory for students intending to do their degree in the Business Computing area and an elective for other business students. The classes at the different campuses had different staff, but covered the same material and used the same assessment procedures. Students were asked to complete an anonymous questionnaire three weeks before the end of the semester. The response rate to the questionnaire was 86% with the returns reflecting the gender spread of the class:

Table 3.5: 1993 Questionnaire response

	Female	Male	Total
Number of students in the class	17 (39.5%)	26 (60.5%)	43
Number of responses	15 (40.5%)	22 (59.5%)	37

Students were asked a range of questions relating to the course, their experiences of the computing subject as well as personal details. Most questions were of the tick the box variety with room for additional comment (see Appendix 4 for a complete summary of questions and student responses).

3.3.2 Data Set B: Focus group interviews - 1993

A focus group interview is an unstructured interview with a small group of people (Zikmund 1991, p82). The researcher introduces the topic and encourages the group members to discuss the subject and so this is more flexible than a question-and-answer session. The issues raised by the questionnaire (A) were explored further with eleven of the same students in small focus groups (3-4 students per group, 3 groups). Topics covered included students' experiences and expectations of the course and the need for more student assistance and support.

3.3.3 Data Set C and D: Individual interviews with students - 1994

The preliminary questionnaire (A) and focus group discussions (B) had explored a range of factors that had been raised in the literature, to see how they related to Business Computing female students. In order to explore the issues of gender and computing further, in-depth and semi-structured interviews with twenty individual female students (past and current) from the Business Computing degree were conducted. Less structured interviews were used as this encourages the participants to express and develop their views without being influenced by the interviewer's preconceptions. In-depth interviews also allow the interviewer to ask many questions and then probe for elaboration after the reply (Zikmund 1991, p92). Tables 3.6 and 3.7 provide the profiles of all the students who were interviewed. Those students listed in Data Set C are still currently enrolled in the Business Computing course, whereas, those in Data Set D have withdrawn from the course.

Table 3.6: Student Details - Data Set C: Individual Interviews with Continuing Students

Pseudonym	Country of birth	Parents' country of birth	Other language at home?	First in family to go to University?	Educational background	Highest level of computer study	Owned a PC while at School
Marie	Greece	Greece	Greek	1 sibling	VCE	VCE	No
Thu	Vietnam	Vietnam	Vietnamese	1 sibling	TAFE	short course Yr 11	No
Natalia	Vietnam	Vietnam	Vietnamese	Yes	TAFE	Adv Cert/ Info Tech	No
Ruth	Australia	Australia	No	Yes	VCE	VCE	No
Jane	Australia	Maltese	Maltese	Yes	VCE	VCE	Yes
Chi	Vietnam	Vietnam	Vietnamese	1 sibling	uni- 1 year	first year Computer Science degree	Yes
Erin	Australia	Scotland	No	Yes	TAFE	Ass. Diploma Programming	N/A
Heather	Spain	Spain	Spanish	2 siblings	TAFE	Ass. Diploma Micro Computing	No
Olive	El Salvador	El Salvador	Spanish	N/A	uni- 2 years	TAFE certificate in Operations	N/A
Stephanie	Australia	Greece	Greek	Yes	TAFE	Ass. Diploma Info. Tech.	Yes
Trang	Vietnam	Vietnam	Vietnamese	Yes	VCE	VCE	No
Ingrid	Australia	Poland / Australia	Polish	1 sibling	TAFE	Ass Diploma Micro Computing	No
Cathy	Australia	Lebanon	Lebanese	N/A	TAFE	Ass. Diploma Info. Tech.	No
Emma	Australia	Greece	Greek	1 sibling	VCE	VCE	No

Table 3.7: Student Details - Data Set D Individual Interviews with Discontinuing Students

Pseudonym	Country of birth	Parents country of birth	Other language at home?	First in family to go to University?	Educational background	Highest level of computer study	Own PC in School	Main reason given for course withdrawal
Amy	Australia	Australia	No	Yes	VCE	none	No	Did not choose to do computing
Lina	Vietnam	Vietnam	Vietnamese	1 sibling	TAFE	Ass. Diploma Info. Tech.	Yes	.Poor English making the course very difficult
Judy	Australia	Australia	No	Yes	TAFE	Ass. Diploma Programming	No	Business Core
Kim	Australia	Yugoslavia / Australia	No	Yes	VCE	within other subjects at VCE	Yes	Did not choose to do computing
Tamara	Australia	Overseas	No	N/A	VCE	VCE	Yes	Business Core
Louise	Australia	Australia	No	1 sibling	VCE	VCE	No	Full-time employment

3.3.4 Data Set E: Bachelor of Business Computing questionnaire - 1995

In 1995, to build a profile of the background of the students, both male and female, all first year Business Computing students were requested to complete a questionnaire at the commencement of the course. A draft copy of the questionnaire was examined for ease of understanding and ambiguity by a number of staff members in the Business Computing department and modified accordingly before it was administered. Initially 101 student responses were received. A reminder letter was sent out three weeks into semester, to those who had not yet returned the questionnaire. Another 22 responses were received within the next two weeks. A response rate of 76% was considered excellent for the analysis. The 123 responses obtained reflected the gender spread of the cohort :

Table 3.8: 1995 Questionnaire responses	Female	Male	Total
Number of students in the cohort	76 (47%)	86 (53%)	162
Number of responses	59 (48%)	65 (52%)	123 (76%)

Students were asked questions relating to their previous educational and computer experience, sources of information regarding the course, jobs they expected to be qualified for, as well as some personal details. The questionnaire is attached as Appendix 5. Data analysis was completed with the aid of the computer statistical package SPSS. The questionnaire responses were coded, categorised and keyed into a computer. Tests for any statistically significant gender differences in students' responses were carried out.

3.3.5 Data Set F: Group interviews with Intervention program students

Group interviews were held with intervention program students at the end of the first year of the program. Wadsworth (1984, p32) argues that group interviews are a very useful tool. They enable the whole group to take part in a collective information-gathering technique which gives all members of the group an opportunity to listen to, and reflect, on what other members have to say. Four group interviews were held with three or four intervention program students in each group. The main topics covered included students' perceptions of the intervention program; was the program worthwhile? Were there difficulties? How could the program be improved?

3.3.6 Data Set G: Progress reports from Intervention program students

At the end of each year all students involved with the MicroNet program were requested to submit a progress report via email to the co-ordinator of the project. Students were asked to indicate whether membership of the intervention program had helped them and, if so, how. They were also asked to identify what the problems were with the program and provide suggestions for improvements.

3.3.7 Data Set H: Intervention program orientation day questionnaires 1995

In 1995 an Orientation day was held to introduce young women to the program. At the completion of the day's activities (see Appendix 6, 7, 8) all students completed a short evaluation questionnaire regarding the experiences of the day (see Appendix 9). 34 students attended the day and 32 responses were received.

3.4 The Social Context

This research was undertaken within a back-drop of a changing social context.

> *.......the academic climate is changing. The new generation of....women has grown up in a time when gender equity is both taken for granted and not yet a reality. These women enter [institutions]...in which they still find traces of the old prejudices, but also substantial efforts to correct them. In their classes they still encounter aggressive men, but now also find assertive women and sensitive teachers who challenge the old patterns of interaction (Derek Bok Center for Teaching and Learning 1994, p1).*

New technologies continually evolve and then, slowly, become integrated into our society. Computers have become faster, smaller, more powerful and even more pervasive in society with students more comfortable and familiar with computers than ever before. Schools and school curricula are ever changing and, consequently, there will be differences in experiences of different cohorts of students. How far can we make generalisations about the experiences of the girls? Or, for that matter, the boys? Clearly, any research in this field needs to take this changing social and educational context into account.

In Australia the education of boys has become a topic of interest after media controversy about boys' poor VCE results relative to those of the girls. It is suggested that girls are no longer disadvantaged after special treatment and special programs.

> *Now what about the boys? It is the boys who are slower to learn to read, more likely to drop out of school, more likely to be disciplined.....In school it is the girls who are doing better, boys are in trouble....*

> *Counter claims are made: That for girls success in schooling does not translate in to post-school equity; that boys get more attention in school than girls at present; that programs for boys entrench privilege, not contest it. The media love to turn the issue into a pro-girl vs pro-boy (or pro-feminist vs anti-feminist) shoot-out (Connell 1996, p3).*

Morrow (1992, p1) suggests that girls are observed to be staying at school longer than boys, that young women are seen to represent more than 50% of the undergraduate population in universities and it is, therefore, concluded that on the education front the girls have won the battle.

The social climate is changing and the issues are complex. However, true equity will not be achieved until there is equity of outcomes for all and this study aims to elucidate some of the factors which are contributing to an inequitable outcome for young women - their attrition from a Business Computing course. Sanders (1990, p182) suggests that 'equity is what we do to achieve equity of outcomes' and this may require treating people differently in order to treat them equally well.

In investigating how outcomes can be improved for young women in a Business Computing course Chapter 4 of this thesis documents the findings of the exploratory and descriptive sections of the research, whilst Chapter 5 focuses on the description and evaluation of the intervention program, MicroNet.

CHAPTER 4 - UNDERSTANDING WOMEN'S EXPERIENCES IN BUSINESS COMPUTING

The experiences of female students in the Business Computing course at Victoria University of Technology will be described in this chapter as revealed in the exploratory and descriptive components of the research. Analysis of the five Data Sets (A - E) used for this section of the study clearly identified a number of key themes of relevance to the female students. The initial questionnaire (A) exposed two areas where female and male students responses were substantially different:

- Male students were much more confident about their own ability
- Female students faced difficulties obtaining sufficient help

These issues were further discussed in the focus group interviews (B), where all participants of the focus groups expressed their appreciation and pleasure at being given the opportunity to 'have their say'. The individual interviews (C & D), while also exploring these issues, highlighted other topics of pertinence for students such as the course structure, career expectations and interactions in the classroom. Of the six students interviewed who had withdrawn from the course (D), four indicated that they wanted to continue with computing even though they did not want to stay in the Business Computing course. The two students who did not want to do any more computing had not wanted to do a computing course in the first place. Finally, the Bachelor of Business Computing questionnaire (E) confirmed a difference in career expectations between the female and male students.

The barriers to successful female computing education were loosely categorised into three groupings of factors in the literature review:

1. Factors relating to the *Computing Discipline* and the *Profession*,
2. Factors relating to the *Institution* and
3. Factors relating to the *Individual*

These same categories will be used to describe the themes which emerged from the Data Sets (A - E). Any categorisation of these themes necessarily involves choices in allocation and is to some extent arbitrary. In some cases a theme could have easily been included under more than one grouping because of the interaction of many of the categorisations. Where this occurred it was placed in the category it seemed to most relate to.

4.1 Factors relating to the *Computing Discipline* and *Profession*

4.1.1 Course Choice

There are hundreds of different courses available at Australia's 38+ universities. In Victoria students applying through VTAC may list up to eight courses in order of preference in their application for a university course. Students are then offered a place in a course based on their TER score and demand for the course. It was obvious from a number of the Data Sets (B, C, D) that many of the young women who enrolled in this particular course, knew very little about the course itself. It appears that an important factor in the decision by many of the women to do the Business Computing course was that they had studied computing at school and had enjoyed it:

> *It's fun, I like it. I did really well in my VCE computing subjects so I thought that I would be better off doing computers rather than other subjects like law (Trang - C[22]).*
>
> *Because I enjoyed using computers and I don't know, I just like it (Natalia - C).*
>
> *Well, I scored highly ...last year, I scored A's and B's. My dad was always saying go computers, go computers.....you've got to have computers before you can do anything else and if you go that way you will have something really good behind you. I thought yeah, okay I find it easy (Louise - D).*

While Stephanie, Marie and Jane (C) also had been positively influenced by their experience of computing at secondary school and, as a result, had decided to continue with it, a number of the students indicated that this course was not what they had really wanted to do at all. For young women such as Heather (D) the outcome ultimately satisfied them:

> *I couldn't do nursing, because I couldn't do Biology and it was really hard for me, so my other option was computers. And, like my plan was to do computers, and then try and get into nursing the following year, but because I love computing and it really caught my attention [I stayed with computers] (Heather - C).*

But others such as Amy (D) and Kim (D), continued to want to pursue other studies:

> *My parents were keen for me to get a degree. They were really pushing me to continue studying. I wanted to do Travel and Tourism but got into this course instead. I had hoped to transfer or to at least do a major in Tourism (Amy - D).*

Although Amy's interests were in Travel and Tourism when she was offered a place in the Business Computing course her parents encouraged her to accept. She hoped to transfer into Tourism or to at least do a major in Hospitality or Tourism. When Amy discovered a 12 week Tourism course which she could study part-time and simultaneously she was offered full-time employment, she withdrew from the course. This co-incided with the loss of a computer assignment which had been four weeks in the making.

> *On the day I left, I lost a computer assignment because of a mistake I made with the disks. I just didn't know I was doing it wrong until it was too late. I just didn't want to*

[22] The source of each quote is attributed to the Data Set from which it came by use of the appropriate letter.

do it again. [At the same time] I got some information that I had written away for about a correspondence course in Travel. Its only for 12 weeks which I can handle. It wasn't the computing that made me drop the course I just shouldn't have started it in the first place! It wasn't the right [course] for me but I sort of got pushed into it (Amy - D).

Kim (D) first enrolled in the common year in 1993. At the end of the year she applied to go into the Accounting stream but was placed into the Business Computing degree instead and, consequently, she went to a part-time study mode. When Kim was finally offered a place in Accounting she returned to full-time study. For Kim and Amy withdrawing from the Business Computing course did not fundamentally have anything to do with computing or the course itself. Leaving the Business Computing course actually reflects their efforts to achieve their goals, rather then a rejection of their goals.

Kim's situation also illustrates that students who enrolled prior to 1994 may not have chosen Business Computing, but still have been placed in the Computing stream after their common year due to high demand for other streams. Other students were in a similar position:

I was originally keen to do Accounting... but after the first year they put me in this course ...so I'm willing to do this course and give it my best (Emma - C).

I can't get into Accounting so I had to choose Computing (Thu - C).

This could be a factor contributing to the high withdrawal rates in 1992 and 1993. It can be assumed, however, that this situation would have been just as likely to have occurred for the male students as for the female students and, therefore, may not have been a critical factor contributing to the difference in attrition rates between the genders.

Students who enrolled in 1994 or thereafter must have at least placed the course in their top eight preferences to have been offered a place. However, the course, and even the field of computing, may not have been high on their list. Certainly the reaction of students to being accepted into the course varied from surprise to great joy and happiness to disappointment. Amy's case shows that although students had chosen the Business Computing option rather than a generic common year, some hoped it would lead to a preferred course through internal transfers and never intended to become a computer professional.

Judy (D) explained that 'to get a better job' was her motivation for choosing the course. Similarly, a number of female students saw computers as a career option which had strong opportunities for their future:

I wanted a career in Computing, I knew that for a fact, so I chose Business Computing so that it would give me a broader area of things I could do. The advantage is that you *won't get stuck with something in Computing, you can branch out into business, or branch out into other things (Ruth - C).*

During the time I was out of the workforce computers came in and the workplace changed drastically, so it had to be a start (Erin - C).

I don't know - programming - I suppose when I did year 12, I was interested in it, and I thought it was a good career (Cathy - C).

When I first started I didn't know anything about computers but because everyone was saying that computers are the way to go these days, and if you know about computers you will get a job later on, I did a TAFE course and loved it. So now I've articulated into the degree (Ingrid - C).

One student chose the course because she perceived it would be an easier alternative to her current course. When Chi was interviewed (C) she explained that her reason for enrolling was the difficulty she had in a Bachelor of Computer Science degree '..but I think it that it is very difficult... so I changed to this course'. The only other reason put forward for enrolling in the course was by a student who had discovered how useful computers could be and this had prompted her decision to enrol. Olive (C) had previously completed two years of an architecture course in another country. The prospect of returning to study and having to use computers was of great concern to her. In preparation Olive tackled a TAFE computer course and then decided to continue with computing which she had discovered was a marvellous tool:

It was new for me and I found how fast you can work with them. I did some autocad and when I was doing my drawings by hand it took me a lot of time but then I find out with the computer you don't have to redraw only fix here or there! (Olive - C).

It was apparent that the majority of the young women were poorly informed about the course that they had enrolled in. At the commencement of the course few were aware of details such as; what the curriculum content was, the common core of business subjects, Co-operative education and whether or not they were eligible.

I did 'Computers in Society' in VCE. I loved it! So I got into this computing course but its not like I expected at all. I hate it. All these business subjects. I didn't think it would be like this (B).

I put this course down on my list of VTAC preferences but really all I knew about it was that it was computing, though not Computer Science, and that [Vic. Uni.] was within driving distance from where I live. I hadn't really expected to end up here (Tamara - D).

This lack of knowledge about the course may significant and will be discussed further in a later section on curriculum.

4.1.2 Career Expectations

While some students were quite clear what possible jobs/careers they saw the Business Computing course leading to, identifying Programmer, Systems Analyst or Computer Operator, most were unsure. It can be expected that a student who chose another discipline area as their first preference but then ended up in the computing course, might not be aware of the variety of career possibilities available. This proved to be the case for Emma (C):

> *I really need some career guidance. I don't really know what my options are. Like when people ask me now I just say computer programming because I really don't know what other computing jobs there are. Its embarrassing, really (Emma - C).*

Yet even among those students who clearly choose to be in the course, many were uncertain what career paths might open up for them on graduation:

> *One that pays lots of money. Something concerned with computers. It doesn't have to be computers all day, everyday. Maybe administration, secretarial something like that (Louise - D).*
>
> *I should have the knowledge to do the basics like computer operator, possibly programming if that's the field I go into, which I don't know what I am going to do yet. That's about it, or maybe the management side (Ruth - C).*
>
> *All I can think of is programming and secretary jobs (Natalie - C).*
>
> *I don't know, I was wondering. I don't know. I haven't a clue (Trang - C).*

Some students like Chi (C) even had erroneous ideas! 'I think a business job like um, just a secretary, yeah like that'. The job of programmer featured strongly in many comments but some of the young women indicated that although they would like to be a programmer, they did not believe they were good enough:

> *I would like to become a systems analyst because I think that I do not have the skills to do programming (Olive - C).*
>
> *I have no idea! That's a big problem I've got. I've got to see a counsellor. But I have some ideas of technical support. Not in the cabling and that, because I'm not familiar with that, maybe help desk. I'd love to do programming very much but I'm not a programmer (Heather- C).*

Such feedback suggests lack of understanding, confusion and a lack of self-confidence by many students. It raises the question as to why these students chose a course that did not appear to have clear outcomes and did not understand where it could lead to.

While the questionnaire (E) showed that there was no difference in previous experience or background between the male students and the female students, the perceptions students had of the career a Business Computing course could lead to were disturbingly different. Many of the young women were unaware of the types of careers the course would lead them to - some, in fact, held false ideas of the job opportunities at the end of it. The final question on the questionnaire (E) asked students to list any jobs/careers they expected to be qualified for at the completion of the Business Computing course. Students were given space to record six answers. The responses are summarised in Table 4.1.

Table 4.1: Possible career/job responses	**Male N = 64**	**Female N = 59**
No response given to this question	**14%**	**31%**
Programming (Including Junior or Assistant Programmer)	**73%**	**39%**
Analyst (Including Systems Analyst, Junior Analyst)	34%	31%
Support Role (Including Systems / IT / PC / Technical/ Software and Network Support)	16%	12%
Computer Operator	11%	12%
Office Administration (Word Processing, Secretarial, Receptionist)	**0%**	**14%**
Accounting Job (Including Bookkeeping)	14%	5%
Sales	8%	0%
Manager (Including Information Manager, IT Manager, Computer Manager, Project Manager)	19%	14%

The other jobs/careers that students listed that they would expect to be qualified for included; Network Administration, Data Communications, Database Administrator, Consultancy, 'a job in the commerce field', Computing Teacher, Business relations, Businesswoman, Engineer, Records Officer. None of these options were listed by more than a total of four students.

The disparity between the female and male answers to this question suggests that more male students have clear perceptions about where the course will lead then is the case for the female students. Twice as many female students (31%) compared to the male students (14%) were unable or unwilling to list any job and did not answer this question at all. For many of the young women the 'secretarial stereotype' is still prevalent. Some 14% of the female students listed an Office Administration / Word Processing / Receptionist type of position as a likely outcome following the completion of their degree, yet no males (0%) identified this area as a possible career prospect. Consequently, almost half of the young women (45%) are entering the course with no apparent understanding of the sort of career options the course leads to and with fairly traditional, stereotyped expectations of the sorts of areas where females with computing skills are likely to gain employment. On the other hand, while 73% of the male students identified Programming as a possible career only 39% of the female students did. Considering that male and female students are exposed to the same curriculum and delivery, such a discrepancy in perception is surprising. This finding raises a number of questions about how such expectations might impact on their experience of the course. For example: what impact is the first compulsory programming subject going to have on those who do not see computing as being related to programming? And those who mistakenly see the course leading them to an office administration or a secretarial career, will they need reassurance that there is a place in Information Technology for them? What are these perceptions of female students based on, ignorance or media stereotypes?

Both the questionnaire (E) and interviews (C & D) indicated a lack of understanding of future career outcomes of the Business Computing degree by the female students. The quotes from the young women show that many of them have no real career paths in mind at all. The questionnaire (E) indicates that this may not be so for the young men. This also raises a number of questions concerning the relationship between perception of career possibilities and students' motivation and commitment to a course of study. For example: if students do not have a clear perception of future career possibilities do they have the same sort of commitment to the course as other students? To be motivated to complete the work required in a three year degree how important is it to be able to 'see' where you are going? Do you need to be able to connect what you are learning with what is possible? If the course, or the subjects within the course, are not what is expected then it could be reasonable to assume that your level of motivation may decrease. It would seem that the perceptions held by the female students of possible career outcomes could be contributing to the greater withdrawal rate by them from the course.

4.1.3 Role Models

None of the female students (B, C, D) personally knew a female or male very well who was employed as a computer professional. For example; Cathy (C) had only just recently met a 'guy who was a programmer', however, she had not spoken much with him about what he did at work. Emma (C) knew of some administration staff at a department store who used computers. Her sister, who is a receptionist, had recently completed a word processing course yet still preferred her typewriter. Ruth's (C) current boyfriend was a manager and used a computer and Stephanie (C) had a cousin who worked with computers, but she was not sure in what capacity. Chi's (C) friend had studied computer science and used a word processor. Natalia (C), Heather (C), Lina (D) and Judy (D) knew no-one who worked with computers. Only one student from those interviewed, Olive (C) was positively influenced by a role model:

I found it very helpful that the first time that I did programming, the teacher was a lady. And I feel that it helps me, because I know that if she can do this, I can too. And in the beginning when I feel this is not for me and I can't do this she was there telling me I can do it. And the way she was trying to let you know you are doing all right. When I first started this course, I [decided] to drop it and I went to her and told her I can't do it any more and I said I don't understand. I don't know what to do. She said "You are not the only one. Its not the language. I know you can do it if you try". And then I did it and she was there to tell me "See you can do it!" (Olive- C).

When some of the young women (B) were then asked to "Name someone, who you know, who you considered to be successful", the responses were very limited; the Prime Minister of Australia, the Premier of the State of Victoria, a boyfriend who was a programmer and two of the female lecturing staff in the Business Computing department were all that the students could identify. The lack of insight into the working lives of *any* computer professionals, either male or female, may partly explain students lack of awareness of job opportunities in this field of study.

4.1.4 Computer Games

An important way to gain familiarity and confidence with the use of computers is through the playing of computer games. However, the students interviewed (C & D) indicated that their home computers were predominantly used for school work. Playing computer games was not a priority use of the computer for most of the young women with seven of the students suggesting that they never played computer games at all. Chi (C) indicated 'I don't know how' and Trang (C) said 'I don't think my computer has games'. Emma (C) declared she was bored with the few games that she had and anyway 'I've joined the gym now'. Only three of the young women (Natalia - C, Jane - C, Ruth - C) conceded that they frequently played computer games. The most frequently mentioned game was solitaire (5 students). However, many students used their machine for other purposes when they were not busy with academic work:

I use it for Wordperfect, database and spreadsheet (Thu - C).

I like to use the computer. I don't like to write a program, I just like to use the graphics or type letters (Chi - C).

I like fixing it up. I like ...shifting through different commands trying to do batch files. I've got some programming assignments that I ...like compiling and running and seeing how I did it and you often play the odd game here and there (Heather- C).

A number of the young women commented that while games were not appealing to them, they did spend time using the computer because of the opportunities it provided to be creative.

I use the slide show stuff [in Quatro Pro]. I think it is really nice to put these different designs like circles and then they put another square on the top of it ......I love it.... (Trang - C).

You are on the computer. Its more your own imagination to what you want to do than someone telling you, you have to learn this and this area. It's more enjoyable (Ingrid-C).

The playing of computer games allows a user the opportunity to press buttons and keys without worrying about what is going to happen. In this capacity such game playing can be an important step for feeling comfortable with computers. Yet it appears many female students (C & D) are not getting this exposure. While a few of the students, who are not interested in games, have found creative alternatives to let them 'play', the majority tend to use the computer only as a tool. Insufficient 'experimentation', 'tinkering' and 'playing' with computers may be contributing to the lack of confidence many of these young women displayed. The self-confidence of the students will be further discussed in the section on Individual factors.

4.1.5 Summary of factors relating to the *Computing Discipline / Profession*

From the Data Sets (A - E) four main themes emerged related to young women and the Computing Discipline and Profession. Firstly, many female students entered the course with limited knowledge of what was involved in a computing course. Second, the young women had a narrow and limited perception of possible career outcomes compared to the young men in the course. The third theme that emerged was that none of the students interviewed personally knew of a female or male role-model in the computing profession. The last issue identified was that the majority of the female students did not play computer games.

4.2 Factors relating to the *Institution*

4.2.1 Course Structure and Organisation

An interesting factor which emerged from the interviews was the dislike the majority of the young women had for the common core of business subjects (Accounting, Business Statistics, Business Law, Management and Organisational Behaviour, Microeconomics, Macroeconomics,) and the difficulty many experienced with these subjects:

I didn't like the first year very much. I think the first year you should be able to do what you want and not to have to do Law and Economics and all that sort of thing (Kim - D).

This course is harder to do with the business core...I don't like to do the business (Chi - C).

Other students had similar concerns:

I don't think I'll be able to manage the business subjects. I've been having difficulties.....so I'm not too sure if I'll be able to pass all these business subjects....I *find it really hard. I prefer to be doing computer subjects....Probably because I'm Asian I'm not very good with English and I'm not very good at writing essays and stuff, like for Micro and Law and all those core subjects. I just prefer Computing to business (Natalia - C).*

Natalia (C) has since chosen to spread the business subjects throughout her course to help her cope with them. Judy (D) and Tamara (D) both suggested that they had withdrawn because of the difficulties they had with the core subjects:

The course was very hard. I found the business subjects very difficult especially Accounting and Economics. I was disappointed that we had to study so many business subjects at once...(Tamara - D).

Tamara withdrew after two semesters in the course and after she had failed seven of the eight subjects she had attempted. She had passed one computer applications subject, failed programming and failed six business subjects. Tamara still wanted to get a career in the computing field and was considering doing a private computer course where the emphasis would not be on business. Judy withdrew after only one semester of the course. She had articulated into the course from a TAFE computing course and had found the core subjects difficult. She was required to do all business subjects in her first semester which she did not like and she failed all of them, although only just. Judy would have considered staying if she had not failed but decided to find another 'real' computing course instead. She left the course and was looking for another computing degree 'without the business component' as she 'missed working on computers'.

Students commented that, although they perceived that fellow classmates did have prior knowledge of the core subjects, they themselves lacked adequate background in these subjects. Tamara (D) expressed concern at not having the preparation necessary for the business subjects: 'they seemed to expect that you would know some of the material already....I had no background knowledge there at all'. Heather (C) was also concerned that she only had a computing background with no previous experience of the business subjects, and that this placed her in a disadvantaged position compared to students who had studied such subjects at VCE. She suggested that she would not recommend the course to other students thinking of articulating from the Associate Diploma as they too would have trouble with the business core. Another student who found the core subjects particularly difficult was Amy (D). All the subjects were new to her, as she had studied maths and sciences at VCE level, and she felt that this had been a real disadvantage for her. These students were convinced that their fellow class mates in the core subjects had, in fact, studied business subjects at VCE level.

Another student who left the course had experienced difficulty with business subjects, including Economics and Law. Lina (D) blamed her lack of English language skills for the difficulty she had in coping with the readings required and the essay writing:

Like for Law I hand in assignment and [the teacher] says 'Lina you got poor grammar' and I say 'I know' (Lina- D).

Unfortunately, Lina was not made aware of the help she could get with her language skills even though the University has staff available to help such students.

The lack of apparent relevance of the business subjects also concerned students. For example, Jane (C) declared:

I just don't see the point [of Statistics]. I get confused. I just don't see the point to it and then I just don't even try. I just think 'When are we ever going to use this?' (Jane - C).

This was supported by Heather (C) who had previously completed an Associate Diploma in Micro Computing:

I got into the Business Computing course and got stuck with Accounting, Economics and Statistics... [I have] exemptions for all my computer subjects so I'm stuck with all the core. It gives you no motivation whatsoever. [At TAFE] it was straight computing. There was no mumble jumble of Accounting, Economics....It was just, ohh, the work was good, it was all related and...I had a wonderful time... I just can't see how Economics is relevant to anything I want to do (Heather - C).

Ingrid (C) declared her preference for computing over the business core; it had a more 'relaxed atmosphere' as you didn't have to be able to 'memorise a lot of facts'. Ingrid had just completed Microeconomics which she found very stressful but for which she received a credit. She was very concerned about the Macroeconomics subject she was about to tackle. Emma (C) was able to pinpoint another difference in delivery between her computing subjects and the other business subjects. Her computing lecturers provided her with a copy of a lecture outline which was not provided in the other subjects:

In computing you can photocopy the whole lecture but this does not happen in other classes. With other subjects I have to go back and revise my notes - write them up properly. With computing you just highlight the photocopy....My note taking is a lot poorer in my computing lectures (Emma - C).

4.2.2 Programming

All computing students are required to do one compulsory programming unit which is usually taken in second semester of their first year. Programming is taught to students using structured techniques, top down design and hierarchical decomposition with the Pascal language as the vehicle in this first unit. Students are encouraged to develop and test an algorithm on paper prior to translating it into code. The 'hacking' of code is frowned upon. Students may then choose to follow a programming stream by doing more units in their later years or they can avoid doing any more units by following a different computing stream.

Although a number of the problems and examples used throughout the programming class were maths based, most of the female students were not concerned by this (B, C, D). What was of greater concern was the fact that many of the problems were not 'real life examples' (B) and therefore 'made no sense'(B). One student (B), who was not a first year student but in her final year of the Accounting degree, was completing the subject as her last elective. She repeatedly told the group how other Accounting students could not believe she was doing the programming subject because it was so hard. Another student (B) felt that 'programming is not the same as computing' and was happy to do other computing subjects if she could avoid doing more programming.

Most of the young women (B, C, D) had strong feelings about programming; they either really liked it or they disliked it, with the majority indicating they had enjoyed the programming units.

> *Programming was difficult because I'd never experienced anything like that before.... It was really good....I like challenges and it challenged me to make these programs and to see how things work, it was really stimulating. It was really, really good. It was probably the best subject (Ruth - C).*
>
> *I want to go back and do more programming. I enjoyed that. Its fun (Judy - D).*
>
> *I don't like subjects were there is no answer. With programming you always see a result - Its great (B).*

Stephanie (C) really enjoyed the programming, found it easy and satisfying and wanted to make it her career. Marie (C) hoped to get a programming job as she enjoyed the problem solving aspect of programming. She made the observation that in her programming tutorials the girls generally asked more questions than the boys 'because the guys seem to know more because they have done it before'. Marie felt that the boys must have completed TAFE courses to acquire this previous knowledge.

A number of the young women indicated that they enjoyed programming, but did not feel they were good enough at it to make it their career. For example, Natalia (C) really enjoyed programming but doubted that she had enough ability:

> *I want to do programming, but I think now that I've done a subject in it I'm not sure about whether I should be a programmer 'cause it's really hard and I think the guys are better at it ...You know of all the subjects of this course the one I have enjoyed the most is programming (Natalia - C).*

Heather (C) indicated that she 'loved' programming, but she, too, didn't feel that she had the knowledge to pursue it as a career. Erin (C) explained that she was not a 'natural' programmer and that the programming subjects she had undertaken were very intense. Her definition for 'natural' programmers included fellow class members:

> *In class I've seen young males and they just whip a program together. It might have a few mistakes in it but it works, then they go home ...and spend all day hooked up to the networks [with their] modems...... (Erin - C).*

Ingrid (C) also believed the male students had prior programming knowledge:

> *I didn't like the programming. I can't do it. I find it brain teasing. It's just too confusing. The guys just went and started typing away. And they could sit at the computer for hours, whereas I couldn't. Like they would go home and do the programming and say they were up till 3 o'clock in the morning...But if it wasn't for the guys I wouldn't have got through because they were a big help ... because they did programming in High school (Ingrid - C).*

Despite this, Ingrid earned two credits for the two programming subjects she completed. In contrast, Tamara's (D) results in programming were disappointing and while she wanted to go on and study more computing she had not enjoyed the programming and did not want to do any more. Similarly, Thu (C) didn't like it that much and didn't feel that she was good enough to consider it as a future career. Kim (D) liked using computers but not in the programming area:

> *I like using computers but doing a program for instance, I find it hard to do.....I don't understand the commands... Unless you know Pascal the program it is really hard to do.....This is the first time I have had a chance to try [programming] but well I didn't know because I hadn't tried it, but I had the feeling that I wouldn't be able to pick it up and I wouldn't be able to understand it. I knew it would be difficult (Kim - D).*

Nearly all the students were aware that programmers required good communication skills and thought that they would spend anywhere between some, or a lot of time, working as part of a team.

4.2.3 Time consuming nature of the course

A number of the students in Data Set B commented on the time-consuming nature of the programming subject indicating that this subject had a heavier work load than any other subject that they were studying, although only three students in Data Sets C and D specifically commented on the time consuming nature of studying in the computing discipline. Olive (C) indicated that the work in computing was time consuming but 'not that hard' while the other two students comments were:

> *I didn't realise that with computing you really have to put in extra hours - even if you aren't having difficulties you need to put in extra hours.....Just the wrong press of a button you can loose your whole work or what-ever. With other [subjects] its just a matter of looking up the books and I just have to make sure I reference it properly. With computing I have to create the assignment and make sure it works (Emma - C).*

Programming needs a lot of time. This does not leave you with enough time to do the other subjects. - I am sure the workload in programming contributed to me failing Accounting (Heather - C).

Another four of the students (Chi - C, Natalia - C, Tamara - D, Amy - D) felt that they experienced difficulties with the demands of their studies. However, they indicated that it was a lack of good time management strategies on their behalf which was causing this.

Managing my time was a real problem. There were long breaks between classes. On Tuesdays for example I had classes from 9 till 11 and then 3 to 5. I would waste much of this time. Then I would get home and have to go to work. I'm a pretty lazy person and just couldn't get organised to use my time properly (Amy - D).

It is so different from TAFE. Its so different, like there are so many free times and you have your own times...there is so much free time if you don't use the time wisely you waste time (Natalia - C).

4.2.4 Mathematics

There was no association between Mathematics and Computing as far as the young women (B, C, D) were concerned. While a number had studied Mathematics at VCE level they felt that this had not helped them with their computing, as only basic maths was required, though it had helped with the business core subject of Statistics. Those students who did not have a mathematical background felt it disadvantaged them in Statistics. Predominantly business examples rather than scientific or mathematical were used in the computing classes so the maths level required did not appear to be of concern to any of the students.

4.2.5 Interactions in Teaching and Learning

In any learning environment inter-relationships exist between the staff member and their students as well as between the students themselves. Individuals have different interpersonal skills to help them respond appropriately in teaching and learning environments. The question of being able to get sufficient academic help provided a wide variety of responses from the students. While some of the young women found their lecturers and tutors to be very helpful, others were scared and intimidated by the staff.

The tutor would do an example on the board and straight away he would pick on a girl and ask "Do you understand?" He is always asking the girls but has never asked the boys if they understand. When I asked him a question I find he gets annoyed....It might be just with me because it takes me longer to understand. Maybe I ask too many dumb questions (Emma - C).

We were given an assignment to do. After he had explained how to approach it, [the teacher] said "It is really a very simple assignment. Even my young son would be able to do it". How can you then approach him and say that you have no idea how to even start? (Trang - C).

I think he'll yell at me if I ask him something stupid because they like to keep standards. I might feel dumb.....If I say the wrong thing he'll say "Oh, No! You do it this way"....... I prefer to ask my friends (Kim - D).

Some [teachers] make you feel ...they put you down. But most of them are good, they are really helpful (Marie - C).

Amy found her teachers extremely helpful except for one who she had for two subjects:

He didn't understand what I was not understanding. I get things muddled up and I would try to get him to help me but he didn't understand what I was not understanding. This made me feel really stupid (Amy - D).

While Ingrid (C), Jane (C) and Louise (D) found all the teaching staff helpful, Ruth (C) had been told by her secondary teachers that at university she would not receive much assistance from the lecturers and that she would be on her own. She was pleasantly surprised: 'The lecturers and tutors know what they were talking about and they also help us!'. The students with a poorer command of the English language were less likely to find all of their teachers helpful. Thu (C), Natalia (C), Cathy (C), Chi (C) and Stephanie (C) all indicated that they had trouble approaching some, or all, of the staff.

Students frequently preferred to ask their friends. However, Judy and Tamara (D), both of whom had withdrawn from the course, admitted that they had not made many friends at the university. Tamara found it hard to get help from staff because she felt they were not often around though they were helpful when approached.

It was hard to get help from anyone. When the tutor was not around, which was often, I did not know who to ask (Tamara - D).

I didn't get much help from anyone - staff or students. I felt I had no-one to ask (Judy - D).

I think that [the course] has got very hard. I can't write a program..... It's very hard to do. ...I can't concentrate because the lesson goes very quickly and sometimes I haven't spare time to ask the teacher about homework (Chi - C).

There were mixed feelings also on the help that was available from classmates. Whereas Ingrid (C) felt she would not have coped without the assistance given to her by the male members of her programming class, other students did not find their classmates helpful.

There is not a lot of interaction amongst the female students once you are in the class. [Males] don't speak to you because you are not on that level - they will share the knowledge with their mates, the guys, but not the females (Erin - C).

[The boys] are not my friends...but they can't (won't?) help me a lot (Chi - C).

In computing the girls were on one side of the room and the boys on the other. The teacher was always with the boys. But I don't think it was because he doesn't want to help the girls I think it is because no [girls] asked for help but the boys do ask for help (Olive - C).

When young males dominate the class and waste time, you don't cover the course in class. This leads to extra homework and is very frustrating. It happens time and time again. It's a lack of control on the teacher's part (Erin - C).

On the subject of having to work directly with other students on a group project, students' over-whelming preference was in favour of individual work. The assessment tasks in the programming subject were a mixture of both individual and group assignments, but 73% of both female and male students (A) expressed their preference for the individual work. It was apparent, however, that students were given little assistance with how to work as a group nor advised as to how the given problem could best be dealt with in a group situation. Comments of not wanting to have to rely on others or of not being able to contribute equally were given.

I worked in a group with two other male students. I felt I let the group down as I could not get my part of the program to work and I couldn't even explain my work to the others sufficiently so that they could help me (B).

Having to complete much of the work as other team members failed to do their share was also of concern. One student (A) claimed that 'Our group was pathetic - the others did not put in', however, another student (A) felt that working in a group 'lifts the burden of the assignment'.

4.2.6 Access to assistance

Evidence from all the Data Sets (A - E) suggests that the female students felt that they did not have access to sufficient assistance. Apart from the many quotes above, relating to obtaining help (C & D) which support the notion that the young women felt they were not given enough support, Data Sets A and B also provide examples for this.

Responses to the question 'Did you feel that there were *adequate sources of help* available to you when you encountered a programming problem? Please explain' on the questionnaire (A), highlighted another difference in student experiences (see Table 4.2). A majority of the female students (60%) did not feel they received enough assistance, in contrast to the male students of whom the vast majority (82%) indicated that they received sufficient help.

Table 4.2: Adequate sources of help

	Female	Male	Total
Yes	6 (40 %)	18 (82 %)	24 (65 %)
No	9 (60 %)	4 (18 %)	13 (35 %)

Female comments:

tutor not on campus
tutor not helpful - hard to find
hard to get help
there is no-one around to ask
teacher based on other campus
few others around especially students
no-one available ,
tutor always available

Male comments

ample books - tutor available
tutor helpful
book good
tutor not much help

Many students commented, in both the focus group interviews (B) and individual interviews (C & D), on the difficulties of getting help:

We need more help. We have a two hour lecture followed straight away by a one hour workshop. The lecturer then disappears to another campus and you don't see him again until the following week. Even though he has given us his phone number you can't explain a programming problem over the phone. He normally comes here early on the day and is then swamped with students. The classes should be spread out over the week (B).

They [lecturers] say 'ask, ask' but when you do go and ask, you get a comment like 'But I've explained that twice already in class' (B).

It is really hard because you don't know anybody and so there is nobody to ask. In the library there is often a bunch of guys working on this stuff but I don't like asking them. I try looking up the text book but it never seems to explain the errors that I get (B).

You have so many questions and a teacher can not answer all the questions. You have such large classes. You need to be able to have a go, get stuck, then have someone who could get you unstuck and then keep going. Males just press all the buttons and don't worry (Erin-C).

The beginning of the course appeared to be particularly problematic:

At the beginning, if you don't have help you are in real trouble (B).

I was really worried at first...... There was no one to help so I would spend hours trying to solve it myself. Often it was the smallest thing, such as a missing semi-colon, and I would feel stupid for taking so long to try and fix such a small thing (B).

4.2.7 Summary of factors relating to the *Institution*

A strong theme which emerged from the data collected relating to the actual organisation of the course centred on the core business subjects. These subjects were found to be difficult and not enjoyable, considered not relevant to computing and taught differently from the computing subjects. The young women did not consider they had sufficient background for the business subjects, but perceived that other students did have prior knowledge of these subjects.

A previous knowledge in mathematics was not considered to be an advantage in computing subjects and individual work was preferred to group work. The majority of the female students liked the programming subjects, though some found it to be time-consuming.

The second major theme to emerge was that the female students perceived the male students to be more capable and more confident in computing areas. There was a general perception that the male students had natural programming ability. There was also a general consensus that the male students received more attention in class, and that the female students were made to feel inferior and inadequate by some of their peers and lecturers. In contrast to the male students, some of the young women highlighted insufficient assistance, in and out of class, as a serious problem.

4.3 Factors relating to the *Individual*

4.3.1 The Students

When gender comparisons could be made (A & E) there was no statistically significant difference in student's cultural background, educational experience, computing experience or the sources of information which students used regarding the course.

Almost half of the students from Data sets C, D and E came from families where no other family member had studied at any university. Therefore, these students did not come to university with a culture or background that included experience of tertiary education. The individual interviews (C & D) revealed that for this group, none of the young women's parents had attended university and any experience of university life came from having siblings who had previously studied, or were currently studying at a university.

It is interesting to note that those students who withdrew from the course (D) were more likely to have an Australian background and less likely to speak another language than the students as a whole. Only Lina, one (17%) of the six withdrawn students (D), spoke a language other than English at home, compared with more than 50% of each of the cohorts of the other Data Sets A - E (see Table 3.4). With the small size of Data Set D, however, this can not be considered to be conclusive.

Lina (D) and her family left her native Vietnam when Lina was in her teens. They spent a year in China, followed by three years in Hong Kong. Due to her age she was placed in Year 10 on arrival in Australia. At this time she knew only a little English. At university she struggled with subjects that required a lot of reading and comprehension such as Law and Economics. Lina left the course to tackle an Associate Diploma in Computing where she hoped her language skills would not be such an issue as she would be studying more computer subjects and less business subjects.

Continuing students (C) anticipated the following reasons could see them leave the course in the future: failing subjects (3), problems with the core (3), finances (1), not being able to get a co-op position (1), sick of studying (1), having to do programming(1); while two students could not contemplate not completing the course. Only one student cited a lack of motivation as a possible cause for future discontinuance of the course, however, a number had indicated that it was hard to stay committed. Two students indicated that they found travel a problem, but having survived half the course they felt that they would continue to cope with the travel required.

4.3.2 Sources of Information regarding the course

The 1995 cohort (E) were asked to indicate *all* sources of information that they used to find out about the Business Computing course. The most common response was the VTAC guide which was used by 84% of the students. Advice from the careers teacher was sought by 37% of the students and 15% took advantage of Victoria University of Technology's Open Day to gather information. All other sources of information were used by less than 11% of students. A few female students (but obviously no males) indicated that their attendance at a previous 'Girls in Computing Day', run by the department, had provided the necessary information. However, there was no statistically significant gender difference in the sources of information which students used regarding the course.

4.3.3 Educational background

While different percentages of students in the different Data Sets came straight from VCE, compared to those who had other educational experiences, such as TAFE, this may be due to changing government regulations on student intake.

The 1995 cohort (E) showed that the majority of students had entered the business degree straight from secondary schooling while a few had articulated into the course with a TAFE Associate Diploma. Of the students 55% had attended Government schools with a further 32% coming from the Catholic secondary system. Only 8% had previously attended Independent or private schools with the remaining students coming from overseas. Students who had transferred or articulated from other courses accounted for 29% of the overall cohort. While there appear to be slightly more students with experience other than VCE in the 1995 cohort (E), there was no significant gender difference in these results.

4.3.4 Previous computing experience

The computer background of students in Data Set A varied considerably. Of these students, who were all from the 1993 programming class, five (33%) of the female students and two (9%) of the male students had no previous computing background at all. Twelve (55%) male students had studied an Information Technology subject at Year 12 or at Associate Diploma level, yet only four (27%) of the female students had the equivalent computing background. While the figures indicate that the male students have more previous computing experience than the female students the number of students involved is too small to draw firm conclusions.

From the 1995 cohort more than half of the students had studied at least one VCE Information Technology subject. 53% had completed Information Processing and Management (the application-based subject) and 33% had studied Information Systems (the programming subject). However, there was no significant statistical difference between the computing backgrounds of the female students compared to the male students.

4.3.5 Access to computing facilities

The decreased cost of increasingly more powerful machines appears to have made home computers more accessible for students. Most of the students had access to a computer at home (A, C, D, E) during the period of their participation in the study. While slightly more males (82%) than females (73%) from Data Set A had a home computer, all interviewed students (C & D) currently had access to a computer at home. For many it was an acquisition after they had enrolled in the course with at least twelve (60%) of students not having had home access while they were completing their secondary education. Having a computer at home was now considered a necessity by the young women. Having the actual machinery (the hardware) is not the complete answer with a few of the female students indicating that they were unable to always purchase all of the programs (software) being used in different classes. While there were also no problems with access to equipment within class, a few students noted that they were unable to access machines with the software that they required outside of class time.

The first programming unit caused some frustration for those without Turbo Pascal as they felt they could not devote enough time to the subject. It was the amount of time required on the computer for this subject which encouraged a number of the young women to obtain home computers.

> *Last semester I did the computer programming subject and I was almost desperate so I kept telling my Dad; "Dad I need a computer desperately". And then he got me one to finish the year (Thuy - C).*
>
> *I wasn't able to do it at home and that affected me (Ingrid - C).*

More female students (A) experienced difficulty with gaining sufficient access to computers or printers (73% compared with 59% of the male students) at the university. While for many this proved to be an annoyance factor of not being able to have immediate access, one student did feel particularly disadvantaged:

> *I don't have a computer at home so I have to rely on doing all my work in the library. I found this extremely difficult, the library closes at 8.30 and is only open for a few hours on the weekend. I felt like I let the group down because I just wasn't able to spend the same amount of time on the assignment as the others did (B).*

4.3.6 Social relationships

Discussion of students (C & D) memories of their first few days at university produced such thoughts as 'scary', 'getting lost', 'freedom', 'boring', 'confusing' and 'liking it'. Overwhelmingly students comments centred around their knowing, or not knowing, other people:

> *Yeah it was [difficult] because you don't know anyone and you don't know where to go, so you feel a bit lost (Stephanie - C).*
>
> *Well the first day was bad because you don't usually know anyone. I don't know which building or room to go to. But then it was okay because it was different from high school. It's more interesting (Marie - C).*
>
> *I was very scared. Because I haven't a friend. It was very difficult (Chi - C).*
>
> *At first I was not sure where to go and when, and who to get help from. I didn't know anyone else in the course and it was hard to meet friends. It took time. I didn't like it then because it felt awful being alone in the cafe and not knowing who to sit next to in class (Tamara - D).*

Some of the students had the belief that they must be the only ones who did not know their fellow students. Ruth (C) declared 'I didn't know anything and I felt so left out' as she knew no-one in her course. Jane expressed similar feelings:

> *I was scared because I didn't know anyone. There were so many people and everyone else seems to know each other except you. I ended up making friends quickly and that was a relief (Jane - C).*

Many students commented on the isolation they felt and the difficulty of forming friendship groups and support networks.

> *I don't like the way everyone worked in isolation for most of the course. It has made me feel that the computer industry is just not for me. I want to work with people. Computing doesn't deal with important issues of everyday life like say, economics, which is what I hope to do (B).*
>
> *We got to pick our own group members but you feel really stupid when everyone else seems to know other people and can form a group and you get left with the others who are also left over. Its really hard working in a group with others whom you don't really know (B).*
>
> *I don't really know many people in the class. In the workshops we are all behind computers and it is very hard because you can not really discuss the issues or get to know each other. You can sort of hide behind the machine when you don't understand something (B).*

Louise (D) actively searched for paid employment during her second year of the course. None of her high school friends had gone on to university and she had made few friends at university . Money was a problem and she felt she was constantly 'broke'. Due to her parents' income she did not qualify for government assistance. Louise obtained a full-time data entry position and deferred her course. She briefly returned the following semester doing one subject part-time, but then withdrew from the course.

While both Judy (D) and Tamara (D) cited difficulty with business core subjects as their primary reason for leaving neither of these students had been able to become part of supportive peer networks and both had experienced difficulty with getting adequate help. Louise (D) spent most of her spare time with her high school friends and had not developed very close links with other students at university. A lack of peer support may have contributed to the decision by these young women to leave the course.

One discussion group (B) suggested that an alternative to the current group assignment late in the semester was to have a group assignment for the first piece of work. This might enable the students to know each other better, sooner, and then a more collaborative atmosphere might follow. Another discussion group (B) observed that it was 'easy' for the male students to meet each other because they could go and kick a football or play pool. The only possibility for the female students was in class or the cafe - which was too noisy and crowded to really meet anyone. It was suggested to the students that an orientation session at the beginning of the semester might help students to get to know one another, thus giving them the possibility of creating networks amongst themselves. However, most students did not respond favourably. One student, whose comments typified this point of view, said:

> *It's a good idea, but I would feel really apprehensive about coming. If I didn't know any one else who was coming, I probably wouldn't go (B).*

4.3.7 Self-confidence

Some students who were not school leavers and who were articulating from TAFE courses expressed their concern about whether they would be able to cope and whether they could meet the standards of a university course:

> *I feel scared the first time. I knew university was higher level than TAFE. I knew they would expect more from me and I didn't know if I would be able to fulfil [the expectations] also in the amount of work that I had to be do. I was also worried because of not only the subjects but I didn't feel comfortable because I didn't know what was required (Olive - C).*

University classes were different to what the TAFE students were familiar with:

> *The first couple of days I liked it. Later on I found that they went so fast and it was hard to catch up. At TAFE they concentrate on teaching you. In university they [go] so quick - they go so very fast (Lina - D).*

The 1993 questionnaire (A) showed the male students were much more confident about their own ability, yet this confidence was not justified by their results. With only three weeks of the semester left and much of the assessment completed almost half of the male students anticipated scores of 70% or greater in this subject. Only two of the female students (13%) felt equally confident (see Table 4.4).

Table 4.3: Anticipated results

	Female	Male
HD 80 -100	0	4
D 70 - 79	2	6
C 60 - 69	6	7
P 50 - 59	6	4
N1 40 - 49	0	0
N2 0 - 39	1	1
Total	15	22

Female comments:

- concerned about exam
- had trouble with theory
- can't do it
- don't understand much but will pass due to lots of study

Male comments:

- hard to grasp
- enjoyable
- will blitz it

The reality of results showed that the male students did not do as well as they expected with the female students performing much better than they had anticipated:

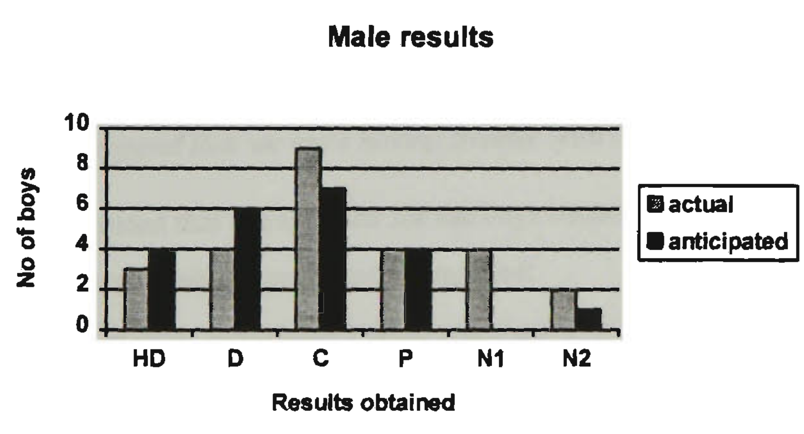


Figure 4.1: Male programming results

Female results

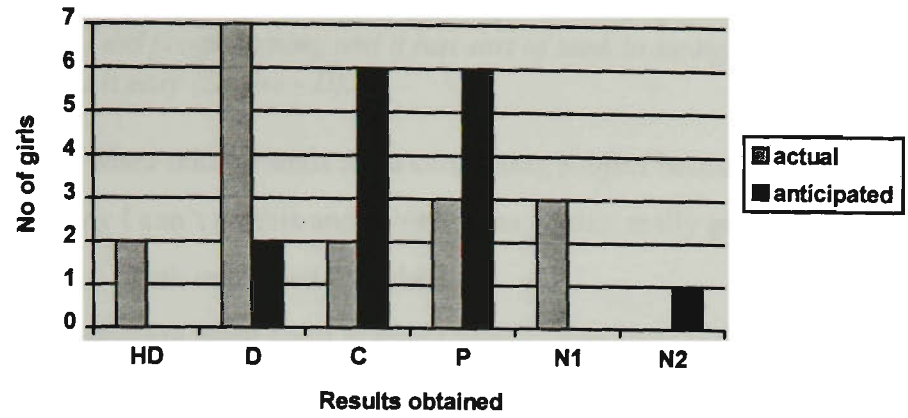


Figure 4.2: Female programming results

Nine (53%) of the 17 female students enrolled in the subject scored above 70% for their final mark. Only seven (27%) of the 26 male students had results at this level[23]. This lack of confidence by the young women in their own ability was also reflected in the question 'How do you rate your current knowledge of computers?' with 67% of the female students responding with average, or below average, compared to 46% of the males.

The focus group interviews (B) confirmed a lack of confidence amongst these students. The following was typical of the comments which arose when the topic of group or individual assignments was raised:

> *The males in our group could just do it. The two of us [girls] really struggled. They just couldn't understand that we were having trouble with it (B).*

Two other students suggested that it was easier for the boys because 'they were better at it' because 'they had more experience' while other students remarked:

> *The lecturer asks in class who doesn't understand and I'm the only one who puts up my hand - in front of all those boys - and they all turn around and look at me when the teacher says 'Oh, Susie' (B).*
>
> *That's one thing, to me boys, I don't know, boys just know everything. Somehow ..... I don't know how. It just must be our brains, we can't pick it up like boys I don't know. But a lot of guys seem to know what they are doing with computers (Kim - D).*

While a number of the young women (C, D) were confident about their own ability some expressed concern about whether they were good enough. Louise, who withdrew from the course six months after her interview, did not display any doubts about her ability during her interview:

23 As the questionnaire was anonymous it was not possible to exclude the results of those students who did not complete the questionnaire (4 males and 3 females) in these calculations.

..I did my VCE, completed that - like was successful and got a high score.... The computer, I find it easy to use, it's like maths some say it is hard, but no, it's easy..... [I could be a programmer] because I picked that up pretty easy and that was the first time I did programming and it just sort of sunk in straight away which was good. I found it easy (Louise - D).

Cathy (C) said that when other friends did a computing subject because it was compulsory to their course 'they say I can't do this and I think I can do that really good.... If you want to do something you can.' Ruth explained that she had

.... started computers when I was in about year 7. And since then I did computers every year and I was really good at it. I always finished work early, the teacher always had to give me extra work as I was ahead of every one else. So I figured I liked it, it was fun so I did it in year 11 and 12 and it sort of got a little bit more interesting so I just kept continuing (Ruth - C).

Most of the female students were not so sure of their own ability. First experiences with the computer were particularly frightening and there was a concern that through their actions they might break the machine.

It is very intimidating at first. It takes a lot of courage to turn it on. You might break it if you do something wrong, or get into an area that you don't know how to deal with. I found that intimidating for a long time (Erin - C).

A lot of people just use [computers]. I had that little bit of fear of technology - it's so advanced...I still worry about breaking it (Emma - C).

Every time something went wrong I was scared I had broken the machine. There was no one to help so I would spend hours trying to solve it myself (B).

Tamara declared she 'felt dumb' at not being able to do the work just as others expressed doubts about their ability:

I haven't got the skill [to do programming]. I need someone always constantly helping me and I need to be in a group thing. I just can't do it by myself.....I'd love to do [programming] though. But I don't think I've got the problem solving technique to do it (Heather - C).

It was very complicated. Especially the programming, I didn't understand that bit. If I'd done it at school and I knew the concept of why to program and what is programming it might have been better.....I still really don't understand it as much as I should but I got through out of necessity (Ingrid - C).

Kim (D) who left the course and transferred to the Accounting degree said

I just use computers but I don't really understand much about the things that's involved in it. I don't understand much. See, when I was in Year 11 and 12 I used computers there. I was always the last one that understood what the teacher meant in doing something. Which is probably why I have always suffered. I don't like them....At uni. [the teacher] he'll just stand at the front and he'll just like explain something on the board and we'll sit and listen and then he'll say "Okay go on , have a go and try and do it yourself", and then I think I didn't understand. I don't know what to do now (Kim - D).

It was a real awakening for some of the students when they discovered that they were not the only ones experiencing difficulty;

> *At the beginning it was hard and confusing. I thought when I started it was because of my understanding of the language that it was giving me trouble. Later on I found out that it was nothing to do with that because everyone was having the same trouble (Olive - C).*

4.3.8 Summary of factors relating to the *Individual*

Students enrolled in the Business Computing course came from a diverse range of cultural and educational backgrounds. Most students had access to a home computer. Those without, experienced difficulties gaining sufficient access to computing resources on campus.

Female students identified feelings of isolation during the early transition to tertiary life. They lacked confidence and under-valued their own ability while, in contrast, the young men over-estimated their ability. Many of the female students were intellectually intimidated by the male students who they perceived to have more ability than them.

4.4 Discussion

This analysis of the range of data collected has demonstrated that the young women entering the Business Computing course had only limited awareness as to what was involved in the course or where it could lead them. Nearly half of the female students (E) had no apparent understanding of the sort of career options the course would lead to and many had stereotyped expectations of female job options. These findings are consistent with the work of Clarke and Teague (1993a, c.1993b), Newton and Haslam (1991) and are also supported by Kramer and Lehman (1990). A contributing factor to students lack of awareness about computing careers may have been their inability to identify role-models in the computing profession. While Sanders and Galpin (1994) and Emms and Kirkup (1992) have questioned the value of role-models, other researchers (Lawrence 1984, Firkin 1984, Clarke et al 1993) support the notion that role-models are important.

The decreasing cost of ever more powerful computers appears to have made it more viable for students to own their own computers as predicted by Kay (1989). While this may help students to complete work at home, it also may place another financial burden on students. Those without access to a home machine loaded with the necessary software were disadvantaged in completing assignments.

The female students from this study identified feelings of isolation during the transition to tertiary life. The work of Gruman (1990), Sampson (1993) Clulow (1995) and Cartwright et al (1994) and others have identified the need to find ways for young women to deal with this critical time. The degree of comfort students felt about the course was affected by the extent to which they had developed social relationships and friendship networks. The importance of supportive relationships with other students in the course is confirmed by the work of Byrne (1993), Harrison (1994) and Harrington (1990). The lack of self-confidence expressed by many of the young women meant that they tended to assume that it was only themselves who were experiencing isolation, heightening their sense of being out of place.

Students were not enthusiastic about working in groups which is inconsistent with the findings of Dain (1992), Greenhill et al (1996), Hattie et al (1987), Lawrence (1984) and Marshall (1992). However, this may be due to the lack of direction students received about how to work as part of a team and the timing of when they commenced team work within the subject.

One of the most salient features to arise out of the data was the perception by many of the students that computing is a male domain. This was reflected in a number of ways. Many young women commented on how easily and confidently young men coped with computing tasks and this led to feelings of being inferior in their own capacity to relate and work with computers. There was general consensus that the male students received more attention in class, a finding corroborated by the work of Clarke (1992), Lawrence (1984), Spender (1989) and the AAUW (1992). The female students were made to feel intellectually inferior by some of their peers and lecturers, a situation also reported by Gerver (1989). In contrast to the male students, some of the young women highlighted insufficient assistance as a serious problem. A number acknowledged feeling incompetent when they requested assistance, especially from male lecturing staff.

With good intentions some of the lecturing staff appeared to be unwittingly exacerbating the problems faced by the female students. The young women just wanted to be treated as any other student; however, their perception was that they were not treated the same. Some of the lecturers reinforced the notion that female students have more difficulty with certain aspects of the course by their over compensation in their dealing with the young women. This may have resulted partly from the growing awareness within the department of the differing needs of the young women and lecturers well-intentioned attempts to be more supportive.

The interviewed students displayed a general dissatisfaction with the compulsory business subjects whilst generally being more positive about computing subjects. Students had difficulty seeing the relevance of the business core and found them to be difficult. The whole body of literature on the lack of women in computing, suggested that it would be the computing subjects which would be of concern, but this was not the case for these young women. They did not consider they had sufficient background for the business subjects, but perceived that other students did have prior knowledge of these subjects. As suggested by Clarke (1992) and Harrison (1994) this can be discouraging. A previous knowledge in mathematics was not considered by the young women to be an advantage in computing subjects. However, Martin, Staehr and Byrne (1996, p6) found a significant difference in computing results between those students who had completed a VCE Maths subject and those who had not. Whilst there is no data available on the correlation of computing and maths results, the majority of the female students liked programming though they found it to be time-consuming. However, a number of the young women indicated that though they enjoyed programming, they did not feel they were good enough at it to make it their career. In short, the young women lacked confidence and under-valued their own ability, while the young men over-estimated their ability, a finding confirmed when data comparing anticipated and actual results was examined. This agrees with the work of the AAUW (1992), Collis (1985), Hawkins (1985), Harrison (1994), Smith and Kelly (1994)and others. The lack of self-confidence of the young women was again demonstrated by a general perception that the male students were more naturally capable at programming.

In many cases the reasons given by those students who withdrew from the course did not appear to relate directly to key issues identified by those remaining in the course. However, when it was possible to probe below the surface, their motivation for leaving was not as clear as their initial justification implied. For example, Amy identified her reason for leaving as not having wanted to do computing in the first place. However, it was the morning that she 'lost' a computer assignment that she left the class and chose not to return. For those students who are feeling ambivalent towards continuing, any combination of one or more of these factors may tip the balance.

There is also a large body of research which suggests that male students are gaining more computer experience than female students (see, for example, Sutton 1991, Finlay 1994, Culley 1988, Kantrowitz 1994). In this case, however, there was no statistically significant difference in the *amount* of student's previous computing experience shown in Data Set E. Yet the *type* of previous experience that students are acquiring may still be very different. The majority of the female students did not find playing computer games appealing. The literature offers a wide variety of reasons for this lack of interest by girls in computer games (Hattie & Fitzgerald 1987, Lockheed 1985, Gerver 1989, Morse 1995, Huff & Cooper 1987, Sutton 1991). Kiesler, Sproull and Eccles (1985) argue that there is a relationship between playing games and serious computing. It was apparent that the young women in this study were not spending time 'experimenting' or 'tinkering' with computers. Indeed, some seemed to be quite fearful of inadvertently damaging the equipment, indicating a lack of familiarity with the hardware and software. This may be contributing to the lack of confidence many of these young women displayed.

CHAPTER 5 -

THE VALUE OF MICRONET

5.1 The Evolution of MicroNet

The establishment of a peer mentor scheme was considered to be the most appropriate mechanism for dealing with the range of factors which seemed to be most significant in affecting young women's experience of the course by providing additional assistance, overcoming the isolation factor and increasing students' self confidence in a 'female' friendly environment. The role of the mentor scheme was later broadened to raise students' awareness of possible career outcomes of the course.

As a result of the initial questionnaire (A) and focus group interviews (B) a peer mentor scheme was established in 1994. With the assistance of a grant from the Equity and Social Justice Unit, the scheme, called MicroNet, was designed specifically to assist the female computing students in making the transition to university life and to provide a support network for the duration of their studies. In 1994 students enrolled directly into the Business Computing degree rather than a common first year, so it was possible to monitor continuance of students at all stages of the course. Though students went directly into the course of their choosing they still had to undertake the common core of business subjects. The Business Computing department chose to provide students with two computing subjects in their first year in addition to six business core subjects. Due to the nature of the timetable, students often found that they had different class mates in every subject. Throughout the next 3 years participating MicroNet students were monitored, interviewed and their progress tracked.

Commencing female students, if they expressed interest to be involved in the program, were placed in small groups with second or third year female students. This gave the new students the opportunity to interact with, and get assistance from, other students who had been through similar experiences. Meetings for the groups were allocated time and space and encouraged to take place on a weekly basis. At least three times a semester the whole group would meet to discuss an area of common interest. Two computers were set aside exclusively for the MicroNet students allowing them access to electronic mail to contact their mentors, class mates and teaching staff. This greatly enhanced communication amongst the students and gave them exclusive use of alternative computing facilities for assignment work.

5.1.1 Establishing MicroNet -1994

Of the three campuses, the St Albans campus is by far the largest. Students from the Melton and Werribee campus transfer to St Albans after one year. The two outer campuses are smaller and students are much more likely to find themselves with the same group of students in other classes. For practical reasons it was impossible to run the mentor scheme on all three campuses and, consequently, the mentor scheme was established at St Albans where it was hoped it would have the greatest effect. As students transferred from the outer campuses in subsequent years they were encouraged to join the program. No comparison of withdrawal statistics can be made between the campuses as too many uncontrollable variables exist (such as proximity to public transport, differing characteristics of large and smaller campuses, the nature of a feeder campus).

In 1994 over the three campuses a total of 147 students commenced the Bachelor of Business Computing with 69 of these commencing their studies at the St Albans campus. Amongst the St Albans cohort there were 30 female students and, of these, 14 students were articulating from other computing courses. From the literature it was concluded that the students most at risk would be the full-time young women who were new to tertiary studies, and, consequently, 16 students became the target group. Continuing female students were contacted by mail to act as mentors (28 students were identified as potential mentors). From the mail-out 12 students indicated a willingness to participate. A training and information session was held with 10 students attending. The new female students were also invited by mail to participate. After a period of two weeks with no replies, individual students were phoned with several positive responses. It became clear that it would require a more personal invitation. At the end of a first year computing lecture the female students were asked to remain behind so that the program could be explained. It was clear that the students were far more enthusiastic about joining when they became aware that other students were also struggling, confused or worried about computing.

There were still difficulties to be overcome in contacting and arranging meeting times as well as a suitable venue. It took until week 5 of the first semester to call the first meeting because of the difficulty in contacting students. At that meeting 10 mentors and 10 first year students came along. Due to the difficulty of matching unknown students on a one-to-one basis the students were arranged into small groups. Some group-building activities were performed and the young women left with the names and phone numbers of all their other group members. The small groups were asked to meet at least once a week. Two more meetings for the whole group were arranged for semester 1 and input from the students as to the structure and content of these meetings was sought. In semester 2 another three whole group meetings occurred. A small area was set up for the young women to use where they could meet. It was recognised that there was a need for the students to be able to communicate easily with each other and email seemed the obvious choice. Two computers were set up in the meeting area and by week 10 most students had an email account and were using the system. The computers were also there for students to use to do assignments. These machines were password protected so only MicroNet girls had access. Email was also used to communicate 'survival' information, get progress reports (G) back from students as well as enabling students to request assistance with an enormous variety of issues.

Formal Meetings

When the group met as a whole, group-building activities, training sessions and other activities were organised. Most of the topics for the information sessions came from the young women themselves. In 1994 the sessions covered topics such as:

- introduction to the university - student services, student union, student administration
- email training
- course information and subject selection
- co-operative education
- tinkering with the hardware
- exam techniques
- motivation
- information about the Australian Computer Society and its careers day.

Ten of the MicroNet students also participated as junior facilitators for the annual 'Girls in Computing day' which the department runs for local secondary girls.

Difficulties

A number of difficulties were encountered throughout the year:

- It was not possible to know until the second week of semester who the new students would be. This made early contact very difficult.
- There were many difficulties in contacting students - wrong numbers, students not there, messages not getting through etc.
- Identifying students from the student administration system was extremely difficult and time consuming.
- A semester is very short -13 weeks duration - so planning pressures were great.
- There was resistance from some staff members of the department. They were concerned that the focus was only on the female students for this program. The choice of a name, MicroNet, was a deliberate attempt to disguise what the scheme was about.

- Timetabling in second semester, in particular, was a problem. It was impossible to find a common time when all the students could meet. At most 16 students had a common time available.
- It took considerable time for the Information Technology Department to establish the email system. As new students joined it would take them several weeks to organise email addresses.
- By second semester the computers provide for MicroNet did not have the necessary software for completion of some student assignments nor was it possible to quickly and cheaply obtain what was required.
- Some groups and group leaders were not as enthusiastic as others, so did not provide the same level of support.

5.1.2 MicroNet - 1995

A much more successful approach was used to inform new students of the existence of MicroNet in 1995. On enrolment day all Business Computing students (on all three campuses) were requested to complete a questionnaire (E). In total 123 students out of a possible 162 (76%) returned the form. It was possible to contact many of the female students prior to the start of the semester and invite them to an orientation day as it was now not necessary for all the information to be gleaned from the student administration system. While the student union was also running orientation sessions these were common to all students rather than focusing on a small subset such as female Business Computing students.

The aim of the proposed orientation day was not only to provide orientation activities but also to hear at first hand the experiences of former students before and after graduation. It would also enable female students to start recognising other female students in this particular course and to give them networking opportunities. All new female students, including those transferring from the outer campuses were phoned and invited to participate. Students articulating from other computing courses were also encouraged to participate. A total of 34 students participated in the day including some current MicroNet members. Students were taken through a series of tasks designed to familiarise them with each other, some of the staff, the physical location of key points, student services and general university life and course information (see Appendices 6 & 7). A fourth year student discussed her co-operative education year and the type of work involved in her position. An ex-student also spoke to the group about her experiences of the course, in the workforce and the computer industry. At the conclusion of the day, the MicroNet program was explained (prior to this no mention had been made about the all-female nature of the day) and students were invited to join. All of the new students signed up. The evaluation at the end of the day (H) indicated that all the students found it a very successful and worthwhile day.

Raising awareness of possible career outcomes

The role of the mentor scheme, MicroNet, was broadened in 1995 and used as a vehicle for challenging students' perceptions of the range of possible Information Technology careers available. Workshops were held on possible career outcomes;

- An evening forum was held with past students speaking about their career paths since completing the course. One past student's opening comments about the course were;

  I hated the course at first. I felt intimidated by computers and didn't know why I had selected the course. I didn't know where the course would lead to. I bought my own computer and began to feel comfortable and familiar with it.

- A session was spent looking at employment advertisements of a major newspaper; what the jargon meant, what type of jobs they could apply for on graduation and those jobs they could aspire to with some experience.
- The Departmental Co-operative Representative spoke to the students about where she had placed Business Computing students and the sort of work done by these students during their placement. Students who had undertaken the program spoke of their experiences.
- An experienced and successful Business woman ran a workshop on workplace etiquette.
- The University's Careers Officer helped students explore career options and ran additional sessions on the techniques of application letters and resume writing.
- A workshop was run on motivation and long term goal setting.

Members of MicroNet were again provided with email accounts in 1995. This enabled communication of all industry recruitment visits, thereby creating greater awareness amongst the students of job descriptions as well as being valuable for final-year students looking for job opportunities. Students were also encouraged to attend the Australia Computer Society's Tertiary Careers evening. Another ten of the MicroNet students participated as junior facilitators for the annual 'Girls in Computing day'. A session was also run on 'exam anxiety'.

Difficulties

While a number of the difficulties of 1994, such as establishing contact, were overcome by new strategies a number of other difficulties similar to those experienced in 1994 were encountered throughout this year:

- Timetabling continued to be a problem with it being impossible to find a common time when all the students could meet.
- It again took considerable time for the Information Technology department to establish the email system. The Business Computing department also began to issue email accounts to all

students in their first computing unit. As a result, email accounts and Internet access, which had in the previous year been a privilege for MicroNet students only, were no longer a special privilege.

- The computers provided for the MicroNet students did not have the necessary software for completion of some student assignments nor was it possible to obtain all that was required.
- Once again some groups and group leaders were not as enthusiastic as others, so did not provide the same level of support.

5.1.3 MicroNet - 1996

It was recognised by members of the Business Computing department that not just female students, but all new students, could benefit from an orientation day run by the department. Furthermore, all commencing students could be assisted by participating in a mentor scheme. Consequently, the department ran an orientation day on all campuses for the 1996 cohort and immediately assigned each student to an academic mentor. In their first computing unit all students were also given access to email and the Internet. As a result, the strategies used to inform and encourage female students to participate in MicroNet in 1995 were not able to be repeated for the 1996 cohort.

Each commencing and transferring female student at the St Albans campus was phoned and invited to remain behind for afternoon tea on the day of orientation. This approach proved to have limited success with only one third of the new female students attending this session compared to the majority of the young women in the previous year. Those who did join MicroNet were not enthusiastic to be part of another mentor scheme and, consequently, the group reluctantly lost this role, becoming more of a peer support and information network. MicroNet continued to provide group information sessions and networking opportunities, but small groups were no longer fostered.

Difficulties

With the department providing orientation, mentors and email facilities to all of the 1996 cohort many female students did not see the need to join the program. Finding a common time for the whole group meetings continued to be difficult. One of the two MicroNet computers was re-allocated elsewhere with the remaining computer rapidly becoming superseded. Budget concerns throughout the University stopped the upgrading of the remaining machine.

5.2 The Value of MicroNet

> *Don't treat us differently - don't call on us more or less often - don't assume we're all experts on feminism if we are the only woman in the section (Derek Bok Center for Teaching and Learning 1994, p2).*

5.2.1 The MicroNet Experience

MicroNet was evaluated through small group interviews (F) and written progress reports (G). The orientation day, held as part of the intervention program at the beginning of 1995, was evaluated by a written questionnaire (H). Another measure used to evaluate the program was the participation of female students in MicroNet and whether they signed up for the following year. Most of the young women maintained their association with MicroNet, which would suggest it has been a success, and evidence from the Data Sets (F, G, H) supports this.

While the creation of MicroNet was of little interest to some of the young women in the course,

> *No thanks. For me I have no problems because I will not tolerate any mistreatment. In fact, in one group assignment, the guys actually had to do what I told them to do (Phone conversation with a second year female student).*

others were very enthusiastic about its introduction:

> *When I heard 'support group' I was thrilled. I said 'Oh yes this is what I need'. I knew that if I needed help especially in an all female environment [I could ask]....If it was males [as well] I probably wouldn't speak out as much. I do get intimidated a bit (F).*

One second year student who was approached to be a mentor for the program was reluctant to do so but then asked if she could join as a mentee. Another student joined MicroNet when she heard that email access was provided. This young woman wanted access to IRC (International Relay Chat) since a friend of hers had met her fiance this way: 'I've joined MicroNet because I want to get married too!'. She soon discovered that she was *not* able to use IRC via the email system available, however, she become an active member of the program when she discovered the program's other benefits.

One benefit that almost all of the young women saw in being part of MicroNet was the opportunity to meet people. Under the 'advantages of the program' almost 90% of the progress reports (G) included comments such as 'made new friends', 'meeting girls that are actually doing computing', 'getting to know others in the course' with similar sentiments expressed from Data Sets F and H.

> *If I need help I can go to friends I met in MicroNet. I have got some other friends but they don't do computing (G).*

MicroNet and the management class have been very helpful. The teacher in that class forced everyone to introduce themselves, to walk around the room and know each others names and backgrounds. MicroNet has been very useful, very very useful. I find it very good because we ...get to know the other girls and get to know things (F).

It was great being able to meet female computer students so that you can recognise a familiar face among a sea of strangers (H).

Great way to meet people and discuss problems/difficulties faced by students (G).

Knowing other students allowed the young women to recognise that they were not the only ones feeling worried or uncertain:

Before MicroNet ...I was worrying you know like 'Oh my God, I feel so stupid' and you know, I don't know what to do, I feel so nervous but after I got into MicroNet I meet a lot of friends and I think everyone is nervous. Everyone is the same, even if they are bold. I feel more confident. Like you are not the only one (F).

Advantages are the meeting of people. It's been really great to get to know quite a few people. I am a new student and it was nice to meet other students who had the same worries as myself (H).

Being part of MicroNet means you don't feel you are the only one in trouble and worrying about the exam (G).

Knowing other people also meant that the young women could help each other. Comments such as 'Being able to ask for help' appeared on almost all of the progress reports and similar views were expressed by the participants of the group interviews (F):

It's been really helpful in terms of looking for help. You are free to ask questions to members if you cannot turn to anyone else. You are not limited to meeting one [year level] of student. In MicroNet you meet 1st year to 3rd year students. So everyone can help one another (F).

The girls would help and they don't tell you that you are dumb. If you ask for help from the boys they would go out later and tell the others you are dumb (F).

If I don't know I ask the girls first [from MicroNet] then if we, as a group, don't know then we go to the boys (F).

One student indicated that she already had developed her own support network;

By the time I joined MicroNet I had made a couple of friends in my course and [they could help me] because they had done it a couple of years back.

One young woman declared that she found MicroNet to be 'Non-intimidating, open environment where you are not afraid to speak up or be ridiculed' (G). The students appreciated the support they got from each other and the staff involved. A few of the progress reports explicitly mentioned that student's involvement in MicroNet had been good for their confidence and self-esteem.

While a number of the mentors had expressed their pleasure at 'being able to help other computing students' (G) and

> *...I think it has been good to be able to encourage someone to stay at university because I think it is hard work, it is worth it in the end. Most people are capable of university, it is just that the morale needs boosting occasionally when things get tough. We can show them that people do survive first year (F).*

some mentors felt out of place:

> *Our mentees were not technically first years as they have done a TAFE course and have done subjects that we are struggling through! It just makes me feel out of place particularly when I'm 18 and my mentees are 20! (F).*

The information sessions were seen as a strength of the program by both the mentors and mentees because as one young women explained, they 'provide information on topics that I have not got the time to find myself'(G). An advantage of MicroNet was listed as:

> *Getting valuable information from attending the sessions (G).*
>
> *Getting more knowledge about computer technology and information about the course and careers (G).*
>
> *Being aware of what is available to students at Victoria University of Technology (G).*

The majority of the young women found that the information sessions which centred around careers were the most valuable:

> *I believe the co-op session [was best] because it was interesting and it allowed me to see what needed to be achieved to be a successful applicant for co-op; which is something that I think is essential to have (F).*
>
> *Careers session and evening were the best. When I started, I thought computing was programming, programming and programming. However, now I know that there are many opportunities and you don't need a lot of technical experience for many of the jobs. You need to be a quick thinker and good communicator (F).*
>
> *Careers session - I had no idea that this sort of information was available to me (G).*
>
> *The Career session - It cleared up a lot of questions about IT that were starting to haunt me so I'm relieved in a sense. I was beginning to wonder whether programming skills were needed to make it anywhere in IT but when I heard one of the speakers say he's not interested in programming I felt relieved (F).*

However, having made students more aware of the range of possibilities created problems for one student who declared; 'I still don't know what I will do. When the door is too wide you just don't know where to go'(F).

Initially, comments about the access to the two computers provided exclusively for MicroNet members were positive; 'very convenient', 'real advantage', 'great to be able to use' , 'wonderful to have computers at our disposal'(G). Predictably these computers soon became the target for suggestions for improvements; 'Computers should have more programs so that the second and third year students can use them to do the assignments' (F). The email was considered a real privilege and very favourably received; 'It's great in that it helps me to get in touch with my friends'(G) but 'It took months before it was up and running' (G).

There were also difficulties. The most common concern students had with the program centred around time; 'meeting times don't fit my timetable', 'unable to find a suitable time to meet', 'not being able to attend meetings due to work commitments', 'time clashes', 'trying to fit the meeting in between lectures tutes and assignments was difficult'(G).

It was obvious in 1996 that only a few of the first year students had joined the program, yet most of the previous participants had re-joined. The loss of the opportunity to have a separate orientation day was a key factor. MicroNet students suggested that in 1997, MicroNet be promoted as a *group* rather than as a mentor program 'as the mentor-mentee thing can be off-putting and they may think I don't need it'(G). Other suggestions for improving the program included 'more information sessions', 'more social gatherings', ' help us learn about the technical terms', 'encourage big group rather than smaller groups' and 'graduation -what do we do now?'(G).

One young woman spoke of her experience of programming during a group interview;

> *When we did programming I really enjoyed it. Because I am not a smart person as such, I don't get top marks...but the others they just made me feel dumb. I heard them say "that group will only get good marks because of Tim and Jo". That made us feel dumb. This is why I didn't go on with programming. I loved it. It was the one subject I put hours into (F).*

This student was very disillusioned and spoke repeatedly about leaving the course. However, with much encouragement and support she successfully completed more programming units and has recently graduated from the course. The day after her exams were completed she commenced her first full-time job - as a programmer! Two other students also suggested that they were still in the course because of the support of MicroNet;

> *I was ready to quit. I feel I am not alone now and I'm not going to quit (G).*

> *I really didn't know where I was going or whether I should be here at all. MicroNet has given me the encouragement to keep going. I will be finished soon and I am so pleased that I stuck it out. Thank you! (G)*

Students sought individual help with a range of concerns:

- motivation
- ACS membership
- special consideration applications
- young achievers award
- subject selection
- assignment work
- personal matters
- references
- concurrent support
- careers / other course information and
- a new topic that they had heard about and felt they should know more about (client/server)

5.2.2 The Class of 1994

There were two changes which had a bearing on enrolments in the Business Computing degree at the commencement of 1994; students enrolled directly into the course rather than a generic common year and one of the selection criteria was altered by DEET. A directive from DEET indicated that at least 65% of the enrolments had to be 'school leavers' - those students who, in 1993, had completed their VCE or had completed the first year of a TAFE course. Consequently there were more school leavers amongst the new enrolments than ever before and students were able to select the Business Computing stream from the outset. A total of 147 students enrolled for the first time in the course (full-time or part-time) during the year. Of these students, 60 were young women, comprising 40.8% of the total new enrolments.

At the end of November 1996, of the 147 commencing students, only 84 (57.2%) remained enrolled in the course, or had already graduated [24] (see Table 5.1). A slightly higher percentage of female students (60%) were still in the course, than male students (55.1%). More female students had withdrawn from the course (23.3%) than male students (20.7%) however, the discrepancy between these rates was not as high as in previous years. Many more male students had been excluded from the course (16.1%) compared with the young women in the course (6.7%).

[24] It is assumed that all students on Leave of Absence will return to their studies and are counted as continuing students.

Table 5.1: 1994 Cohort

	Male (N = 87)			Female (N = 60)			Total (N = 147)		
	No.	%		No.	%		No	%	
Withdrawn	18	20.7%	44.8%	14	23.3%	40.0%	32	21.8%	42.8%
Transferred	7	8.0%		6	10.0%		13	8.8%	
Excluded	14	16.1%		4	6.7%		18	12.2%	
Leave of Absence	10	11.5%	55.1%	4	6.7%	60.0%	14	9.5%	57.2%
Graduated	10	11.5%		12	20.0%		22	15.0%	
Should Graduate[25]	5	5.7%		2	3.3%		7	4.8%	
Continuing	23	26.4%		18	30.0%		41	27.9%	

There are many reasons why a student who enrolled in the course does not graduate after three years. A 1994 student who maintained a full-time load, successfully completed all subjects and did not opt to undertake a year of co-operative education could be expected to graduate at the end of 1996. A student who had first enrolled in the course in 1994 but had advanced standing from a previous course, could have graduated prior to 1996. Students who took either six or twelve months leave of absence would need to add the required time to their course on return to studying. Some students may not graduate from the course at all, either by formally leaving the course before completing it or by being excluded. A student could be excluded from the course for failing to make satisfactory academic progress, or failing to attend classes and having neglected to withdraw from the course.

Of the students who formally withdrew from the Business Computing course, the majority did so in the first year. Over the three-year period just over one fifth of the cohort (32 students) withdrew from the course with 20 of these students making this decision during the first year. Of the 13 students who transferred to other courses, 6 did so during the first year, 6 during the second year and 1 in the third year. This is consistent with attrition research (Upcraft & Gardner 1990; Tinto 1987; Noel et al 1987) which indicates that the first year of any course is a critical time for students.

Of the 60 female students who enrolled in 1994, one third became involved with MicroNet. Of these, 90% were still enrolled or had graduated by the end of November 1996. In comparison, only 45% of those female students who did not participate in MicroNet were still enrolled (see

25 These statistics were compiled in November 1996 so semester 2 final results were not yet available. However, from their previous results, these students were on track to graduate.

Table 5.2) and compared to 57.2% of the entire cohort. While it is likely that MicroNet played a significant role in this result it should be noted that other factors may have contributed to the high retention rate of MicroNet students. Even though all of the young women in the course were encouraged to join the scheme, participation was voluntary and the students who chose to partake may have been more committed to the course in the first place. There were also more female students enrolled in this year than in any before (40.8%) which would lead to more natural support and networking opportunities for the students and this may also have been a contributing factor. The higher retention rate suggests that MicroNet did have a positive effect in influencing young women to continue with the course and that it did seem to fulfil a function for those students who joined it. The nature of the MicroNet program best catered for those students who were academically capable but may have been lacking in confidence, struggling with transition issues or a lacking a sense of future direction.

Table 5.2: 1994 Female Students

	MicroNet (N = 20)			Non-MicroNet (N =40)		
	No.	%		No.	%	
Withdrawn	1	5.0%		13	32.5%	
Transferred	1	5.0%	10.0%	5	12.5%	55.0%
Excluded	0	0.0%		4	10.0%	
Leave of Absence	0	0.0%		4	10.0%	
Graduated	4	20.0%		8	20.0%	
Should Graduate	1	5.0%	90.0%	1	2.5%	45.0%
Continuing	13	65.0%		5	12.5%	

During the collection of these statistics on Business Computing enrolments it was noted that the number of students who failed individual subjects was staggering. The University has a policy of converting all late subject withdrawals to an N2 - fail. While this policy may be making the situation appear worse than it actually is, it was noted that after two years of academic study only 17 students out of the 1994 cohort (11.6%) had not failed *any* subject. While outside of the scope of this study, it is an area which requires further investigation.

For reasons to do with the Student Administration Department at Victoria University of Technology, which were beyond the control of the researcher, comparison statistics could not be obtained for the entire population of students enrolled in the Business Computing course during this time frame (1994 -1996).

5.3 Discussion

Much of the literature on peer mentor schemes describes such schemes as a strategy for the retention of female students, but does not evaluate the effectiveness of the strategy (see for example, Clulow 1995; Gruman 1990; Johnson 1990). Though offering different types of peer mentor schemes, both Gibson and Hartnett (1993) and Martin and Turner (1996) report a number of positive benefits for students involved with such programs. Cartwright and Colville (1995) also report advantages for students in their mentor scheme, while suggesting refinements to enable the female students to obtain greater benefits. The peer mentor scheme in this study, MicroNet, has been in operation for three years. Based on student feed-back and the higher retention rate for MicroNet students, it has been valuable for those women in the Business Computing course who joined the program. MicroNet was designed to specifically address the issues of concern to young women in the course by emphasising the building of self-esteem and confidence, overcoming transition issues, and by providing a supportive network and information with a computing career focus.

Student participation in the program was voluntary and, consequently, varying proportions of each new cohort of students have chosen to participate. The students who chose to participate in the program may have been more committed and enthusiastic about the course then those who elected not to be involved. Indeed, it is possible that the students who did not participate may actually be the ones most in need of such a scheme. In 1996 the department began to implement strategies for all students which duplicated some of the MicroNet activities. Doing so appears to have negatively impacted on the strategies' success for female students compared to when they were just focused on the young women. Incentives which encouraged the young women to join the program in 1994 and 1995 have become mainstream. All Business Computing students now have access to email and the Internet. An orientation program is run for all first-year enrolments and all students are assigned an academic mentor at the commencement of their course. It was these initial incentives that encouraged some of the young women to join the program. In 1996 with fewer exclusive benefits to offer, there was a drop in the number of first-year female students who participated in MicroNet. By mainstreaming the initiatives the department unwittingly detracted from what MicroNet was trying to do.

MicroNet may have been less attractive to the young women in the 1996 cohort, not just due to the loss of incentives to join, but the students themselves may also have had less need of such a scheme. Throughout Australia most fields of study where female students comprised less than half of the enrolments in 1983 have shown a steady increase in female participation over the past ten years (Data Matters, 1995). This indicates that societal attitudes may be changing towards non-traditional areas of study for women. Certainly the enrolments in the Business Computing course by young women have steadily improved over the three-year period (see Table 5.3) thereby altering the balance of the female-male ratio.

Table 5.3: Female Undergraduate Students 1994-1996

	1994	1995	1996
New enrolments	40.8%	46.9%	48.1%

In addition to the national trend of increasing female participation in tertiary study, there have also been some influences specific to Victoria. The implementation of the VCE in 1992 saw the establishment of three new studies under the umbrella of Information Technology. Student enrolment in these studies have grown markedly[26]. With more young women studying IT at secondary level it is reasonable to assume that tertiary enrolments would see a similar flow on. Not only would the proportion of women increase, but so too would the proportion of women with prior experience in computing. These factors may have offset the feeling of gender isolation and lack of computing confidence that was present with the initial MicroNet intake. Hence recent students may not have felt the same need to seek support. If this is so, it contrasts to a suggestion in the literature that the introduction of computers into secondary schools has actually resulted in a decrease in the number of women in Computer Science courses (Lang, reported in Maslen 1996).

From the descriptive research it is clear that some of the students who had withdrawn from the course in the past had attributed their withdrawal to reasons other than those directly related to their experience of the course (eg; not their preferred course, full-time employment). The reasons given did not necessarily overlap with the factors identified which were of concern to many of the young women presently in the course. However, in a number of cases it does appear that some of these other factors influenced the final outcome. For some of the women who withdrew it appears that not being committed to the course *and* a combination of other factors resulted in their leaving. Consequently, it is the interaction of a range of factors which contribute to particular outcomes. However, a student who is less clear about their commitment to the Business Computing course may also not be prepared to participate in a scheme such as MicroNet and thus may not benefit from the support it was demonstrably able to provide.

[26] For example, of the approximate 55000 students undertaking VCE unit 1 subjects in 1996, 20600 students were studying Information Technology 1 thereby making it the 4th largest subject of the 80+ possible subjects (Houghton, 1996). Female students represent 46% of the students in IT courses at school in 1996 (Lang, reported in Maslen 1996).

Through constant monitoring, evaluation and refinement, the program has undergone numerous changes since 1994. MicroNet will have to evolve, adapt and change to enable it to continue to be relevant and valuable for each new cohort of female students. In order to maximise the outcomes for students the program requires increased support from the department. Allocation of staff and provision of appropriate computing resources will enable MicroNet to function more effectively. Forward planning to ensure a clash-free time-slot is available for meetings will resolve many of the difficulties that were experienced in recent years. However, such an intervention program will struggle to survive if it relies on only a few enthusiastic individuals who want to provide a supportive environment for young women.

CHAPTER 6 -

CONCLUDING REFLECTIONS

> *It is a fact that children in economically advantaged countries are on the whole accustomed to having computers in their homes and schools, and girls and boys alike are confident using them as both learning tools and for entertainment. Many of the next adult generation won't be burdened with a lack of knowledge and understanding of computer technology and many of the experts...will be women (Senjen and Guthrey 1996, p21).*

Senjen and Guthrey envisage a future where women will be as knowledgeable about computer technology as men. Yet this research highlights that computer technology still has the power to intimidate women. While the intake into the Business Computing degree is approaching equity in terms of gender, work still needs to be undertaken to *ensure* equity of outcomes.

Female students in the Business Computing course (C, D) needed to be able to overcome a feeling of isolation and required support and encouragement to raise their self esteem. None of the young women were able to identify with any person working as a computer professional and there was a notable difference in vocational aspirations between the male and female students. The female students had poorer, and in some cases, erroneous perceptions of likely course outcomes. The young women perceived the computing environment to be a male domain and many felt inferior in their ability to work with computers compared to their male peers. There was a general dissatisfaction with the core business subjects for which many of the female students felt they were ill-prepared. Another factor for some students was that without access to a home computer and appropriate software they were disadvantaged in completing their work. Although programming was a subject which was enjoyed by many of the young women only a few felt that they would be 'good enough' to ultimately make it their career. Students' lack of confidence and under-valuing of their own ability was a consistent theme throughout the study.

It is evident that a complex array of factors interact to produce the experiences and outcomes for young women in the course. For each student a particular combination of these factors will produce different outcomes. Those students who left the course attributed their leaving to situational or motivational reasons, yet, there is some evidence which suggests that many experienced the same difficulties that are highlighted above. In most cases it appears that it was the combination of factors which lead to the students' withdrawal.

Strategies implemented to re-dress the complex range of factors which affected student experiences in the course and, ultimately, the outcomes, included the establishment of a peer support network. For the young women in the course, with their perception that the classroom was a male domain, MicroNet was valuable in creating a 'female-friendly' space. The peer support network played an additional role by profiling successful women and disseminating accurate and relevant vocational information.

MicroNet was successful for the young women who participated because it was developed to focus on the issues which the research indicated were of importance to the women. It used the experiences of these particular women as the starting point and it specifically addressed the issues that were of concern to them. It was refined to continue to meet their needs. Like any such program there were a number of logistical issues which were difficult to overcome, such as finding a free timeslot in which to run the scheme. It was also time-consuming to establish the peer support group and equally time-consuming to keep it running. There was resistance from some members of the department who were concerned that the focus of the program was only on women. Some lecturers would argue that the young women did not have a problem based on their previous experience targeting a small number of high achieving females. Another problem with the scheme was the reluctance by some young women to join. In fact, those who may need support most may be least likely to participate voluntarily. Being uncommitted to the course, not wanting to be labelled as needing help, or labelled as a 'feminist' discouraged some from participating.

One of the unique characteristics of the computing industry is rapid change. Computers are becoming increasingly more powerful, faster, cheaper and smaller. There are also continuing changes to many of the factors which affect students and their chosen courses, for example;

- In 1997 a much greater HECS fee will be charged which has already discouraged many mature age women from applying for courses (Messina 1996).
- The Business Computing Department at Victoria University of Technology has undergone a name change in 1996. In future it will be known as the Information Systems Department and offer an Information Systems degree.
- The first programming language has been changed from a procedurally based language to visual programming which may be more female-friendly (Smith & Kelly 1994).

Exactly how these particular changes will affect female students applying for the Business Computing course or in persisting with their studies remains to be seen. The very nature of Information Technology education means that the environment in which students learn and the factors which affect them are changing all the time. Peoples' experiences and attitudes are changing, so future intervention strategies will need to be appropriate to the time, situation and the context.

The literature suggests that there are two different approaches to the issue of gender and computing; the '*women in* technology' approach which expects change to come from equal access to education and employment and, the 'women in *technology*' approach which focuses on the nature of technological work and its environment. This study indicates that access to the opportunity of education is not enough. Making what was perceived to be a male environment more friendly by giving an alternative support mechanism did have an impact. While this has not changed the computing industry, it has made change at a lower level in the capacity of young women to cope and support each other in what they perceived as a male domain. Changes in young women's needs over time suggest that the genderedness of the domain is changing as the percentage of young women increase. Examples from other cultures indicate clearly that the societal and cultural context is responsible for the gendered nature of computing and, therefore, that it can change as this context changes. But at this time in our society it is clear that without such intervention strategies too many women will not become computer professionals. It is only with increasing the proportion of women in the computer industry that changes can be made regarding the nature of the work itself.

In this study no research was able to be undertaken to examine student's comparative performance in computing subjects to other subjects and this issue warrants further research. Students in this study perceived their computing subjects positively relative to a core of business subjects and it would be valuable to investigate their relative performance in the business core and in computing / information systems in comparison to other Bachelor of Business students.

Another area that also would seem to warrant further investigation is that of computer games. The female students in this study did not express much interest in playing such games and some had in fact never played any computer games. How do users learn to relate to computers in a non-fearful way? What is the role of computer games in socialising students into feeling comfortable with using computers? Can computer games be devised which are appealing to young women or do alternative mechanisms need to be found which will allow women to find computers less intimidating?

This study also highlights the necessity for accurate careers education. The outcomes of Information Technology courses need to be made more visible and understandable for students. As Careers Counsellors are a frequent primary source for information for students they need to be made aware of the breath of computer careers available and the changing opportunities within the computer industry. They also need to be aware of the perceptions students might have of computing careers in order to be able to accurately advise the students.

Changing attitudes and increasing awareness of the difficulties women face in any non-traditional area is a long term process. There is no quick and easy solution to the problem of student retention and it would be unrealistic to expect that one study would have a dramatic impact. However, this project makes a significant contribution to redressing the imbalance of women in computing in one course and provides a valuable insight into some of the more generic factors linked to student success in tertiary education.

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1992-95 VCE ENROLMENTS FOR SELECTED STUDIES

	Unit No.	1995 Total Females	1995 Female %	1995 Total Males	1995 Male %	1995 Total Enrolments	1994 Total Females	1994 Female %	1994 Total Males	1994 Male %	1994 Total Enrolments
Information Technology 1	1	9555	47	10823	53	20378	9160	47	10218	53	19378
Information Technology 2	2	9179	47	10467	53	19646	8700	47	9643	53	18343
Information Processing & Management 3	3	6190	50	6124	50	12314	5848	53	5288	47	11136
Information Processing & Management 4	4	5964	51	5836	49	11800	5532	53	4928	47	10460
Information Systems 3	3	197	12	1483	88	1680	246	18	1087	82	1333
Information Systems 4	4	191	12	1431	88	1622	237	18	1045	82	1282
Information Technology in Society 3	3	206	62	124	38	330	206	68	98	32	304
Information Technology in Society 4	4	190	62	115	38	305	200	69	91	31	291

	Unit No.	1993 Total Females	1993 Female %	1993 Total Males	1993 Male %	1993 Total Enrolments	1992 Total Females	1992 Female %	1992 Total Males	1992 Male %	1992 Total Enrolments
Information Technology 1	1	8975	49	9498	51	18473	7494	50	7531	50	15025
Information Technology 2	2	8570	49	8848	51	17418	7346	50	7375	50	14721
Information Processing & Management 3	3	5157	53	4627	47	9784	5064	56	4055	44	9119
Information Processing & management 4	4	4885	53	4284	47	9169	4764	56	3754	44	8518
Information Systems 3	3	340	22	1208	78	1548	422	25	1271	75	1693
Information Systems 4	4	314	21	1154	79	1468	402	25	1211	75	1613
Information Technology in Society 3	3	246	64	136	36	382	420	67	211	33	631
Information Technology in Society 4	4	239	65	127	35	366	403	68	187	32	590

Source: Statistics supplied by Ross Turner, Manager Research and Evaluations Unit, Board of Studies 1996

BACHELOR OF BUSINESS COMPUTING SUBJECT HISTORY 1991-92

Year	Gender	No. Pass	% Pass	No. Fail	% Fail
1991	Male	438	75.13%	136	23.33%
	Female	308	76.62%	84	20.90%
	Total	746	75.74%	220	22.34%
1992	Male	538	75.03%	154	21.48%
	Female	294	74.81%	88	22.39%
	Total	832	74.95%	242	21.80%
Overall	Male	976	75.08%	290	22.31%
	Female	602	75.72%	172	21.64%
	Total	1578	75.32%	462	22.05%

Note:
1. The above table refers to students who have not withdrawn from their course in the assessment period.
2. Statistics provided by Greg Young, Victoria University of Technology, Melton Campus Statistician.

VICTORIA UNIVERSITY OF TECHNOLOGY

Dear Student,

I am currently interviewing Bachelor of Business students (past and current) about their attitudes towards, and experiences of, computer technology. I am undertaking these interviews as part of a study to find the reasons behind the attrition of women in Business Computing. Information gained will be used to implement strategies to improve the situation for women in Business Computing.

If you agree to be interviewed, your interview will be treated with strict confidentiality. Any reference to your interview in the write up of the project will have any identifying data removed. Any reference to you, and any individuals to whom you refer, will be given pseudonyms.

I would like to stress that your participation, or non participation, in these interviews will in no way affect the results of any of your subjects in the Bachelor of Business.

Thank you for your assistance.

Annemieke Craig

I,...

of...

agree to be interviewed for the research on:

'The reasons for the attrition rate of women in Business Computing'

being conducted by Annemieke Craig at Victoria University of Technology.

signed:................................ date...........................

APPENDIX 4 -

QUESTIONNAIRE 1993 - SUMMARY

Responses:

1. Which area do you now plan to do your degree in:

	Female	Male	Total
Computing	4	10	14
Accounting	9	10	19
Marketing	1	1	2
Economics	1	0	1
Undecided	0	0	0
Other	0	1-Managmt	1
Total	15	22	37

Of those students now intending to study computing 3 of the males and 2 of the females indicated that this was not the area that they anticipated studying when they applied to the university (was Q4).

2. Have you experienced any difficulties in making the transition to tertiary studies?

	Female	Male	Total
Yes	3	5	8
No	12	17	29

Female comments on the difficulties faced:

Need to be more independent
Difficult to find tutors - not enough time in tutes
On our own

Male comments on the difficulties faced:

move to Melton
some people unhelpful
returning to study after 20 years in workforce
laziness
travel - lack of computers

3. What do you anticipate your result will be in this subject:

	Female	Male
HD 80-100	0	4
D 70-79	2	6
C 60-69	6	7
P 50-59	6	4
N1 40-49	0	0
N2 0-39	1	1
Total	15	22

Female comments:

concerned about exam
had trouble with theory
can't do it
don't understand much but will pass due to lots of study

Male comments:

hard to grasp
enjoyable
will blitz it

5. Did you feel that there were **adequate sources of help** available to you when you encountered a programming problem? Please explain.

	Female	Male	Total
Yes	6	18	24
No	9	4	13

Female comments:

tutor not on campus
tutor not helpful - hard to find
hard to get help
there is no -one around to ask
teacher based on other campus
few others around especially students
on-one available
tutor always available

Male comments

ample books - tutor available
tutor helpful
book good
tutor not much help

6. Have you experienced any difficulties with -

	Female			Male		
	Yes	No	undecided	Yes	No	undecided
1. course content	7	7	1	8	14	
2. delivery/teaching of the course in the lectures	2	13		1	21	
3. delivery/teaching of the course in the workshop	2	13		3	19	
4. gaining sufficient access to computers/printers	11	4		13	9	
5. other specific difficulties	2	12	1	2	18	2

Female comments:

1. programming difficult; confusing/hard; number of assignments; hard to get access to machines;
2. concepts need reiterating; explained clearly
3. tutor not helpful; tutor inattentive to our needs; workshop time used accordingly
4. computer lab always full; printers big problem
5. obtaining teacher contact; time; no student interaction - feel on your own

Male comments:

1. hard to understand at first; well designed; parameter passing difficult; hard to write code
2. well explained; good notes'
3. willing to help; no teaching done in workshop; longer time needed
4. insufficient maintenance on machines; labs always full; very difficult access
5. group work; computer access

7. Did you prefer the individual assignments or the group work?
(most groups were of mixed sex and were chosen by the students)

	Female	Male
Individual	11	16
Group work	2	4
Both	2	2

Female comments:

confusing to work with people you don't know
don't want to rely on others
more ideas, others to help but less satisfaction
difficulties with timetables
group - lifts the burden of the assignment

Male comments:

hard to organise group
individual assignments easier
meeting others a problem
group pathetic - others don't put in
don't want to rely on others

8. At any stage have you considered withdrawing from your enrolled course?

	Female	Male
Yes	3	3
No	12	19

Female comments

when my program wouldn't work and because I am the way I am - I panic very quickly
failure - will never understand
pressure - too many assignments due at the same time

Male comments

pressure
not sure what want to do
personal problems

9. What possible factors may influence you to withdraw from your present studies in the future?

Female comments

financial problems
if fail
pressure
get a job

Male comments

pressure
if fail x 3
health
stress, lack of motivation
if get a job

10. Do you have suggestions for improvements to the Programming Techniques Course?

Female comments

less complicated assignments
less assignments
more help
break 2 hr lecture into 2 x 1 hour

Male comments

get macs not IBM
give more problems
break 2 hr lecture into 2 x 1 hour

Personal Details

All students were studying full time.
There was one mature female and one mature male student.

14. Do you receive Austudy?

	Female	Male
Yes	7	8
No	8	14

15. Country of birth:

	Female	Male
Australia	11	15
Other	4	7

16. During your schooling was there a language other than English spoken at home?

	Female	Male
Yes	5	12
No	10	10

Female

Turkish; Chinese; Arabic x 2 ; Vietnamese

Male

Italian x 5; German; Tamil; Turkish; Greek; Albanian; Lebanese; Chinese

17. Were most of your lessons taught in English, during your schooling?

	Female	Male
Yes	15	21
No	0	1 (Indonesian)

18. Educational background - highest level studied prior to 1993:

	Less than Yr12	Yr12/HSC/VCE	TAFE-Adv.Cert	TAFE-Ass.Dip	Other
Female	0	10	0	1	3*
Male	1	18	0	3	0

*all of these began degree in 1992 but had not done any other study since HSC/VCE

19. How do you rate your current knowledge of computers?

	Very Poor	Poor	Average	Good	Very Good
Female	0	1	9	3	2
Male	0	2	8	9	3

20. Tick the level most representative of your highest previous knowledge of computing: (Before entering the Bachelor of Business)

	Female	Male
None	5	2
No formal training but used at home	2	2
No formal training but used at work	0	2
Yr10 Computer awareness/keyboarding	2	1
Yr11 Info Tech (or equivalent)	1	1
Yr12 Info Tech (or equivalent)	4	11
Short Course	0	1
TAFE-Adv. Certificate Course	0	0
TAFE-Assoc. Diploma	0	2
Other	1 TAFE subject	0

21. Do you have a computer, to which you have access, at home?

	Female	Male
Yes	11	18
No	4	4

BUSINESS COMPUTING DEPARTMENT
1995 BACHELOR OF BUSINESS COMPUTING STUDENT QUESTIONNAIRE

You are asked to complete this questionnaire to assist with course planning and the development of student support structures. Please ☐ the relevant boxes. Thank you.

STUDENT DETAILS Full Time ☐ Part Time ☐

Surname: .... First Name .... Student ID ....Male ☐ Female ☐

Mailing Address ....

Contact Phone Number ....

1. In what country were you born? Australia ☐ Other ☐ please specify ....

2. Where was your mother born? Australia ☐ Other ☐ please specify ....

3. Where was your father born? Australia ☐ Other ☐ please specify.................

4. Do you speak a language other than English at home?
No ☐ Yes ☐ if Yes, please specify ....

5. How many members of your immediate family (parents, brothers or sisters) have studied at any University?
None ☐ One ☐ Two ☐ More than two ☐

EDUCATION EXPERIENCE

6. What type of secondary school did you last attend?

Australian Government Secondary College/School ☐
Australian Catholic College/School ☐
Other Australian Independent College/School ☐
Overseas Secondary Education ☐
Year 12 or equivalent at a TAFE College ☐

7. Have you completed any other course since leaving secondary school?
No ☐ Yes ☐ please specify course ....

8. Have you ever had to sit for; a three hour exam? Yes ☐ No ☐
a two hour exam? Yes ☐ No ☐

COMPUTER EXPERIENCE
(Please note: For this course you are <u>not</u> required to have a background in computers)

9. Do you have access to a computer at home?
No ☐ Yes ☐ please specify what sort ....

10. How do you rate your level of competency in computer use?
None ☐ Very Poor ☐ Poor ☐ Average ☐ Good ☐ Very Good ☐ Excellent ☐

11. What background do you have in computers? (Please tick all appropriate boxes)

- None ☐
- At school in Years 7,8,9, or 10 ☐
- VCE Subject Year 11 ☐
- Year 12 -IP&M ☐
- - IS ☐
- Post Secondary Course ☐
- Used a computer at a friends house ☐
- Used a computer at home ☐

12. Which of the following do you use? (Please tick all appropriate boxes)

- Word Processor ☐
- Spreadsheets ☐
- Filing/Database ☐
- Programming ☐
- Games ☐
- Communication ☐

VICTORIA UNIVERSITY

13. Why did you select to study at Victoria University of Technology? (Circle the most appropriate number)

1. The University has an excellent reputation for teaching and/or Research.
2. The University offers this course in which you are interested.
3. The University has been recommended to you by others.
4. The campuses of the University are located close to your residence/workplace.
5. You received an offer only from this University.
6. The atmosphere of the University Campus appeals to you.
7. Your friends attend the University.
8. Other, please specify ....

14. Why did you elect to study the Bachelor of Business Computing? (Circle the most appropriate number)

1. The course has an excellent reputation.
2. The field of study is particularly interesting to you.
3. The course sounds interesting.
4. The course will enable you to gain credit and transfer to another course after one or more years of study.
5. This course offered you a place and your preferred course did not.
6. Other, please specify ....

15. Where did you obtain information about this course? (Please tick all relevant boxes)

School/Careers adviser ☐ JAC☐ Open Day☐ Newspapers☐
Girls in Computing day ☐ Friends/Relatives☐ VCE Planner☐ VTAC guide☐

16. List the jobs/careers that at the conclusion of this course you expect to be qualified for.

....

....

Orientation Agenda

Wednesday 22 February 1995
11 AM - 3 PM
Joan Kirner Building - Bob Hayes room

11.00

Official Welcome	- Associate Professor Angela Scollary
Why Victoria University and BBBC?	- Annemieke Craig
Co-operative education	- Kerri C. (co-op student 1994)
Where will the course lead	- Lisa P. (ex-student)
University life	- Annemieke Craig and current students
Question box	

11.45 **Treasure Hunt** - make sure you collect lots of treasure along the way!!

12.30 **Library Tour** - Lian Todd

12.45 **Lunch** - Joan Kirner Courtyard
Provided by the student union

1.30 **Student Union** - Joelle De Saint

2.00 **Student services** - Michelle Harris (counsellor)
- Joanne Brandeburg (nurse)
- David Kontig (careers)

2.15 **Discussion of treasure hunt** - Annemieke Craig
Your questions answered
MicroNet
Evaluation

3.00 **Conclusion**

Treasure Hunt 1995

Bachelor of Business Computing GROUP......................

You will undertake this treasure hunt in a group. Please have each group member write down their name and phone number on your sheet:

Name..Phone Number:................................

Name..Phone Number:................................

Name..Phone Number:................................

Name..Phone Number:................................

Name..Phone Number:................................

You need a map, a pen, a list of staff members and a folder (for collecting any treasure that you find!).

Work out the name of the staff member involved in the first clue in Section A. The whole group should proceed to that person's office. At this office, each student should introduce themselves and then the group should seek answers to the following questions.

Work out the next destination from the next clue in Section A. When you have completed section A go and discover the treasure in Section B.

Section A

1. O...... how did his brother Denis sail?

Name of staff member...Office...............Phone...........................

Which first year subject is this person responsible for?...

How many students will take that subject in semester 1, 1995?..

Now look around and

1. List the staff members who have offices close by:

....

2. I need some support!

Name of staff member...Office...............Phone........................

Role of staff member?...

One member of the group needs to collect some treasure here. What was this treasure?
....

Now look around and

1. Name the place where you could leave messages for staff members:
....
2. Name the place where messages are left for BBBC students:..

3. Sherlock Holme's faithful companion

Name of staff member..Office...............Phone..................

Discover what pathways are all about;..

....

4. Postscript

Name of staff member..Office...............Phone..................

Which first year subject is this person responsible for?...

Which semester is this subject usually studied in?...

Section B

1. Find your way to the canteen without going outside the ex-premier's building.
   On your way;
   what storage space can you see...
   what could help you to get fit this semester..
2. How many computers in; 4c237..............* 4c335......................*
3. How many rows in; 4c137..............* 4c436......................*
   *collect treasure at each of these locations
   * if any of these rooms are locked find out instead when they are available again
4. Where would you find a duty programmer or 'help'?...
5. What is the room number of the co-op office on the fourth floor?......................................
6. How many student forms are available for collection outside the Faculty of Business Office?
   ....
7. When is the book shop open?..

Once you have completed section A and B go via the central plaza to the library. Please wait outside until we have all arrived. Please be no later than 12:30 PM.

[1] Adapted, with permission, from Cartwright and Colville.

APPENDIX 8 -

ORIENTATION QUESTIONS

The following questions students placed anonymously in the question box. They were answered at the end of the day if they had not already been covered:

How easy is it to do 5 subjects in 1 semester?

What hours are the computer labs open?

What types of sporting clubs are there?

Can timetables be changes so its not necessary to come in 5 days a week?

Who can I speak to get help to get a part time job?

When do we find out about text books?

Is it necessary to have a computer at home?

What do I have to do about subject exemptions?

What is the student union all about?

Do you have to find your own work for co-op?

Can a timetable be changed?

Where do you go for financial help?

Where can I get more help with English?

What and where can we go on our breaks?

Where do you park your car?

Will I have classes on all 5 days?

What type of clubs are available?

Where will our classes be held?

Is there a time limit on parking?

When is the mid semester break?

Where are the computers situated for student use?

Will the timetable change?

Where do we get our text books?

ORIENTATION 1995

Bachelor of Business Computing

Participant Details (Optional)
Last Name:_______________________________FirstName:__________________

Please complete the table below about today's activities. The codes to be used for the first five columns are:

(SA) Strongly agree
(A) Agree
(U) No opinion or Undecided
(D) Disagree
(SD) Strongly Disagree

	Clear Purpose	Interesting Material	Presented well	Thought Provoking	Under-standable	On a scale of 1 - 6 (**with 1 meaning most enjoyable**) how do toda activities rate?
Introductory session						
Treasure Hunt						
Library tour						
Student Union Rep						
Counsellors						
Email						

What was the best thing about participating in today's activities:

What else should would you have liked us to cover today?

General Comments:
