

# Declining Participation in Computing Education: An Australia Perspective on the “Gender and IT” problem

Julianne Lynch, Ph.D.  
Deakin University

## Abstract

Participation in post-compulsory computing education has declined over recent years, both in the senior years of secondary school and at university. This trend has been observed in most developed countries, despite reported and projected skills shortages in Information Technology (IT) industries. Within the computing education enrollment mix, girls and women continue to be under-represented and recent years have seen female participation fall even more rapidly than that of males. This article reports on findings of an Australian study which explored secondary school students’ beliefs about and attitudes towards computing education and careers in IT. Factors that might discourage girls in particular from pursuing post-compulsory computing education and careers are discussed, along with broader implications for school education in an era when information and communication technologies are an integral part of our daily lives. Findings include the persistence among both boys and girls of inaccurate and outdated views of the field of IT and low expectations of both school IT curricula and pedagogy in terms of their relevance and interest for students. Many of the issues identified as discouraging students in general from pursuing computing education appear to have a greater discouraging effect on girls, and this is compounded by stereotypical views of the field as male-dominated and unwelcoming to women and girls.

## 1. Introduction

This article reports findings from a three-year national study of post-compulsory computing education in Australian secondary schools. The article focuses primarily on the beliefs and attitudes of secondary school students and the reasons behind a decline in enrollments in senior computing subjects. The article is in three parts. In part one, I explore the phenomenon of declining participation rates, with a particular emphasis on the persistently low and falling numbers of girls who choose to study post-compulsory computing subjects. This problem is framed with reference to the perspectives of a range of stakeholder groups. The second part of the article describes the research project – its aims, participants, and data collection processes.

In the third part, some key findings of the of the qualitative components of the research are reported, focusing particularly on possible explanations for students’ decreasing interest in computing education, both for boys and for girls. A number of themes are explored with

reference to teacher and student interview excerpts, including students’ misconceptions about computing education and the opportunities it provides, students’ beliefs about and perceptions of school computing subjects, and forces that might discourage girls in particular from pursuing post-compulsory computing education.

The paper concludes with some thoughts on school education more generally and the challenge of supporting current and future generations of students to see themselves, not only as consumers, but as critical users and producers of new technologies.

## 1.1 Falling Interest in Computing Education in Australia

Enrollment in post-compulsory computing and information technology education, both at school and university, has been in decline in Australia since 2000. Our analysis of enrollment figures for Year 12 IT subjects in the Australian states of New South Wales (NSW), South Australia (SA), and Victoria revealed big drops in participation from 2002 to 2006 in most IT subjects, with the only exceptions being those subjects with a significant emphasis on skill development in software applications (Downes & Kleydish 2007). Participation in those Year 12 subjects focusing on programming and software design and development have suffered most in terms of the drop in student interest during this time.

Within the context of a drop in overall participation rates, women and girls continue to be a special case. In 2006, girls contributed to less than 24% of enrollments in Year 12 High School Certificate (HSC) IT subjects in New South Wales and in Victorian Certificate of Education (VCE) subjects in Victoria. (Note: Victoria and New South Wales are two of Australia’s eight states and territories.) While, in NSW, overall (boys and girls) enrollment in Year 12 HSC IT subjects decreased by 49% between 2002 and 2006 (the equivalent Victorian decline was 53%), the participation of girls during this period fell by 60% (68% in Victoria). The gender disparity in both enrollments and in the rate of decline is even greater for the software development subjects in these states. Where in NSW and Victoria, overall participation rates in the software development subjects decreased respectively by 49% and 40% from 2002 to 2006, girls’ participation in these subjects fell by 69% and 71% in these states (Downes & Kleydish, 2007). These declines have seen the numbers of girls enrolled in what are

considered to be the more difficult IT subjects to be very low indeed. Where girls in 2002 comprised 13% and 12% or the enrollments in the software development subjects in NSW and Victoria, respectively, in 2006 they made up only 8% in each of these states (Downes & Kleydish, 2007). At the individual school level, this manifests in some schools having only a very small handful (one, two, or three) or no girls at all taking these subjects.

The low level of participation of girls and women in computing education, training, and careers is an enduring problem despite the considerable improvements made over the past three decades in terms of gender equity in other areas of education. Women make up less than 30% of Australian university enrollments in IT (James, Baldwin, Coutes, Krawse, & McInnis, 2004). This is seen as an equity issue and also as a problem for the IT industry, which anticipates that current shortages in specialist skill areas will worsen if more school students (both boys and girls) cannot be recruited into university courses (Australian Department of Communications, Information Technology and the Arts, 2006; Multimedia Victoria, 2004, 2007).

## 1.2 Exploring the Problem

Problems do not exist independently of the perceptions of stakeholders, and a problem for one group is not necessarily constructed as a problem (or the same problem) for another. The key stakeholders in the problem of falling interest in computing education and careers include:

- Employers and industries who have economic interests in the status, sustainability, and outcomes of school education in this area;
- Managers and educators in university IT departments whose work and careers are invested in attracting school leavers to university IT courses;
- Curriculum developers and teachers who work with the IT curriculum; and,
- Students (and their parents and guardians) who hope to gain a range of returns (e.g., social, cognitive, emotional, and economic) from their formal schooling experience and qualifications.

The interests of each of these stakeholder groups are outlined briefly below.

### 1.2.1 Employers, Industry, and the Nation: A Problem of Skill Supply and Failed Public Relations

A commonly told story of the IT industry, in Australia internationally, is one of "boom and bust." This perception was established during the mid- to late- 1990s when reports in the popular media were dominated by developments in the United States stock market, which became known as the 'dotcom' phenomenon. During the height of this period of rapid growth, the Internet, and related businesses were seen as a limitless source of employment. However, by 2000, the

"dotcom bubble," as it became known, was beginning to burst and this was also widely reported in the popular media, as was the resulting "glut" of IT workers. University enrollments then decreased as the opportunities for employment declined (Frauenheim, 2004; Lea, 2006). Apart from a few notable exceptions (e.g., multimedia and computer game design, and double degrees in business and IT), the numbers of students enrolling in Australian university IT courses has declined steadily since the "bubble" burst (Dobson, 2007).

Eight years later, the IT industry no longer commands the attention it did during that period of dramatic change, and the general public is not as well versed in the subsequent developments in the industry, or with the trends anticipated for the future (State Government of Victoria, 2006). In fact, as is supported by the findings of the research reported in this article, the dotcom story is still at the forefront of popular imaginings about this industry. The students and teachers interviewed by this study still perceived the field as one that is in decline or, at most, lukewarm in terms of exciting employment opportunities. Consistent with this image of the IT industry are the continued sluggish enrollments in university IT courses. However, despite these popular perceptions, government and professional bodies report that the need for IT graduates in Australia is not being met and that the IT industry, as well as other industries that employ IT professionals, face a potentially serious shortage of skills in the next few years (Australian Department of Communications, Information Technology and the Arts 2006; Multimedia Victoria, 2004, 2007). Even before the dotcom collapse and related declines in interest in IT careers, women were seen as an untapped pool of potential graduates. In Australia, women make up only 15% of the IT industry and this 15% is over-represented in computing support roles and under-represented in computing professional roles (Australian Department of Communications, Information Technology, and the Arts, 2006).

As well as misconceptions around employment and career opportunities, the IT industry struggles against stereotypical but largely inaccurate images of the nature of work within the industry. The traditional stereotype is one of a male, socially inept, computer programmer, working "24/7" in isolation and in intense connection with his computer terminal. Contrasting images that circulated during the dotcom period of moneyed male youth, with flashy cars and online empires, do not seem to have dented the more traditional stereotype. An Australian study of attitudes of 17–19-year-old Victorians found 59% agreed that a career in IT meant sitting in front of a computer all day, with a similar proportion agreeing that a career in IT would be boring (Multimedia Victoria, 2004). This study also found that young women, in particular, emphasized the importance of creativity, human interaction, and job security as

important aspects of a career — characteristics they did not associate with careers in IT.

The Australian IT industry, professional organizations Australian state governments have put considerable effort into countering these beliefs through campaigns that target school-aged and university students, seeking to emphasize the new types of roles and ways of working that have emerged in the IT industry. These campaigns promote the collaborative, project-based nature of much of the work of an IT professional, emphasize the importance of interpersonal and communication skills, and highlight management opportunities. Recent examples of campaigns promoting the industry more generally include The Australian Computer Society's *About ICT Industry* video (Australian Computer Society, n.d.) and the Victorian Government's *Upload your future* student career sessions (State Government of Victoria, 2007). Examples of initiatives specifically targeting girls and women include *Go Girls, Go for IT* (Victorian ICT for Women, n.d.; Women are IT WA, n.d.) — a series of events run by different professional networks in a number of states, providing career advice to school-age girls, and *Elev@te* (YWCA Australia, 2007) — a three-day camp that aims to increase school-age girls' confidence and exposure to technology.

IT employers and industry bodies generally recognize that a range of public relations exercises, particularly those targeting girls and young women, are important both in terms of recruiting greater numbers into the industry, as well as increasing the diversity of recruits. Women are sought after, as they are seen as a source of much needed communication, networking, and lateral thinking skills (Roan & Whitehouse 2007). The IT industry research literature also recognizes that, despite the illegality of formal barriers to women's participation, women continue to encounter subtle forms of discrimination in what is a predominantly male dominated workforce (Anderson, Timms, & Courtney, 2006; Webster 2005). Although roles and work practices in the IT industry are increasingly being promoted as women-friendly in their focus on projects, collaboration, and interpersonal communication, it is also an industry dominated by contract work and salary bonuses, which may not necessarily be attractive to women.

### 1.2.2 University Departments: Death or Rebirth of an Academic Discipline?

The number of students pursuing university studies in IT has been decreasing in Australia in recent years. Between 2002 and 2005, overall university enrollments in Australia increased by 6.8%, yet enrollments in IT decreased by 18.5% over the same period (though they were partially buoyed by relatively stable enrollments of overseas students) (Dobson, 2007). This is part of an international trend which has very few exceptions among western countries. In Australia, there are a few IT courses which are

exceptions to this trend. Courses that have not suffered a decline in numbers include those that emphasize computing application, focus on multimedia and games development, and that are offered as double degrees with business courses.

Overall numbers of university IT students have dropped; however, the fall in female enrollments has been greater than the fall in male enrollments, and it started from a much lower base. In 2002, only 24% of Australia's university enrollments in IT courses were women (James, Baldwin, Coutes, Krawse, & McInnis, 2004). Between 2002 and 2005, the number of female IT students studying in Australian universities declined by over one-third (Dobson, 2007).

There is ongoing debate among university academics and IT professional organizations about the sustainability of disciplines such as computer science, given the continuing decline in enrollments. Some argue that the traditional computer science curriculum (with a primary focus on programming) is no longer suitable for the preparation of today's (and future) IT professionals (Timson, 2007). More interdisciplinary studies with a focus on the application of technologies may ultimately prove to be more attractive and more suitable (e.g., McBride, 2007). Such beliefs are increasingly evident in the strategies used by universities to attract students. Courses and promotional materials from Australian universities are beginning to emphasize connections between computing and the creative arts, between computing and other sciences, and between computing and business studies. New courses in multimedia and gaming and other aspects of computing perceived as being "more fun" are being developed and promoted. Partnerships between Australian university departments and high profile commercial groups such as Microsoft® and Cisco® are also seen as a means of attracting students who might otherwise be nervous about pursuing more traditionally focused computer science and software engineering courses.

### 1.2.3 Curriculum Workers: Navigating Competing Agendas

It is widely recognized by secondary school computing teachers and educational authorities that senior computing subjects have experienced dramatic decreases in enrollments over the past several years. As detailed above, a review of participation rates in Year 11 and 12 computing subjects over the past five years in the three states participating in the research reported in this article revealed significant drops in participation in most computing subjects (Downes & Kleydish, 2007). This was particularly the case for subjects that focus on the disciplinary knowledge of computer science, with subjects focusing on applications faring less badly. Exceptions to the general decrease in enrollments were a subject titled *Information Processing and Publishing*, offered in the state of South Australia, which

has a significant emphasis on skill development in applications. Vocational Education and Training (VET) studies offered in Multimedia in both New South Wales (NSW) and Victoria are also exceptions to the more general decline in enrollments (Downes & Kleydish, 2007).

The general decline in senior computing enrollments is a problem for curriculum workers, particularly teachers, who have emotional and material investments in the sustainability and status of computing as a school subject area. For teachers who have invested time, energy, and status in the development and delivery of computing education as a specialist area in which they are the experts, the decline in enrollments represents a threat to the future viability of such subjects. To such teachers, the demise of this subject area would require them to recast and reposition themselves and their expertise within the context of their workplaces. The positioning of computing teachers as members of staff is complex. They often play multiple roles as computing experts in the school who, further to their specialist teaching role, promote and support computing across the curriculum, as well as playing managerial and support roles in relation to their schools' computing infrastructure and related resources.

Some teachers and schools have taken steps to attract more students to post-compulsory computing subjects by attempting to increase general interest, or to interest girls specifically. Some computing curriculum documents make explicit reference to the suitability of this area of study for girls. For example, the syllabus for the New South Wales Stage 6 subject, *Software Design and Development*, states that this subject is intended for both girls and boys, pointing to an emphasis in the content on creativity, problem-solving, and collaboration. Australian state education departments have also undertaken initiatives to increase girls' enrollments in computing studies; for example, the Queensland Department of Education, Training and the Arts (2006) has developed a *Girls and ICT Strategy*, along with a range of multimedia and other resources, that is intended to help schools in that state increase girls' interest in computing studies.

#### 1.2.4 Students and Parents: Why IT Is Not a Problem

With the convergence of computing and communication technologies, their use in the home for work, education, and leisure has increased dramatically over the past two decades (OECD, 2001). Young people in Australia are high users of new technological gadgets, particularly mobile phones, music (MP3) players and social applications of the Internet (Australian Bureau of Statistics, 2007). However, while this growing fascination with network and communication technologies might be thought to correlate with an increase in interest in IT education, there are other cultural forces that possibly mitigate against this outcome. The increased interest in, and usage of, such technologies does not

necessarily lead to an interest in learning about the disciplinary knowledge that underpins the engineering logic embedded in these devices.

Today's university students have grown up with these technologies and largely take them for granted. They are generally not privy to the history behind their development and the initial excitement that surrounded the invention of the first microcomputers and the use of computer chips in household equipment. The science that is behind the development of such technologies is extremely remote to the vast majority of a generation who are considered by some to be "digital natives" (Prensky 2001). This point was brought home in a *Sydney Morning Herald* (Timson, 2007) article, which pointed out that current first year university students were only six years old when Windows® 95 appeared on desktop computers.

Other potentially mitigating factors include narrow, outdated understandings of what a career in IT might entail, and potentially contradictory messages about IT jobs and employment opportunities. Student interview data collected by the study reported in this article suggests that not only do a large proportion of students (particularly girls) find school IT education boring and irrelevant to their aspirations, but they also see it as a bad strategic choice in terms of immediate returns in their final school certificate scores and in terms of long-term career prospects.

In terms of factors influencing subject choice for the senior years of secondary school, our survey results indicated that an interest in the subject, the ability to find a job later in life, university entrance and the ability to get a high mark, were important considerations for 89.6%, 86.1%, 68.3% and 55% of students, respectively. Of these considerations, there were significant gender differences for the reported importance of the ability to get a good mark (57.1% of boys and 33.4% of girls said this was important when choosing subjects; boys were also more likely to rate themselves as good at IT). Of interest because it contradicts a common assumption, boys were also more likely than girls to indicate that having friends in the same class was an important consideration (16.5% of boys compared with 6.9% of girls). Liking the subject teacher and the views of parents of the importance of subjects did not rate highly in terms of their influence on students' subject choices. Neither survey nor interview data indicated that students believed that an ability in mathematics was important to the pursuit of studies in computing, which is consistent with the general finding that students have a very limited understanding of what senior studies in computing entail.

## 2. Gender and Information Technology Research Project

This article draws on findings from an Australian research project, the broad aims of which were:

- to ascertain why the proportion of girls who enter education pathways leading to IT careers continues to be so small; and,
- to identify strategies that might lead to increases in the numbers of girls who qualify for, choose, and enter IT courses at the higher education level.

With a view to meeting these aims, the following research questions were framed as drivers for the design of the project:

- How do girls and boys decide what to study at years 11 and 12?
- What are girls' and boys' understandings and opinions of secondary school IT subjects, IT career-related courses and IT-based careers, and what informs these understandings?
- Why do girls and boys choose or reject post-compulsory IT educational pathways, including senior secondary IT subjects?
- How do post-compulsory curriculum structures, school contexts and pedagogical practices affect boys' and girls' interests in pursuing studies in IT-related areas?
- What changes need to be made at the school level to better and more accurately promote IT industries, and the educational pathways that lead to them, to girls and boys?

To answer these questions, a multi-staged project was designed that included teacher and student interviews and a student survey. The school-based data were complemented by an analysis of student participation in post-compulsory IT subjects, based on data from state boards of study, and by an analysis of state IT curriculum documents and interviews with selected curriculum designers. The states included in the study were New South Wales (NSW), South Australia, and Victoria. The study confined its school-based data collection to teachers involved in the delivery of IT education and students undertaking the latter part of their secondary schooling: those in Year 10 in 2005 about to embark on their post-compulsory secondary school studies (who may or may not have elected to pursue future post-compulsory studies in IT), and those in years 11 and 12 in 2006 and 2007, respectively, who had had varying degrees of opportunity to reflect on their senior secondary subject choices. Because the study was primarily interested in students' subject selection the factors and issues that influenced their decisions around IT subjects, it was seen as important to include students who chose *not* to enroll in these subjects, as well as those who did, so that the perceptions and reported experiences that led to a rejection of these subjects could be ascertained.

The data collection methods are outlined here briefly to provide some methodological context to the findings and discussion that follows.

## 2.1 Data Collection

A mixed methods approach was taken to exploring how IT is socially constructed as an area of study, how IT educational pathways become gendered, and how this influences the decisions of boys and girls to pursue or reject post-compulsory IT education. The data collection methods employed included semi-structured teacher interviews, a student survey (largely quantitative), and semi-structured interviews with groups of students. The selection of participants for these parts of the study was driven by the selection of schools. In the recruitment of schools to the project, we sought to vary the level of female IT enrollment, the socioeconomic profile of the schools, and the location (urban, rural, and metropolitan) of the schools.

In total, 26 schools participated in the study (12 from NSW, seven from SA, and seven from Victoria). Only 22 of these schools participated in all data collection phases (teacher interviews, student interviews, and student surveys). Of the 26 schools, 10 were metropolitan, six were located in regional centers, and 10 were rural. In terms of female participation in post-compulsory IT subjects, nine had a high level of participation, three had a moderate level of participation and 14 had a low level of participation. Because of the low overall percentage of girls enrolled in senior IT subjects in Australia, a Year 12 participation rate above 40% was described as high, while a rate between 20% and 40% was considered moderate, and a rate below 20% was considered low. In terms of socioeconomic status (SES), four schools were classified as high SES, 10 were medium SES, and 12 were low SES. These classifications were based on information from respective state authorities.

Each mode of school-based data collection is outlined below.

### 2.1.1 Teacher Interviews

IT coordinators and other teachers of senior IT subjects were interviewed in each school. Through these interviews we sought three main types of information:

- school demographic information;
- information about the school's IT education, including subjects offered, resourcing and support, level of participation by boys and girls, student performance and student destinations, and any special programs or initiatives; and,
- teachers' perceptions of IT education and of the gender gap in enrollments, including their perception of the value of senior IT subjects, their views on the advantages and disadvantages of specific Year 11 and

12 IT subjects, their understanding of students' subject choices, and their explanations for the gender gap.

The teacher interviews were conducted either via telephone or in person, depending on the proximity of schools to the researchers, and were audio-recorded and subsequently transcribed.

### 2.1.2 Student Survey

A quantitative survey was developed to explore how students decide what subjects they would study in years 11 and 12 and what factors might influence their decisions to pursue, or to avoid, IT subjects. Through a 35 item survey we sought to attain individual demographic information, perceptions of schooling, reported computing skills and behaviours, plans for future study, reported motivators for subject choice, career aspirations, and perceptions of IT careers. The survey was administered to students who were either at the end of Year 10 or in the early stages of Year 11 in each school. The numbers of students surveyed in each school varied, based on practicalities within each school. In total, 1430 completed student surveys were returned.

### 2.1.3 Student Interviews

Students were interviewed in small groups ranging from three to seven students, with most groups comprising four or five students. Sixty-six groups of students were interviewed. In most cases, students were grouped according to gender and level of interest in IT (as indicated by their survey responses), such that, where practicable, groups could be categorised as high interest girls, low interest girls, high interest boys, and low interest boys. In some cases, due to practicalities in particular schools, student groups included both boys and girls. Through these interviews we sought to gain insight into students' perceptions of IT and their IT behaviours, their ideas about the IT subjects offered in their school and of the teachers who teach them, their views of the IT industry and careers, and their explanations of the gender gap in IT education and careers. Student interviews were audio-recorded and subsequently transcribed.

### 2.1.4 Curriculum Review

A consultant was commissioned to conduct a review of Year 11 and 12 IT curriculum documents in each participating state, as well as an analysis of female and male enrollment trends over recent years.

### 2.1.5 Limitations

An important data source that was not included in this study was the direct observation of IT classrooms. We have relied upon the reports of students and teachers to provide insight into what goes on when current IT curricula are implemented in classrooms. Our view of this important site of gender and IT politics is, therefore, limited.

A further limitation potentially derives from the decision to conduct student interviews in groups. Group interviews have both advantages and disadvantages in terms of the quality of data collected (Ho, 2006; Kitinger, 1995): while there is a potential in a group setting to collect richer data from school students than might be solicited in an individual interview, there is also a risk that the influence of the peer group will lead to a tendency towards "group think" and a bias in the data. Individuals might be less likely to put forward unpopular ideas in the presence of their peers. Based on our experience in previous studies, we decided that a group setting would be more likely to stimulate extended student responses, and that it would also allow us to observe the workings of popular discourses around computer use, IT studies, and subject choice. While we did observe interviews where individuals appeared to self-censor their opinions and self-reports, we also observed interviews where students put forward ideas and preferences that were clearly unpopular amongst their peers. Robinson and Davies (2007) take up this issue in detail in relation to this project and students' willingness to self-proclaim as "nerds."

### 2.1.6 Analysis

A range of analytical methods were employed in order to make sense of the large body of data collected via the methods outlined above. These included an exploratory factor analysis of the quantitative student survey data, a content analysis of curriculum documents, quantitative analyses of student participation and performance, and thematic content analyses of the teacher and student interview data. A constant comparative approach (Maxwell, 1996) was used to reduce the interview data. This involved reading and rereading interview transcripts to identify and then interrogate common themes within and across interviews. *NVIVO* (QSR International Pty Ltd, 1999-2002) was used to manage this process. This article draws primarily on themes identified through this process to discuss commonalities in students' reported beliefs, perceptions, and experiences that might help to illuminate the research questions. Some reference is made to the quantitative survey findings.

## 3. Why Are So Few Students Interested in Pursuing Computing Education?

The remainder of this article provides an overview and discussion of the research findings as well as some recommendations in relation to declining enrollments in IT, with a particular emphasis on the themes arising from the qualitative student data (interviews). It focuses on common themes found in the data across sites, rather than on differences between schools and between states. First, factors involved in the general decline (males and females) in participation in IT education are examined, focusing on students' misconceptions about this area of study and the

opportunities it provides, their perceptions of the content and teaching methods, and their attitudes towards school IT subjects. Then, the special case of girls and IT education are considered.

### 3.1 Student Misconceptions

The students in this study repeatedly described Information Technology (both as a field of study and as an area of employment) in ways that suggest they hold misconceptions. These included misconceptions about employment and career opportunities in IT, outdated views of the IT professions, and misconceptions about the focus of senior IT curricula.

#### 3.1.1 No Jobs

Students mistakenly believed that there were very few employment and career opportunities in IT. This belief was often based on advice from parents or teachers. The following exchange was typical when interviewees explored the issue of employment opportunities:

*Male student: There's no point 'cause there's already a lot of people in computers.*

*Interviewer: Okay. So you reckon that a lot of IT jobs have been taken up anyway?*

*Male student: Yeah.*

IT teachers reiterated this belief:

*There has been a glut of IT graduates, and jobs – they have dried up now. (IT teacher)*

*Interviewer: Are there reasons you think that students are tending not to study IT?*

*IT Teacher: There are no jobs.*

Such views are in stark contrast to current statistics and future projections by the Australian IT industry and government bodies, which describe and predict further skills shortages in the IT professions.

Students commonly believed that, although the IT industry did not offer much in terms of employment and career opportunities, computing skills were necessary in most areas of employment.

*There's lots of jobs that require computers, a computer background and that. (Male Student)*

*...its about every job. (Male Student)*

This idea was reiterated by IT teachers who may, given their belief in a lack of IT-specific jobs, promote their subject area to students as being of more general appeal. When this issue was explored in student interviews, students were often of the opinion that, yes, computing skills were

important in a wide range of employment areas; however, they also believed that they had reached a sufficient level of skill during their compulsory years of schooling and that senior studies in IT would not add any value in this regard.

#### 3.1.2 IT Professionals Are Nerds

Students also held very narrow views of what work in Information Technology might look like, drawing on popular stereotypes found in the media that portray an impersonal, non-communicative, and non-creative work environment. Both teachers' and students' exposure to the range of professional roles that university studies in IT might lead to was very limited. When talking about the sorts of jobs that might be available, the most common areas cited were low level technical support roles, programming, and Web page design.

Both boys and girls saw IT – as both an area of study and as a career – as gendered. It continues to be seen as a male domain and one that is characterized by non-hegemonic images of manhood (e.g., the male “nerd” or “geek”).

*Interviewer: What sort of image do you think the IT industry has? What sort of picture do you get in your head when we talk about the IT industry?*

*Male student: Nerd guys with computers in dark rooms. I'm sorry, but that's what I get.*

*Interviewer: What do you think the IT industry would be like to work in? What sort of image do you think it's got?*

*Female student: Nerds!*

*Male student: That's it... a big room full of nerds and computers!*

*Interviewer: Do you know anyone at school who's going to do a lot of IT stuff?*

*First male student: Simon. I think my mate, Simon, he's good with computers.*

*Second male student: He's a nerd.*

*Interviewer: Is that good or bad these days?*

*Third male student: It's good cause you're smart with computers, but it's bad because, like, you get bashed up.*

*Interviewer: Now, you haven't got any girls in your class, got any ideas why that is? She might have come at the beginning and now she's dropped out.*

*First male student: IT is a boy subject.*

*Interviewer: IT is a boy subject you think?*

*Second male student: They probably think it's nerdy.*

*Interviewer: Do you think you guys are nerdy? Do you think your IT class is nerdy?...*

*Second male student: I'm a nerd.*

*Interviewer: You're a nerd?*

*Second male student: Yeah.*

*Third male student: I don't think I enjoy IT that much to be a nerd.*

*Interviewer: To make you a nerd?*

*Third male student: Well I don't sit at my computer all the time. Play games and all that all the time. I don't even play games. I don't know why girls...I think it's just because they're not interested in computers.*

The student interview data suggests that these out-dated images of the industry have survived repeated waves of industry public relations exercises relatively unscathed, and that such images contribute to students' lack of interest in pursuing computing education. For further discussion of gendered images of IT identified by our study, please see Rowan (2007) and Robinson and Davies (2007).

### **3.1.3 Year 11 and 12 IT Is Just “More of the Same”**

Many students also held inaccurate views of what the senior school IT curriculum might look like, basing their beliefs on their own experience of IT education in earlier years. In Australia, it is common for the IT education in the compulsory years of schooling to focus primarily on developing basic IT literacy and skills in commonly available software applications. A curriculum analysis performed by Downes and Kleydish (2007) revealed that, although year 11 and 12 IT subjects focus primarily on content that belongs to the disciplines of software engineering (e.g., software development approaches and processes) and information systems (e.g., networks and communication systems), students have almost no opportunity to be introduced to relevant concepts and skills prior to choosing to study these subjects. The discontinuities in the sequence of school IT curricula identified by our study is discussed in detail by Downes (2007).

Very few students in this study reported having had school-based experiences that might introduce them to the type of thinking and content found in senior IT subjects. Based on their earlier experiences of school-based IT education, many students incorrectly assumed that senior school IT subjects would cover similar ground to what they had experienced before.

*Well, between year 8 and 10 we just did Excel from worksheets, and the main difference was it was harder, but more of the same thing. Still Excel, and more of it. So probably Year 11 will be more of the same. (Male student)*

As another student pointed out, by the time they gain some understanding of what is in the year 11 and 12 subjects, they have already made their subject selections (increasingly a selection of non-IT subjects).

*When we come to year 10, we decide on what career we want to do: “hey this is interesting, I might pursue my career in that.” But it's too late when we find out that “hey, [IT] is really interesting in year 11 and 12”*

*because we've already made a decision and its like ‘oh well maybe I want to do that’. ...it's a bit too late. (Male student)*

Furthermore, for those students who do choose to study senior IT subjects, they may do so under a false impression of the focus of these subjects, with many students assuming that these subjects will be relatively easy and that, if they have been successful in IT in previous years, then they will be successful in their final years. As one teacher explained:

*For the Year 12s, not a lot of theory is done beforehand so it becomes a bit of a shock coming from Year 10 & 11. Before Year 12 the students get to do lots of good stuff like making Web pages and making programs. The school hasn't been demanding that students actually do the other part which is knowing why people do this and what makes up the components of a particular network and how it works. (IT teacher)*

Misconceptions about content may contribute to the low enrollments in IT at the senior years and also to more suitable students electing to pursue other areas of study. As discussed below, students who considered themselves to be highly skilled with technology were no more likely than other students to enroll in senior IT subjects.

## **3.2 Failure of Curriculum and Pedagogy**

Our interview data suggests that students do not see the IT curriculum (as they assume it to be) as relevant to their current or future lives beyond the importance of a basic level of fluency in commonly encountered software programs. Nor do they find or expect learning activities in IT classrooms to be intrinsically motivating.

### **3.2.1 Perceived Irrelevance of IT Curricula**

Many of the students in this study saw little or no connection between the IT education they experienced at school and the IT behaviours and skills that they developed at home or in the community. In the majority of cases, the IT curriculum failed to connect with students' existing technological expertise and interests.

As mentioned above, senior school IT curricula in Australia focuses on developing understandings about the approaches and processes used in software engineering and information systems. Yet, prior to the senior years, students are positioned solely as users of technologies. During the compulsory years, they do not consider the design and development of information technologies, and opportunities to position themselves as architects of such technologies are scarce. The following quotes suggest that students' familiarity with everyday digital technologies and software tools, combined with their positioning solely as users or consumers of such technologies in the compulsory years, mean that the notion of studying the technology itself is

foreign and largely unconnected to the way they see themselves and their lives. The following Year 11 IT student demonstrated significant insight into this problem:

*I don't think people are studying IT because I think that in your younger years, because you're brought up around computers and technology, they automatically think [they] have a good grasp of knowledge of how to do basic tasks, and in year 7 and 8 you might have a few lessons on them but they never go in depth into like coding and stuff like that and being able to do your own things, so kids don't really get interested in it. And then they're sort of pushed towards other paths and stuff. (Female student)*

Similarly, this IT teacher saw students' everyday familiarity with and use of information and communication technologies as detracting from an interest in studying the technology itself. This teacher explains how students see very little (if any) connection between Information Technology, the school subject area, and the technological tools they use on a daily basis.

*It's what they've grown up with. They don't recognize it as technology. They would probably have more technology in their bedroom than I would have in my classroom at school, but they don't even recognize that it's technology. They'll have the TV, the DVD player, the iPod, the phone, all of that, and yet to them it's different. ... their use of technology is just so familiar, it's just second nature to them. But they don't recognize it as being technology. They just see it as another gadget. They don't equate the gadget being IT. (IT teacher)*

We had anticipated that, among our student participants, we would find a small sub-group who had a high level of skill and interest in IT and would, therefore, be interested in pursuing senior studies in IT. Surprisingly, however, the student survey data suggested that those students who rate themselves as having high level skills in IT are no more likely than other students to pursue non-compulsory studies in IT (see Vickers & Ha [2007] for a detailed discussion of the quantitative survey results). This surprising finding might be partially explained by the fact that 70% of those students who rated their own skills highly said that they learn more about computers at home than at school. It may also reflect student misconceptions of the content of senior IT subjects, and the incorrect assumption that these subjects will continue the compulsory years' focus on fluency with software applications. This finding suggests that there is a poor match between the school IT curriculum offerings (as perceived by students) and the needs and interests of those students who develop skills and interest in IT outside of school.

### 3.2.2 "Boring" Learning Activities

Overwhelmingly, when the students in our study reflected on studying IT at school, they reported it was "boring." When students were asked to recall something they had done in IT that was 'fun', most were able to recall a project that they had enjoyed, but these were seen to be exceptions to what were described as generally boring exercises. The types of activities they noted as having been engaging included Webpage design (usually using Web-authoring software), video and audio editing, and making animations; that is, there was a preference for activities that required students to make use of software applications for design and production purposes as opposed to what were seen as the more theoretical components of IT studies. As one female student explained, learning activities that provided scope for "creating your own stuff" was preferred over more prescriptive or textbook-based work:

*Interviewer: What about you? What was the most fun that you've ever had?*

*Female student: Yeah just like creating your own stuff rather than going by textbooks and what the teachers say. Like, they give you a task, but being allowed to put your own sort of twist on it. So if they give you, like, set things you have to put it on...like you can put on however you want sort of thing.*

Both students and teachers spoke about the theoretical and the applied components of IT as if they were binary opposites. There was no mention in interviews of how theoretical and practical components might relate to or support each other; rather, they were more often seen as ways of dividing up class time (i.e., yesterday we did practical work on the computers; today we are using the textbook to do theory). The applied components were sometimes seen by students to be creative and fun, while the theoretical components were almost always described as boring. There seems to be no room within this binary construction for creative and "fun" approaches to theory.

One way that the theory-practice nexus might be broached such that the assumptions we identified might be interrupted is via the use of project work where theoretical constructs are needed to solve "real world" problems. Such pedagogical approaches are advocated by industry bodies (as reflecting the work practices of IT professionals) and are incorporated into some school IT curriculum documents. However, as documented by Gannon (2007), we found very little evidence of the implementation of such approaches to the IT curricula.

### 3.3 Girls: A Special Case?

Our review of the relative performance of boys and girls in senior IT subjects revealed that, when girls do study senior IT subjects, they do at least as well as the boys (see Downes & Kleydish, 2007 for details). However, girls do not

recognize their own IT skills, and they are less likely than boys to rate themselves as highly skilled with IT (see Vickers & Ha [2007] for a discussion of this finding).

When asked why they find the prospect of studies in IT unattractive, girls often say that it would be boring, individualistic, and repetitive, and many of the girls in our study expressed a preference for working together to create products that would be useful in connection to real world contexts. None anticipated that senior IT subjects would offer opportunities for this sort of learning.

Our interview data supports existing research in that it suggests that girls have more interest than boys in technologies that can be used to communicate with friends (e.g., social software, instant relay chat facilities, mobile phones, and SMS). As one teacher explained:

*Girls in their teenage years are interested in technology but not the technology of computers. They're interested in iPods and mobile phones, but they are not like the boys who play games for hours on end. They are just not interested in that. (IT teacher)*

However, neither the students nor the teachers we talked to saw a relationship between girls' use of such technologies and school IT learning. This type of technology usage was seen as social in nature, rather than as an area of IT expertise or interest.

The study of IT, professions of IT, and interest and skills in this area were constructed by students and teachers alike as gendered, with many students saying that girls were naturally less inclined to be interested or skilled in this area. Some girls also demonstrated some understanding of the potentially male dominated culture of IT professions.

#### 4. Conclusion

There is no one solution to the gender and IT problem as it has been articulated here – it is a challenging, multifaceted, and persistent problem whose roots can be found in our most basic assumptions about gender, the role of schooling, the place of technology, and in our habitual ways of thinking and talking about such things. Despite efforts made by the Australian IT industry to recruit more females, it continues to be, and to be seen as, a male dominated field. Similarly, initiatives at both the tertiary and secondary education levels have failed to make significant headway in the correction of persistent gender disparities in participation. In fact, in recent years at the secondary education level, girls' participation relative to boys' has decreased. Many boys, girls, and teachers continue to see it as an area that is not attractive to females, and stereotypical views of girls' and boys' relative suitability for study in this area persist.

However, this is not just a gender problem: in Australia, as in many other developed countries, overall participation in IT education has declined since 2000. The research project reported here suggests that contemporary school students do not see IT education as interesting or as offering opportunities. This is a problem that needs to be tackled on multiple fronts – both on the level of strategy in terms of curriculum development, career education, and teacher education, and professional development, and on the level of on the ground tactics that can be employed in schools.

Finally, the findings of this research have implications that go beyond issues of IT education and careers; they raise important questions about not only how schools “do” IT, but about how they speak to and recruit and maintain the attention of a new generation of students, both boys and girls, for whom information and communication technologies are a defining characteristic of their social worlds and who position themselves as users and consumers of these tools instead of as potential architects of the future.

If Information Technology is to survive as a subject area in the senior years of schooling, schools need to focus on making better connections between classroom learning and the expertise developed outside school. There is a lot more room for overlap between the types of technological experiences students have in the community and the ones they have at school. By taking advantage of students' existing skills and interests, schools would be better positioned to assist students to become critical users and producers of the new technologies that are now found in almost every sphere of life.

#### References

- Australian Bureau of Statistics 2007, *Australian social trends*. ABS: Canberra, ACT, retrieved October 18, 2007, from <http://www.abs.gov.au/ausstats/abs@.nsf/mf/4102.0?OpenDocument>
- Australian Computer Society. (n.d.). *About the ICT industry, video recording*. Australian Computer Society. Retrieved July 1, 2007, from <http://www.acs.org.au/index.cfm?action=show&conID=aboutictvideo>
- Australian Department of Communications, Information Technology, and the Arts (2006). *Overview of the Australian ICT industry, November 2006*, Retrieved July 1, 2007, from [http://www.dcita.gov.au/communications\\_and\\_technology/publications\\_and\\_reports/2006/november/overview\\_of\\_the\\_australian\\_ict\\_industry](http://www.dcita.gov.au/communications_and_technology/publications_and_reports/2006/november/overview_of_the_australian_ict_industry)
- Anderson, N., Timms, C., & Courtney, L. (2006). If you want to advance in the ICT industry, you have to work harder than your male peers. Women in ICT industry survey: Preliminary findings. Paper presented at the AusWIT conference, Adelaide, December 4-5.

- Dobson, I.R. (2007). *The IT education bubble: An analysis of university student statistics 2002-2005*. Fairfield, Victoria, Centre for Population & Urban Research Monash University and The Educational Policy Institute.
- Downes, T. (2007). The nature and purpose of Computing and Information Technology subjects in the senior secondary school curriculum in New South Wales. In J. Lynch (Ed.), *Gender and IT: Ongoing challenges for Computing and Information Technology in Australian Secondary Schools* (pp. 63-80). Altona, Victoria: Common Ground Publishing.
- Downes, T., & Kleydish, A. (2007). *Curriculum, participation and performance of senior secondary Computing and IT subjects in NSW, Victoria and South Australia*. A GaIT Working Paper (unpublished report), Charles Sturt University. Available on request from [tdownes@csu.edu.au](mailto:tdownes@csu.edu.au).
- Frauenheim, E. (2004, August, 11). Students say no to computer science, *CNET News*. Retrieved October 19, 2007, from [http://www.news.com/2100-1022\\_3-5306096.html](http://www.news.com/2100-1022_3-5306096.html)
- Gannon, S. (2007). Perceptions of changing pedagogies in Computing and Information Technology. In J. Lynch (Ed.), *Gender and IT: Ongoing challenges for Computing and Information Technology in Australian secondary schools* (125-147). Altona, Victoria: Common Ground Publishing.
- Ho, D. (2006). The focus group interview: Rising to the challenge in qualitative research methodology. *Australian Review of Applied Linguistics*, 29(1), 5.1-5.19
- James, R., Baldwin, G., Coutes, H., Krawse, K., & McInnis, C. (2004). *Analysis of equity groups in higher education 1991-2002*. Australian Department of Employment, Science & Technology, Canberra.
- Kitzinger, J. (1995). Introducing focus groups (Qualitative Research Part 5), *British Medical Journal*, 311, n.7000, 299-304.
- Lea, V. (2006, July 18). Echoes of tech wreck fading away, *The Australian*. Retrieved October 19, 2007, from <http://www.australianit.news.com.au/story/0,24897,19819018-15348,00.html>
- Maxwell, J. Q. (1996). *Qualitative research design: An interactive approach*. Thousand Oaks, CA: Sage.
- McBride, N. (2007, March 13). Time to get with the program, quit flogging that horse, *Sydney Morning Herald*. Retrieved March 20, 2007, from [http://www.smh.com.au/articles/2007/03/12/1173548107\\_457.html](http://www.smh.com.au/articles/2007/03/12/1173548107_457.html)
- Multimedia Victoria (2004). *Attitudes to ICT careers and study among 17-19-year-old Victorians*. Melbourne: Multimedia Victoria.
- Multimedia Victoria. (2007). *ICT Skills Snapshot 2007*, Multimedia Victoria, Melbourne.
- OECD. (2001). *OECD science, technology and industry scoreboard: Towards a knowledge-based economy*, Paris: OECD.
- Prensky, M. (2001). Digital natives, digital immigrants, *On the Horizon*, 9(5), 1-6.
- QSR International Pty Ltd (1999-2002). *QSR NVIVO, V2.0.161*, Melbourne, Australia.
- Queensland Department of Education, Training and the Arts (2006). *Girls and ICT strategy 2005-2008*. Retrieved November 12, 2007, from <http://education.qld.gov.au/smartclassrooms/pdf/girls-ict-strategy.pdf>
- Roan, A., & Whitehouse, G. (2007). Women, Information Technology and waves of optimism: Australian evidence on mixed-skill jobs, *New Technology, Work and Employment*, 22(1), 21-33.
- Robinson, K., & Davies, C. (2007). Boy nerds, girl nerds: Constituting and negotiating Computing and Information Technology and peer groups as gendered subjects in schooling. In J. Lynch (Ed.), *Gender and IT: Ongoing challenges for Computing and Information Technology in Australian secondary schools* (pp. 97-110). Altona, Victoria: Common Ground Publishing.
- Rowan, L. (2007). A question of attention: Challenges for researching the under representation of girls in Computing and Information Technology subjects. In J. Lynch (Ed.), *Gender and IT: Ongoing challenges for Computing and Information Technology in Australian secondary schools* (pp. 41-62). Altona, Victoria: Common Ground Publishing.
- State Government of Victoria (2006). Collaboration tackles ICT skills shortage, *Connecting Victoria: The Victorian Government ICT Newsletter*, no. 23, p.6, Retrieved November 12, 2007, from <http://www.mmv.vic.gov.au/uploads/downloads/ResourceCentre/ConnectVictoriaIssue23.pdf>
- State Government of Victoria (2007). *Upload your future*. Retrieved July 1, 2007, from [http://www.mmv.vic.gov.au/uploads/downloads/Skills\\_careers/UploadYourFutureEventDetails.pdf](http://www.mmv.vic.gov.au/uploads/downloads/Skills_careers/UploadYourFutureEventDetails.pdf)
- Timson, L. (2007). Is computer science dead? *Sydney Morning Herald*, March 12, Retrieved 20 March 2007, from [http://www.smh.com.au/articles/2007/03/12/1173548107\\_417.html](http://www.smh.com.au/articles/2007/03/12/1173548107_417.html).
- Vickers, M. & Ha, M. (2007). The imagined curriculum: Who studies Computing and Information Technology at the secondary level, in J. Lynch (Ed), *Gender and IT: Ongoing challenges for Computing and Information Technology in Australian secondary schools* (pp. 27-40). Altona, Victoria: Common Ground Publishing.
- Victorian ICT for Women. (n.d.). *Go girl, go for IT*. Retrieved July 1, 2007, from <http://www.vicictforwomen.com.au/www/html/177-go-girl-go-for-it-2006.asp>
- Webster, J. (2005). Women in IT professions: Corporate structures, masculine cultures, *Proceedings of the 3rd European Symposium on Gender & ICT: Working for Change*, February 1, 2005, Manchester, United Kingdom.

Retrieved November 12, 2007, from <http://ict.open.ac.uk/gender/2005/papers/Webster.doc>  
 Women are IT WA (n.d.). *Go girl, go for IT*, Retrieved July 1, 2007, from <http://gogirlwa.org.au/index.php>  
 YWCA Australia (2007). *Elev@te: Young Women and Technology Leadership Project 2007; Student Evaluation Report*. Retrieved July 1, 2007, from <http://www.learningplace.com.au/uploads/suborgimages/286/elevate-evaluation-report-for-Web.doc>

### Acknowledgements

The introductory sections of this article are based on a book chapter written by the author and published in Lynch, J. (Ed.) (2007). *Gender and IT: Ongoing challenges for computing and information technology education in Australian schools*. Altona, Victoria: Common Ground Publishing. Excerpts have also been included in an Australian professional publication – *Snapshot* – published online for the membership of the Australian National Schools Network.

The research project upon which this article draws was funded by the Australian Research Council's national competitive grants program. It is formally titled *From High School to Higher Education: Gendered pathways in information, communication and computer technology education*. The project was supported by the following industry partners: the New South Wales Department of

Education and Training, the Australian National Schools Network, the South Australian Department of Education and Children's Services, and the Office for Women in the New South Wales Department of Premier and Cabinet. The views expressed in this article are those of the author only, and may not reflect the views of the Industry Partner organizations. The research team drew on expertise from three Australian universities: Charles Sturt University, Deakin University and the University of Western Sydney.

### Author Information

Julianne Lynch, Ph.D.  
 Senior Lecturer  
 School of Education  
 Faculty of Arts & Education  
 Deakin University  
 221 Burwood Hwy  
 Burwood, 3125, AUSTRALIA  
 +613 9244 6970  
[jlynch@deakin.edu.au](mailto:jlynch@deakin.edu.au)

Julianne Lynch is a teacher educator, with a particular interest in supporting pre-service teachers to think critically about how new technologies are used in the classroom and to develop pedagogical approaches that support credible connections between learners' lives, communities, interests, and expertise and their classroom use of technologies.