Flaws and gaps in the women in computing literature

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Abstract

There are flaws and gaps in the current literature on women and computing. An analysis of Australian university enrolment data is used to compare Computing and Information Systems (IT) enrolments to the fields of Law and Medicine. There are flaws in the reasoning that the lack of role models and inhospitable nature of the IT field is an explanation for poor female enrolments. Gaps are evident in current published research as well as a lack of on-going statistical analysis of intervention programs. Questions are raised about the role the media plays in determining career choice perceptions in young females, particularly in relation to the status of computing careers.

Keywords

Gender, Information Technology

INTRODUCTION

Over the last 25 years or more there has been a concern that females are not embracing the field of computing and information technology (IT) to the same extent as males. There are recurring explanations as to why this may be so. The under-representation of females is attributed to:

• the inhospitable nature of the field in both education and employment areas;
• the lack of female role models and mentors;
• the perceived isolated nature of programming;
• the media reinforced imagery of computer ‘nerds’ and ‘geeks’;
• the different relationship with technology that females have compared to males;
• the advantages males have in their use of technology because of their preoccupation with computer games;
• teaching methods in the field being more suited to males than females;
• differentiation in education experiences in mathematics, science and technology.

It needs to be determined if these recurring explanations are more than localised opinions that have grown to be accepted as truisms over time or are based on solid evidence. When comparing the percentage of female enrolments in the field of Computer Science and Information Systems (IT) in the Australian environment to the fields of Law and Legal Studies, and Medicine and Medical Science, some obvious flaws in reasoning and gaps in explanations are evident. This paper will analyse recent literature in this area and use statistical comparisons with the two disciplines mentioned to emphasise the flaws and gaps in current published research.

Many people in education, business and government perceive the gender imbalance in the field of computing as an issue. The sociologist Mills’ definition of an issue implies that it has wider societal implications than a trouble.

"matters that transcend ... local environments of the individual... They have to do with the organization of many such milieux into the institutions of an historical society as a whole...An issue, in fact, often involves a crisis in institutional arrangements." (Mills 2000:8-9).

A trouble on the other hand is defined as a local or personal problem involving the self, a private matter (Mills, 2000:8). These definitions are apt when applied to explanations for the gender imbalance in IT. Many of the reasons cited for females not entering the field are based on personal experiences (troubles) but collectively, the lack of females in the field can be interpreted as an issue for all of society, due to reasons of lack of diversity, under-utilised creativity, power concentration and the influence of IT in the wider society (Borg 2002:13-14).
Since the 1980's a number of programs have been instigated in the USA, UK and Australia to encourage females to enter computing and information technology at a greater rate than at present. Some of these programs have had a measure of local success but the overall trend of females not choosing this discipline at tertiary level remains. A closer investigation of the recurring explanations indicates that there are flaws and gaps in the reasoning. There is an absence of published data about any sustained success of intervention programs and little improvement in overall enrolment numbers of females Australia wide. Each of the recurring explanations will be examined in more detail to determine if they are flawed, and highlight any gaps in the reasoning or information presented.

STATISTICAL COMPARISON

To set the basis of the argument current statistics are presented. Figure 1 shows in graphical form that the number of females enrolled in university in Australia has increased steadily over the last 10 years from 42.5% of the total student body in 1990 to 55.2% in 2000. This is an average annual growth of 0.3%. Female enrolments in Medicine and Medical Sciences have increased by 12.9% over the same time period, to become more than half of the student body since 1998. Female enrolments in Law and Legal Studies have outnumbered males since 1996. They have increased by 9.2% with an average annual growth of 0.9% over the last 10 years. Female enrolments in Computer Science and Information Systems on the other hand have decreased by 3.3% in the same time period. The enrolment peaked at 27.7% in the early nineties, slumped to 22.6% in 1997 and in the last 3 years has been increasing slightly each year to reach 24.1% in 2000. This is not even one-quarter of the total enrolments in this field.

![Females as percentage of total enrolment](image-url)
Computer Science & Information Systems female enrolments as percentage of total enrolment.

Figure 2 offers a closer look at the different classifications within the Computer Science and Information Systems field of study. The overall statistics are broken down into four sub-categories of:

- Computer Science, Information Systems – General (not Business Data Processing) CS&IS Gen;
- Computer Science CS;
- Information Systems IS;
- Computer Science, Information Systems – Other CS&IS other.

Two of the sub-categories have declining female enrolments, Computer Science and Information Systems – General shows a decline in female enrolments of 4.3% over the ten-year period, and Computer Science a decline of 0.5%. Information Systems and the final category that includes 'other' have had slight increases of 0.3% and 1.1% respectively.

In the three years since 1997 there has been a growth in this field of an average of 0.6% per year. At this rate it will be another 60 years before females achieve 50% enrolment in the discipline. These statistics as well as current literature form the basis for the following discussion.

FLAWS AND GAPS IN ARGUMENTS

Each of the common reasons given for explaining the lack of female enrolment in computing and information technology courses will be discussed in more detail in this section. Some of the explanations are clearly flawed when applied wider than this discipline. Where programs have been instituted and achieved positive results, there is little data to show that any have persisted for longer than five years. There is an absence of ongoing evaluation of programs that may have produced initial growth in numbers but did not gain in momentum to become self-sustaining when the particular program funding ended, or personalities involved in its initiation moved on. The reason why self-sustaining growth is not attained needs further investigation.

The inhospitable nature of the field in both education and employment areas

It is claimed that the nature of the IT field is not attractive to females due to long working hours to meet deadlines or late night stints debugging code or finishing projects for university credit or employers (Johnson & Stewart Millar 1998:10). This is not an environment that is supportive of females, be they daughters, mothers or wives. The safety issue of walking to cars at night through unlit paths or car parks has been written about as well as the inhospitable laboratory environment that has been likened to a male locker room (Pearl et al 1990:49).
This argument is flawed because it can be applied to many professional fields, but in particular Law and Medicine. Both these areas were bastions of male power in the early 20th century; both had inhospitable work environments and male dominated offices, courtrooms, university lecture theatres, tutorial rooms and laboratories. Law and Medicine also require long hours of work to complete cases, or hospital shifts, meet deadlines or finish projects, yet in both these fields women have overcome the barriers of inhospitality and male dominance to the extent that in the last 10 years, the number of females enrolling has surpassed the number of males (refer Figure 1). None of the fields are particularly female friendly work environments, but IT more than the other two should allow for more flexible work environment through increased telecommunication capabilities, yet this is the area females are least likely to enter. The flaw in this argument is that the employment and education environment in IT is no more inhospitable than many other professions. Long hours are a product of many careers, particularly for new entrants into the fields. This cannot be the reason females are avoiding computing.

**The lack of female role models and mentoring programs**

It is claimed that the small number of females in the IT field leads to a lack of role models and perpetuation of the image of the discipline as being 'male'. The lack of validation of seeing similar people to oneself, be it same gender or same ethnicity, contributes to feelings of isolation (Jones 2002: 24-25). There is also the perception that the current females in computing are somehow 'different' because they are going against society's impression of what a female should be (Turkle 1995:56). There is a similar flaw in this theme as in the previous. The lack of role models did not prevent females breaking down barriers in Law and Medicine, where the argument that females do not feel comfortable in an area where they are constantly facing sexism and "old boy" networks also applied. The need to establish mentoring in the field is also mentioned. Several programs have proven successful in encouraging young women to select computing courses, based on little more than personal contact prior to enrolment and the promise of on-going mentor support (Jewell 2002). It is believed that having a critical mass of females will make a difference to the field, but there is no evidence that this critical mass, once reached, will maintain its own momentum. On the other hand, the growing number of females in the Information Systems business environment has not resulted in a momentum of positive changes but has lead to a shift in skills evaluation. In this area female skills are being marginalized. Females with social, communication and technical skills are finding that their technical skills are being doubted, while males with social, communication and technical skills are being touted as "wizards" (Woodfield 2002: 128).

"The degree to which social skills are defined, recognised and assessed is highly dependent upon a worker's gender" (Woodfield 2002:133).

There is also a positive and negative side to role models. Often in IT they are portrayed as exceptional women, and therefore discarded by females who perceive themselves as anything but exceptional. It is when ordinary women succeed in the area of IT that they will be effective role models. This will be discussed further in relation to the media. Once more the fact that women have moved in to Medicine and Law despite them being male dominated fields gives hope that one day the same will happen in IT, but the lack of role models and mentoring programs cannot be presented as a reason why females are currently avoiding the discipline.

**The perceived isolated nature of programming.**

The image of the lone programmer working long hours in a room lit by the glow of a computer screen is often reflected in the media. The reality of the profession is that programmers often need to work in teams. The image of the law student sweating over law books in a library until closing time is also isolating, but cannot be attributed to turning females from that profession. The difference may be attributed to human interaction in employment. Lawyers and doctors need to interact with people to ply their trade, and this is not the popular image of anyone in the IT industry. There is little understanding that programmers often work in teams or that the discipline also produces system analysts who need to communicate with many different types of people, or business analysts who must interact and solve problems of stakeholders daily. Common perceptions are difficult to change and there is a lack of understanding by the population in general that IT is more than programming.

This perception is a valid reason for contributing to the gender imbalance in the field, and is also reinforced by current research. It is the basis for the "I can, but I don't want to" syndrome that reported no evidence that females were less able than males to achieve in IT (Dundell, Glissv & Slan 1995:226), they just chose not to pursue this field. In more recent data presented by Jewell females rated the IT field to be of medium difficulty (Art being the lowest, and Law the highest) and the lowest in people involvement (Jewell 2002). A survey of over 200 female secondary students in Australia found that the most common response for why they believed females were not choosing computing as a career path was a lack of interest (Lang 1999). It is not the difficulty of programming that is deterring females from following the discipline, but the perceived isolation of the task.
There is a need for more detailed analysis of the factors that engender an interest in the discipline, as well as what part both educational experiences and the media play in creating misperceptions about the career path.

The media reinforced imagery of computer 'nerds' and 'geeks'

The effect of the media in its reinforcement of the male domain of computing cannot be under-played. Computer magazines are predominately produced by males, for males and portray the images of males using, designing and spending their leisure time on computers. When the media portrays females in IT, they often are given the 'geek' image of being social misfits, loners, or are the product of a damaged background. They are not portrayed as 'normal' smart females who succeed in the field because of their normalness, not despite it. If women are portrayed they are often "passive users of technology while at the same time reinforcing their traditional sex roles" of chief homemaker or child-carer (Stewart Millar 1998: 22). An example of an influential cinema release in 2001 was "Legally Blonde", a lightweight portrayal of a young female who loved shopping, boys, beauty products and her girlfriends yet still succeeded to become an exceptional law student. The same can also be said of the television series "Ally McBeal". The advantage of media support for role models in Law and Medicine, particularly in the last few years when popular television shows and cinema releases have portrayed female lawyers and doctors with equal status and power to their male counterparts, play a part in the influencing young females to choose these career paths. If only Ally McBeal was a systems analyst or software engineer.

It is when 'ordinary' females succeed in a field that they may be more successful as role models and there is no cinema release, or television program that portrays females in the role of successful and powerful IT professionals. The power of the media in the 21st century is very important in helping young females identify with a sub-culture and the media is perpetuating the gendered nature of IT being male (Stewart Millar 1998).

The difficulty is that changing public perceptions takes time. Perhaps in another 20 years there will be such images for females to follow. At the moment there are a limited number of public IT savvy females, and they do not achieve much media exposure, or when they do, they are tinged with comments of radical feminists, a term that is taking a downturn in society today. The influence of the media on the perceptions of females in IT is under-investigated. It is assumed it is powerful but there is little data to support assumptions.

Females having a different relationship with technology than males

It is a common perception that males develop an all-consuming interest in cars or trains or computers to a much greater degree than females. There is qualitative data supporting this disparity in interest. Margolis and Fisher found that males in their study described themselves as having an "epiphany" like experience when they discovered computers and programming, usually at quite an early age. Females, while liking working with computers, did not have the same emotional experience (Margolis & Fisher 2002: 18).

A debate exists over whether the difference in the relationship to technology between the sexes is a socially constructed persona or biological determinism. A flaw in the biological determinist argument is that in communist countries females are expected to move into technical fields, which they do successfully. While much is written about female's relationship with technology, little is written about their use of it. They can drive cars equally as well as males, they use domestic technology exceedingly well, often more capably than males, from washing machines to sewing machines. Is the stanza "Men design, women use" a biologically determined fact or is it or social construction (Trauth 2002:105)?

The flaw in this theme is the widely held belief or myth that it is necessary to have a relationship with computer to be successful in the IT field. When females are required to use computers in the work environment they tend to develop a pragmatic attitude to them and become competent users (Dundell 1995:220). However females in the tertiary environment are often surrounded by males with an all-consuming passion for computers, or programming, which they do not share. This can lead to them doubting their ability to succeed in this area. There is some evidence that gender education of academic staff, parents and students can overcome this widely held assumption (Margolis & Fisher 2002).

Males being advantaged in their use of technology because of their preoccupation computer games

There is an argument that the lack of equivalence in access to IT is an ethical issue because the computing games market, written for males by males, gives them an unfair technological familiarity with both software and hardware from a very young age (Huff 2002:112-115). Males are more attracted to playing computer games and when females do play games it is for often for different purposes. Females tend to prefer more passive games and game playing is not a major part of their leisure activities (Lang 1999). Females however are portrayed as the main users of e-mail and on-line chat. Unfortunately because of the difficulty in monitoring or collecting statistics of computer use, it is hard to determine who is using what.
As a consequence of the computer games market, a majority of males entering tertiary courses have already mastered some programming. While there is some data and information existing about poor pedagogical practices in this field of study at tertiary level (Margolis & Fisher 2002:77), there are gaps in the attention to improving pedagogical practices in this field at both secondary and tertiary level. There is an absence of data investigating the student experience in the IT classroom at primary, secondary and tertiary institutions.

**Teaching methods more suited to males than female**

Much has been written about male and female learning styles (Belenky et al 1986) and differentiation in experiences in education due to gendered self-efficacy beliefs (Bandura 1997; Pajares 2002). In a male dominated profession it can be extrapolated that without gender awareness, male teachers can favour the learning styles of male students. A cross cultural comparison comparing the gender of maths and IT teachers showed that Asian students were exposed to female IT teachers to a greater degree than Australian students (Lang 1999). This is put in to context by the female enrolment in IT in Singapore at tertiary level hovers around 40%. The predominance of male teachers in the IT area at secondary school could have an influence on the perception of the career path as male.

There are flaws and gaps in this theme due to a lack of empirical data, and a belief that this is considered "pop psychology". Many believe gender differences are not biologically determined, but are a product of social engineering. Some studies have shown that gender awareness education improves the experiences of females in this discipline, and when applied to secondary school teachers, is carried through to an increased female enrolment in computer science courses at the tertiary level (Margolis & Fisher 2002).

**CONCLUDING DISCUSSION**

In the USA after over 22 years of intervention programs that have not delivered the expected results. It is only now that questions are being asked.

- How does environment and culture shape interest in IT?
- How does the IT education curriculum shape student interest in the discipline?

The Australian situation is no different. The employment and education environment in IT is no more inhospitable than many other professions yet the lack of role models there did not prevent females breaking down barriers. Where effective programs have been instituted there is little data to show that any have persisted for longer than five years. The absence of ongoing evaluation of programs that may have produced initial growth in numbers but then did not gain in momentum is a serious gap in the published data. There are many flaws in the literature where claims are based on 'troubles' rather than 'issues', and are clouded by emotive language and ominous warnings. A number of questions are outstanding in this area. Why is it that females have broken down the male dominated bastions of Law and Medicine yet are still reluctant to enter IT? Is it due to a lack of perceived status of IT influencing choice of able females? How important are media portrayals of females in professions to career choices of younger females? Is the lack of self-efficacy of females in maths and technology still evident in 2002 and can it be blamed for turning females away from the field? What is the overt and covert discrimination in educational environments and is it really present in IT more than other fields?

According to current growth rates it will be many years before a semblance of gender equality in IT is achieved, if ever. The enrolment statistics in IT lag behind the average growth rate of females in tertiary education in general. Sustained research and quality interventions are required at a societal level to ensure that the female voice is heard in this discipline.

**REFERENCES**


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