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CHAPTER 1

Introduction: Exploring the gender and IT problem and possible ways forward

JULIANNE LYNCH, Deakin University

This book has grown out of a research project that focuses on gender and the study of Computing and Information Technology (CIT) at the senior secondary school level. It contributes to a longstanding tradition of inquiry regarding gender differences in participation within what have historically been considered the male-dominated disciplinary areas of science, engineering, mathematics and (more recently) Computing and Information Technology. What are popularly referred to as the ‘Girls and …’ problems (Girls and Science, Girls and Engineering, Girls and Maths ...) have attracted the attention of many educational and feminist theorists and researchers. Over the past three decades, these researchers have explored the question of why fewer girls than boys participate in such areas, why this is considered to be a ‘problem’ and how this problem might be rectified. Despite advances made, these discipline areas continue to be seen as problematic by those who seek to promote females’ equal and full participation in education and employment.

Participation rates for girls in CIT education, both at school and at university, continue to be significantly lower than those of boys, despite over 20 years of research attention, numerous waves of intervention and the vastly increased integration of computing technologies into our daily lives. Much of the research in this area has been stimulated by the CIT industry’s need to attract more graduates, and its desire to include more women and a more diverse range of graduates suited to the new roles now available in this industry. Much of the existing research has therefore focused on reducing female attrition at the university level. This book builds on research at the school level that has begun to document complex gender differences in the nature and level of computer use by boys and girls, as well as the relations between computing as a field of practice and the gendering of identities within this field. We have sought to identify how the CIT curriculum is socially constructed as an area of study and how this influences the decisions boys and girls
make to pursue, or to avoid, CIT education pathways. Thus, we hope to develop a better understanding of the processes that occur during secondary school that lead to gender-based disparities in rates of entry to university CIT courses.

This introductory chapter is in three parts. First, I provide a description of the field of practice with which the book is concerned: CIT education. An explanation of the terminology used in the book is provided and the gender and IT problem is discussed. In the second part, I provide a description of the research project that is the basis of each of the subsequent chapters. Finally, the contribution of each chapter is introduced and discussed, and some preliminary recommendations stemming from this ongoing research project are outlined.

Part I: Computing and Information Technology (CIT) and the gender problem

What do we mean by CIT?

In this book, we are concerned with a diverse field of study and practice that we refer to as Computing and Information Technology (CIT). We use this term in three main ways: to refer to a school curriculum area, a major university discipline, and a group of industry sectors, all of which concern themselves with a particular category of technology. Artefacts — such as computers, computer software, computing accessories, handheld digital computing and communications devices, computer networking, and digital communication infrastructure — and the knowledge, processes and techniques that inform the development, implementation and servicing of these technologies, fall within the definition of Computing and Information Technology (CIT) used throughout this book.

In Australian schools, CIT education is manifested at the senior secondary level in subjects such as Information Technology, Information Systems and Information Processing and Management, offered at the Victorian Certificate of Education (VCE) level in Victoria; Information Processes and Technology and Software Design and Development, offered at the Higher School Certificate (HSC) level in New South Wales; and Information Technology Studies and Information Processing and Publishing, offered in South Australia (SA). Similarly titled subjects are offered in Years 11 and 12 in other Australian states and territories. Content areas commonly included in these subjects include programming, software development processes, ethical issues involved in software development, project work and project management, information systems, systems development, computer hardware, communications technology and multimedia.1

1. Since the collection of data reported in this book, these (and other) CIT subjects in Victoria have been renamed. The pre-2006 names are retained here and throughout this book to reflect the names used by students and teachers in our school data.

2. Among the subjects listed above, Information Processing and Publishing is an exception in its inclusion of units focused on skills development in the use of business and publication applications (Kleydish & Downes 2007).
In response to the rapid growth of the CIT industry, university education in CIT has developed over the past 20 years from a specialty area located in Science and Engineering faculties to a number of sub-disciplines, many now forming the focus of independent university departments and faculties. University studies in CIT include areas such as electronics (as applied in the development of computing technology), computer science and software engineering, communications technology, information management, information systems, and (more recently) multimedia and computer game design. Most of the senior secondary school subjects currently offered in Australia, such as those named earlier, have been designed as pathways into university CIT courses — however, they are not prerequisites for entry into such courses. Most university courses in CIT require prerequisite study scores in English and mathematics. The Vocational Education and Training (VET) sector also provides opportunities for senior secondary school students to study CIT. VET certificates are offered in areas such as multimedia, software applications and network administration. These certificates do not usually provide a pathway into university education.

As an industry, CIT includes technology-focused sectors, such as Telecommunications and Consulting and Software Services, as well as personnel employed in non-technology focused businesses, for example in Finance and Administration and Government Administration and Defence (Multimedia Victoria 2005). Occupations within this industry include professional roles in areas such as Business and Systems Analysis, Database and Systems Administration, and Networking and Support (Australian Bureau of Statistics [ABS] 2006), which usually require at least a bachelor level qualification. The work of CIT professionals is often supported by technicians who hold diploma level qualifications. CIT technicians are also found in non-technology focused businesses, where they provide support for the maintenance of computer infrastructure and telecommunications networks (ABS 2006).3

A note on terminology
The terminology used to describe the field of practice discussed in this book is fraught with potential confusion. We have chosen to use a somewhat clumsy and unfamiliar term (Computing and Information Technology) to refer to the formal curriculum areas that explicitly focus on the domains of knowledge and skill outlined earlier. We chose not to use the more popular term ICT (Information and Communication Technology) because its common usage has led to a lot of slippage in meaning. In relation to school education, the term ICT is used in a number of

3. Although these areas are subject to similar gendered patterns as other CIT occupations, technical roles and the types of education and training pathways that lead to them are generally seen as outside of the scope of the research project, because these employment outcomes are not recognised as part of the CIT undersupply problem. That said, gendered patterns of employment in such technical roles are likely manifestations of some of the same issues that we explore in this volume.
different ways. In most Australian states, ICT is now used to refer to the computing hardware and software available in schools, the integration of this technology across the school curriculum, the development of students' skills in the use of these tools (which is currently promoted as a cross-curricular or interdisciplinary enterprise in all Australian states and territories), and sometimes to the elective or mandatory specialist CIT subjects offered in Years 7-10. To add to the confusion, junior-level CIT subjects are often referred to as IT (Information Technology). Among educators, the term ICT is often used interchangeably with IT as evident in references to ICT teachers and IT teachers. It is also sometimes used by senior CIT teachers when referring to the formal curriculum area that we call CIT. Despite CIT teachers' own usage of these other terms, in this volume we will consistently use terms such as CIT education, CIT subjects and CIT teachers, to avoid potential confusion. As a term, Computing and Information Technology appropriately reflects the current focus of many of the state senior CIT curricula in relation to the disciplines of computer science and information technology.

Importantly, we wish to distinguish between CIT as a formal curriculum area or discipline and initiatives which seek to increase students' general ICT literacy. This distinction is somewhat artificial and potentially deceptive in a number of ways. First, one might expect to see a developmental path in students' learning as they move from encountering computing technologies in their other curriculum areas towards studies in senior CIT subjects. However, as discussed in Chapter 4 by Downes, such pathways are rather haphazard and are rarely formalised (if they can be said to exist at all) at the school level. There are, in fact, distinct differences in the focus and aim of K–10 ICT initiatives and senior CIT subjects, such that their relationship is more often characterised by discontinuities and tensions, rather than a developmental pathway. However, despite discontinuities in the formal curriculum, specialist CIT subjects and cross-curricular ICT initiatives are both sources of students' CIT learning, as are their out-of-school experiences with computing technology. In the eyes of our participants, particularly Year 10 students who have no direct experience of senior CIT subjects, the distinction may not be particularly meaningful. Further, the relationship between performances of gender and the construction of technology can be assumed to cross over the line we are drawing between specialist senior CIT subjects and other sites of technology use, both in and out of schools. The distinction is artificial; however, it serves a pragmatic purpose in defining the scope of our research and clarifying the distinction between the generic uses of computing and IT tools, and CIT as a specialist subject. It is also a useful device for focusing our attentions on the processes and constructions that pertain specifically to the problem we seek to illuminate — the persistent low numbers of girls enrolling in senior CIT subjects — and how aspects of this problem interact with, and are influenced by, performances of gender and technology at other sites.

4. This point is taken up in detail by Toni Downes in Chapter 4 and by Catherine Harris in Chapter 5.
In my opening paragraph, I referred to the 'girls and ...' problems; however, limited participation of females in historically male-dominated fields is no longer seen merely as a girls' problem. Inquiry and intervention in such areas have moved beyond feminist movements of the 1970s and 1980s where it was believed that changing girls' attitudes and behaviours could lead to equal participation (Dillabough 2001). Instead, we frame the different attitudes and behaviours of girls and boys as a gender issue: children learn to perform particular versions of femininity and masculinity, influenced by the multiple and sometimes conflicting messages about what it means to be a girl or boy which emanate from a range of sources within their cultural context (see chapters by Robinson & Davies and by Rowan in this volume for more detailed discussions of contemporary perspectives on gender). Such performances can be self-limiting in terms of orientation to educational and career choices and they are notoriously difficult to interrupt. This understanding of gender underlies the research project upon which this volume is based.

**Gender and CIT: What is the problem?**

The low level of participation of girls and women in CIT 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, enrolments in CIT subjects and courses continue to be low in schools and universities, with women making up less than 30% of CIT university enrolments (James, Baldwin, Coutes, Krawse & McInnis 2004). This is seen as an equity issue and also as a problem for the CIT industry, which anticipates worsening current shortages in specialist skill areas if more school students (both boys and girls) cannot be recruited into university courses (Department of Communications, Information Technology and the Arts 2006; Multimedia Victoria 2004).

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 gender and IT problem 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 CIT departments whose work and careers are invested in attracting school leavers to university CIT courses.
- Curriculum developers and teachers who work with the CIT curriculum.
- 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 in the following pages.
Employers, industry and the nation: A problem of skill supply and failed public relations

A commonly told story of the CIT industry, in Australia and 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 CIT workers. University enrolments 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 CIT), the numbers of students enrolling in Australian university CIT courses has declined steadily since the 'bubble' burst (Dobson 2007).

Seven years later, the CIT industry no longer commands the attention it did during that period of dramatic change, and the general public are 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 our research, the dotcom story is still at the forefront of our imaginings about this industry. The students and teachers we interviewed 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 CIT industry are the continued sluggish enrolments in university CIT courses. However, despite these popular perceptions, government and professional bodies report that the need for CIT graduates in Australia is not being met and that the industry, as well as other businesses that employ CIT professionals, face a potentially serious shortage of skills in the next few years (Department of Communications, Information Technology and the Arts 2006; Multimedia Victoria 2004). Even before the dotcom collapse and related declines in interest in CIT careers, women were seen as an untapped pool of potential graduates. In Australia, women make up only 15% of the Australian CIT industry and this 15% is over-represented in computing support roles and under-represented in computing professional roles (Department of Communications, Information Technology and the Arts 2006).

As well as misconceptions around employment and career opportunities, the CIT industry struggles against stereotypical but inaccurate images of the nature of work within the industry. The traditional stereotype is one of a male, socially inept, computer programmer, working 'twenty-four/seven' 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. A Victorian study of attitudes of 17–19-year-olds found 59% agreed that a career in CIT meant sitting in
front of a computer all day, with a similar proportion agreeing that a career in CIT would be boring (Multimedia Victoria 2004). This study also found that young women, in particular, emphasised the importance of creativity, human interaction and job security as important aspects of a career — characteristics they did not associate with careers in CIT (this finding is discussed in the chapters by Gannon, Robinson & Davies, and by Vickers & Ha).

The CIT industry, professional organisations and state governments have put considerable effort into countering these beliefs through campaigns that target school-age and university students, seeking to emphasise the new types of roles and ways of working that have emerged. These campaigns promote the collaborative, project-based nature of much of the work of a CIT professional, emphasise 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 (ACS) About ICT Industry video (ACS 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 2007) — a three-day camp that aims to increase school-age girls' confidence and exposure to technology.

CIT employers and industry bodies generally recognise 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 CIT industry research literature also recognises 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 CIT industry are increasingly being promoted as women-friendly in their focus on projects, collaboration and interpersonal communication — as pointed out by Gannon in Chapter 8 of this volume — it is also an industry dominated by contract work and salary bonuses. Gannon suggests that the flexibility and mobility of this industry can be read in ambivalent ways by women.

University departments: Death or rebirth of an academic discipline?
The number of students pursuing university studies in CIT has been decreasing in Australia since 2000 (Dobson 2007). This is part of an international trend which has very few exceptions among western countries. In Australia, there are a few courses which are exceptions to this trend. Courses that have not suffered a decline
in numbers include those that emphasise computing application, focus on multimedia and games development, and that are offered as double degrees with business courses. Overall numbers of university CIT students have dropped; however, the fall in female enrolments has been greater than the fall in male enrolments, and it started from a much lower base. In 2002, only 24% of Australia’s university enrolments in ICT courses were women (James, Baldwin, Coutes, Krawse & McInnis 2004).

There is ongoing debate among university academics and CIT professional organisations about the sustainability of disciplines such as computer science, given the continuing decline in enrolments. 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) CIT 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 more students. Courses and promotional materials are beginning to emphasise 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 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.

Curriculum workers: Navigating competing agendas

It is widely recognised by secondary CIT teachers and educational authorities that senior CIT subjects have experienced dramatic decreases in enrolments over the past several years. A review of participation rates in Year 11 and 12 CIT subjects over the past five years in the three states participating in our research revealed significant drops in participation in most CIT subjects (Kleydish & Downes 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 enrolments were the Information Processing and Publishing subject in South Australia, which has a significant emphasis on skill development in applications, and VET studies in Multimedia in both NSW and Victoria (Kleydish & Downes 2007).

The general decline in senior CIT enrolments is a problem for curriculum workers, particularly teachers, who have emotional and material investments in the sustainability and status of CIT as a school subject. For teachers who have invested time, energy and status in the development and delivery of CIT education as a specialist area in which they are the experts, the decline in enrolments represents
a threat to the future viability of such subjects. To such teachers, the decline of this subject area would require them to recast and reposition themselves and their expertise within the context of their workplaces. The positioning of CIT 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. As Harris points out in Chapter 5, cross-curricular ICT initiatives and specialist CIT subjects often have conflicting agendas, as well as being in competition for resources, which adds to the complexity of the micropolitics of being a CIT teacher.

Some teachers and schools have taken steps to attract more students to post-compulsory CIT subjects by attempting to increase general interest, or to interest girls specifically. Some CIT curriculum documents make explicit reference to the suitability of this area of study for girls. For example, the syllabus for the NSW 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. State education departments have also undertaken initiatives to increase girls' enrolments in CIT 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 CIT studies.

**Students and parents: Why CIT 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 (ABS 2007). However, while this growing fascination with network and communication technologies might be thought to correlate with an increase in interest in CIT 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 recent *Sydney Morning Herald* (Timson 2007) article, where Justin Zobel of RMIT University pointed out that current first year university students were only six years old when
Windows® 95 appeared on our desktops. It is possible that the increased integration of technologies into the social environment in which young people inhabit actually reduces interest in CIT as a disciplinary study.

Other potentially mitigating factors include narrow, outdated understandings of what a career in CIT might entail, and potentially contradictory messages about CIT jobs and employment opportunities. Our student interview data suggest that not only do a large proportion of students (particularly girls) find school CIT 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.

Part II: The GaIT Project

Each chapter of this book reports preliminary findings from our research project, funded by the Australian Research Council’s (ARC) national competitive grants program, titled From High School to Higher Education: Gendered pathways in information, communication and computer technology education. This project was funded as a Linkage Project by the ARC in the 2005 round of competitive grants for a three-year period ending in 2007. It is supported by the following industry partners: Robert Stevens and Ruth Habgood from the New South Wales Department of Education and Training, Viv White from the Australian National Schools Network, Ken Lountain and Dianne Mellowship from the South Australian Department of Education and Children’s Services, and Alexandra Shehadie from the Office for Women in the New South Wales Department of Premier and Cabinet. The project has become known (and in this book will be referred to) as the Gender and Information Technology (GaIT) project.

The GaIT research team draws on expertise from three Australian universities: Charles Sturt University, Deakin University and the University of Western Sydney. It comprises a range of skills and knowledges spanning both quantitative and qualitative research methodologies, and expertise in such diverse content areas as youth studies, technology and education, educational diversity and disadvantage, school curriculum and subject culture, teachers’ work and teacher identity. This diversity is reflected in the authorship and flavour of the chapters included in this book and is one of the strengths of the volume.

In the section that follows, I outline the aims and methodology of the research project and briefly describe the range of approaches to data analysis taken by the authors of subsequent chapters. In terms of the project design and data collection, this chapter serves as a reference for other chapters, all of which draw on the data described here. However, the foci and analytical approaches taken by individual authors will be expounded in detail within individual chapters as appropriate.

5. The views expressed in this book are those of the respective authors only, and may not reflect the views of the Industry Partners or their respective organisations.
Project aims and scope

The broad aims of the GaIT project are (1) to ascertain why the proportion of girls who enter education pathways leading to CIT careers continues to be so small and (2) to identify strategies that might lead to increases in the numbers of girls who qualify for, choose, and enter CIT 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:

I How do girls and boys decide what to study at Years 11 and 12?
I What are girls' and boys' understandings and opinions of secondary school CIT subjects, CIT career-related courses and CIT-based careers, and what informs these understandings?
I Why do girls and boys choose or reject post-compulsory CIT educational pathways, including senior secondary CIT subjects?
I How do post-compulsory curriculum structures, school contexts and pedagogical practices affect boys' and girls' interests in pursuing studies in CIT-related areas?
I What changes need to be made at the school level to better and more accurately promote CIT 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 CIT subjects, based on data from state boards of study, and by an analysis of state CIT curriculum documents and interviews with selected curriculum designers. The states included in the study were New South Wales (NSW), South Australia (SA) and Victoria. The study confined its school-based data collection to teachers involved in the delivery of CIT 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 CIT), 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.

Most of the chapters in this volume were written early in 2007. At this point, data collection was completed but a year of project analysis and reporting remained. Thus, most of the chapters focus on responding to the first of our aims — to ascertain why so few girls pursue CIT education. This is undoubtedly the easier of the two aims to meet, for it involves an analysis of the situation at hand. Devising strategies that might lead to change is a much more ambitious aim, particularly when broader social forces and issues of identity are involved. That said, a number of the chapters make implicit and/or explicit recommendations in terms of pedagogy, curriculum, teacher education and professional development, and other aspects of the gender and IT problem. These, along with the key finding reported in each chapter, are summarised at the end of this introductory chapter.
Data collection

A mixed methods approach was taken to exploring how CIT is socially constructed as an area of study, how CIT educational pathways become gendered, and how this influences the decisions of boys and girls, to pursue or reject post-compulsory CIT education. The data collection methods employed included semi-structured teacher interviews, a (largely quantitative) student survey, 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 CIT enrolment, 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). School pseudonyms and summary profile information (female participation, socioeconomic status, and location) are tabulated in Appendix A, by state. Teachers were also given pseudonyms. Pseudonyms are used consistently throughout this book where it has been appropriate to refer to particular schools and particular individuals. Of the 26 schools, 10 were metropolitan, six were located in regional centres, and 10 were rural. In terms of female participation in post-compulsory CIT 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 CIT 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 here.

Teacher interviews

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

- school demographic information;
- information about the school's CIT 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 CIT education and the IT and gender problem, including their perception of the value of senior CIT subjects, their views on the advantages and disadvantages of specific Year 11 and 12 CIT 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.

**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, CIT 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 CIT 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.

**Student interviews**

Students were interviewed in small groups ranging from three to seven students, with most 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 CIT (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 CIT and their CIT behaviours, their ideas about the CIT subjects offered in their school and of the teachers who teach them, their views of the CIT industry and careers, and their explanations of the gender gap in CIT education and careers. Student interviews were audio-recorded and subsequently transcribed.

**Curriculum review**

Alfred Kleydish was commissioned by the GaIT project to conduct a review of Year 11 and 12 CIT curriculum documents in each participating state, as well as a summary of female and male enrolment trends.

**Limitations**

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

A range of analytical methods have been employed in order to make sense of the large body of data collected via the methods outlined earlier. Chapter 2 by Vickers and Ha reports findings from an exploratory factor analysis of the quantitative student survey data. Chapter 4 by Downes uses a model-driven content analysis to examine curriculum documents, as well as providing a comparison of student participation rates in a range of subjects, comparing male and female participation rates over time in NSW. In Chapter 8, Gannon uses summary statistics to describe characteristics of the CIT job market, as well as providing a discussion of a particular CIT syllabus. Chapters by Rowan, Harris, Robinson and Davies, Reid and van den Akker, and Gannon, all use various forms of thematic content analysis to support their reporting of the qualitative teacher and student interview data. Where appropriate, specific data analysis methods have been elaborated in particular chapters.

The final part of this chapter examines the contributions of the book, discussing the main conclusions and implications of each chapter.

Part III: Contribution of this book

In the seven chapters that follow, drawing on parts of a common data set, the authors bring a range of perspectives and their diverse expertise to bear on the question of why overall participation in senior secondary CIT subjects is decreasing, why the participation of girls continues to be so low and indeed continues to decrease, and what avenues might be explored as a response to these problems. The chapters have different but overlapping foci: three of them explore issues in relation to the CIT curriculum (Downes; Vickers & Ha; Harris⁶), two pursue issues of pedagogy (Gannon; Reid & van den Akker⁷), four examine issues related to CIT teachers (Harris; Reid & van den Akker; Rowan; Robinson & Davies⁸), and four address issues relating to students (Vickers & Ha; Rowan; Robinson & Davies; Gannon⁹). The contribution of each chapter is discussed here in relation to these four aspects of the gender and IT problem — curriculum, pedagogy, teachers and students.

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6. While the primary focus of chapters by Vickers and Ha and by Harris are ‘students’ and ‘teachers’ respectively, each contributes to our understanding of the CIT curriculum: how it is perceived and the micropolitics that surround it.

7. While the primary focus of Reid and van den Akker’s chapter is CIT teachers, their analysis extends to different pedagogical approaches and how they feature in the broader context of teachers’ work and lives.

8. The chapters by Rowan and by Robinson and Davies focus on students’ gendered constructions of CIT and of themselves as CIT students and users of technology; however, in their attention to the contribution of teachers’ beliefs and behaviours to such constructions, they both provide insight into how teachers conceive of CIT and the ‘girls and CIT’ problem.

9. Although the primary focus of Gannon’s chapter is CIT pedagogies, a key contribution is her analysis of students’ reported experiences of such pedagogies, thus adding to the picture we have of students’ beliefs about CIT subjects.
CIT curricula

Curriculum is an important aspect of the gender and IT problem. Central questions include:

- What is included and what is not included in the formal curriculum?
- What do manifestations of curriculum frameworks and syllabuses look like in classrooms?
- How are CIT curricula (as intended and as enacted) perceived by teachers and students?
- What impact do each of these have on participation generally and on the participation of girls specifically?

The answers to each of these questions have the potential to illuminate the processes behind boys' and girls' subject choices, the reasons behind the decline of CIT enrolments and the persistent and worsening gender gap.

In Chapter 4, Toni Downes provides a detailed analysis of enrolment patterns and the intended curriculum (i.e., syllabus documents) in New South Wales. She uses the ACM Model Curriculum for K–12 Computer Science (Tucker, Deek, Jones, McCowan, Stephenson & Verno 2003) to analyse the foci and purpose of intended CIT curricula in this state from Kindergarten to Year 12. Her analysis draws attention to gaps and discontinuities in the scope and sequence of CIT school education. Specifically, she describes the shift in focus from curricula which, in the K–10 years, focus almost exclusively on applications and computer literacy, to senior years' curricula wherein a discipline-based approach sees students focusing on substantive concepts from the disciplines of software engineering and information technology. Downes suggests that this discontinuity may have a deleterious effect on senior CIT enrolments because of the ill-informed beliefs that students form about CIT subjects, based on their K–10 experience.

This analysis is supported by the findings reported by Margaret Vickers and My Trinh Ha (Chapter 2), where the authors demonstrate that students expect Year 11 and 12 CIT subjects to have a similar focus on skills development and common software applications as those computing studies subjects encountered in the more junior year levels. Downes develops the concept of the imagined curriculum to describe the constructions of students who have no direct experience of Year 11 and 12 CIT subjects, yet need to choose whether to enrol in these subjects based on their perceptions of what they might entail and what purposes they might serve. As other chapters point out (e.g. Chapter 7 by Reid & van den Akker), sources of alternate messages about senior CIT subjects vary between schools, with many providing very little encouragement in terms of career advice relating to these particular subjects. Students' prior experience of school-based CIT education dominates in its influence on the imagined CIT curriculum. Taken together, these analyses demonstrate how both K–10 CIT subjects, and computer use as it is framed by other non-CIT syllabuses, support misconceptions of senior school CIT curricula and potentially narrow understandings of what higher education or careers in CIT
might look like. Downes' analysis of the instances of CIT education found in non-CIT syllabuses is also supported by arguments put by Catherine Harris in Chapter 5, who describes how CIT subjects and ICT cross-curricular initiatives are often 'at loggerheads' in terms of purpose and resources. A theme common in most of the chapters is students' narrow understandings of what senior CIT education and related higher education and careers might entail.

As well as providing some insight into how the nature of current school curricula might contribute to low senior enrolments, Downes also illuminates the recent downturn in enrolments and examines the impact of recent curriculum changes. Downes presents an historical analysis of participation rates and curriculum changes in NSW CIT subjects, revealing that previous (1995-2000) growth in student numbers (including significant growth in the proportion of girls) correlated with the instrumental focus of CIT subjects during that period. She speculates that this instrumental focus might have contributed to the relatively high pre-2001 proportion of female students participating in NSW senior school CIT education. She also suggests that the significant change in orientation of the senior CIT subjects (away from a focus on applications and computer literacy towards a focus on disciplinary knowledge), which occurred as part of the 2001 curriculum redevelopment, may have contributed to the decline in female participation which followed.

Together, these chapters help us to define and understand some of the ways in which curriculum issues contribute to low and declining overall enrolments in CIT subjects. What 'studying CIT' might mean is confounded by the lack of clear distinctions between CIT itself, and the use of technology in cross-curricular ICT initiatives. For many students, their extensive use of sophisticated computers at home, combined with the 'computer literacy' focus of the junior curriculum, leads them to conclude that they have little to gain from continuing their formal study of CIT into Years 11 and 12. Part of the problem lies in the imaginings Year 9 and 10 students construct, but these imaginings in turn build on and magnify problems that are inherent in the intended and enacted curriculum. Taken together, the Downes, Vickers and Ha, and Harris chapters raise important questions about the gendering of curriculum and provide a critical lens for future curriculum enquiry in this area.

CIT pedagogies

The gender and IT problem, and declining numbers more generally in CIT education, is increasingly framed as one of student disinterest. Pedagogy has the potential to influence students' enjoyment of school subjects and thereby to increase their motivation towards further study in this subject area. Pedagogies also have the potential to provide students with insights into the nature of work within particular fields and careers so are an important, but often overlooked, vehicle for raising students' awareness of CIT careers.
In Chapter 8, Susanne Gannon explores girls' experience of the new NSW Information and Software Technology elective (IST) (NSW Board of Studies 2003) by examining the pedagogical assumptions of the syllabus documents supporting the new curriculum, as well as teachers' and girls' reported experiences and opinions of it. As with a number of the chapters in this volume (Robinson & Davies and Vickers & Ha), Gannon focuses on the reported experiences and opinions of the 'high interest' girls, that is, those identified through their earlier survey responses as having a high level of interest in computing and information technologies.

In her analysis of the pedagogical assumptions behind the IST curriculum, Gannon identifies a strong emphasis on collaborative project-based project work and links with the community. This analysis is contextualised within a discussion of academic literature on innovative practices in the pedagogical use of ICT, and industry recommendations that CIT school education should reflect dominant CIT work practices, both which support the use of project-based pedagogies. She finds that the IST curriculum documents incorporate pedagogical directives informed by those recommendations emanating from research and from the CIT industry. However, both student and teacher interview data suggest that the types of project-based collaborations and links with community enterprises advocated in the formal syllabus documents are rarely seen in schools' implementation of the new IST curriculum. More often, students reported a dominance of individual book work and individual computer skills work. Gannon discusses the many forces that can mitigate against teachers' adoption of recommended pedagogical approaches and how the very nature of teachers' work as professional educators necessitates a transformation of intended curricula into local contexts. She provides an example of how the same CIT syllabus documents can be implemented in significantly different ways in different teaching contexts.

Gannon examines teacher and student interviews from five NSW schools. Her findings suggest that girls tend to lose interest as they progress in this subject due to a dominance of learning activities that they find uninteresting. The girls' perceptions of CIT pedagogies were constructed around a creative versus theoretical binary, where the adjective creative was used to describe design-based activities that make use of software applications (particularly multimedia and web-authoring software) and theory referred to book work and essay writing. The girls expressed a preference for activities that they characterised as creative and a strong dislike for what they termed theory. Within such a binary, there is no room for imagining creative approaches to theory or more generative views of the relationship between theory and practice. Nor is there — returning to the work by Downes and by Vickers and Ha on students' imagining of the senior CIT curriculum — room within the framework of these girls' perceptions for the possibility of a creative approach to fundamental computing science theory and processes. In Chapter 6, Kerry Robinson and Cristyn Davies point out that interest, or lack of interest, in particular CIT activities is often gendered, influenced by hegemonic discourses of gender that
position boys and girls differently. Similarly, these girls' desire for the *creative* and rejection of *theory* can be read as consistent with dominant constructions of femininity. Leonie Rowan, in Chapter 3, also takes up the issue of gendered interest and constructions of femininity, demonstrating how, when students explain gender differences in participation in CIT education, they describe 'natural differences' between boys and girls. Rowan also points out that, in terms of interest in CIT subjects, individualised computer-centred pedagogies are off-putting for both girls and boys.

It is conceivable that project-based pedagogies, should they be implemented, might hold some potential in terms of deconstructing the *creative* versus *theoretical* binary, challenging girls' (and boys') beliefs about school-based CIT education and attracting more students to enrol in senior CIT subjects. In Chapter 7, Carol Reid and Jose van den Akker describe the case of one school (Yellow Robin High School), where a female CIT teacher has bolstered female CIT enrolments by exploiting links with the local community and the informal networks that support the social relationships of the school — suggesting that as a response to declining female enrolments in CIT education such approaches warrant further attention.

Gannon's chapter sheds light on how students' experiences of different pedagogical environments can serve to further reinforce their narrow constructions of CIT as a field of study and practice. Gannon's analysis focuses on the constructions of 'high interest' girls; however, it is conceivable that the impressions these girls have of different pedagogical approaches, and their limited/limiting conceptions of the relationship between theory and practice as manifest in CIT education, could be shared by girls more generally and by boys as well. In fact, data excerpts quoted by Gannon suggest that some teachers have quite narrow conceptions of how the theory and practice of CIT might be incorporated into their classes. Similar *theory* versus *practice* constructions are identified in Harris's chapter on teachers and CIT subject subculture. However, Gannon warns that, although negative evaluations of CIT pedagogies may be disincentives for future interest in this subject area, positive experiences do not necessarily translate into future enrolments in CIT subjects. Some of the other factors that might contribute to girls' (and boys') decisions to discontinue CIT studies are discussed under 'Students and CIT' beginning on page 21.

**CIT teachers**

The beliefs and attitudes of teachers, as well as their behaviours and pedagogical practices, have the potential to affect powerfully the beliefs, attitudes and behaviours of students. Two chapters of this volume take CIT teachers as their primary focus. In Chapter 5, Harris uses a case study of one Victorian school (Otter College) to examine CIT teachers' self-perceptions, their perceptions of CIT as a school subject and how these contribute to CIT *subject subculture*. In Chapter 7, Reid and van den Akker explore the diversity of knowledge, practices and attitudes found
amongst CIT teachers from 12 NSW schools and examine how power and agency feature in these teachers’ work and the differential effects of different power strategies on participation in CIT education.

Harris explains that, compared with other subject areas, very little work has been done towards understanding CIT as a school subject subculture, with much of the research into technologies in schools focusing on cross-curricular initiatives and the responses of non-computing specialist teachers. Harris focuses on what she terms the ‘middle ground’ of curriculum; that is, how teachers, through their beliefs and their talk, begin to enact curriculum before they enter the classroom. She cites research that suggests teachers’ constructions of CIT subjects influence students’ beliefs about these subjects. She also demonstrates how, within the same school, teachers’ different career histories, as well as their CIT education and training and roles within the school, can lead to different perceptions of CIT subjects and different understandings about their roles as CIT teachers. Her observations resonate with those of Gannon and of Reid and van den Akker on how different teachers working in different contexts can implement the same curriculum documents in very different ways.

As part of the context to this chapter, Harris provides an overview of the positioning of CIT in Victorian school curricula. She describes the shift from a cross-curricular and interdisciplinary focus in the K–10 years to more differentiated, subject-based curricula in the post-compulsory years. However, she points out that many Victorian schools continue to offer both mandatory and elective CIT subjects during the compulsory years of schooling, despite state curriculum frameworks that focus on interdisciplinary approaches. Her analysis provides insights into the complex and contested nature of CIT in schools and leads her to conclude that the CIT subculture at Otter College is ‘diffuse and is not based on shared understandings of CIT knowledge and pedagogy’ (p. 93). In terms of teachers’ gendered constructions of CIT subjects, teacher talk at this school contrasts two senior CIT subjects, where girls are reported to be more attracted to the subject that is constructed to be more ‘practical’ in that it focuses on software applications, and where boys are reported to be more attracted to the subject that is constructed as being more ‘academic’, with a focus on programming. Similarly, teachers in this school assert (as if it were ‘natural’) that their junior school elective CIT subject focused on design and software applications is ‘more suited to girls’ interests’, while one focusing on computer-controlled machines and engines is ‘more suited to boys’ interests’. The contribution of such teacher talk to the social construction of CIT as a subject area, and to the production of limited/limiting conceptions of femininity and masculinity, is taken up in chapters by Rowan (Chapter 3) and by Robinson and Davies (Chapter 6).

Through her detailed analysis of the context of CIT education in this school and her analysis of the ways that two teachers in this school talk about CIT education and their roles in the school, Harris identifies a number of issues that
potentially mitigate against a sense of a well-established CIT subject subculture. These include the following: the lack of a designated departmental space in the school’s staffrooms (with one teacher having a desk in the school administration office); the multifaceted nature of this teacher’s role wherein, further to her teaching duties, she also provides technical support to the school’s administrative staff; tensions between CIT subjects and cross-curricular ICT initiatives in terms of purpose and resources, with teachers fearing that increased emphasis on interdisciplinary approaches to CIT education will threaten the viability of dedicated CIT subjects in the junior years; and individualised and insular work practices, such that the two CIT teachers in this school have very little knowledge of each other’s quite distinct approaches to the content and pedagogies of the CIT subjects that they teach.

The perspective provided by Harris’s chapter reminds us that CIT is a nascent discipline that holds a complex position in relation to other curriculum areas and cross-curricular initiatives. Unlike more longstanding subject areas, like English and Mathematics, CIT school education is not supported by strong professional organisations (those that exist often serve multiple and conflicting agendas around CIT-specific curricula and the integration of ICT for learning across the school curriculum more generally), nor is CIT school education defined by well recognised and popularly valued content areas or pedagogies. Different teachers, even within the same school, have different ideas about what is valuable within the CIT curriculum and how it ought to be taught. As pointed out by Downes in Chapter 4, the scope and sequence of CIT content as it exists in current secondary school curricula in Australia is yet to reach maturity. Harris reports that CIT subjects are often constructed in functional and vocational terms. Such terms fail to recognise the disciplinary content outlined by Downes. In terms of pedagogy, as highlighted by Gannon in Chapter 8, even where syllabus documents recommend particular pedagogical approaches, such approaches are yet to be understood and/or supported by the majority of CIT teachers. These issues raise questions about the future of CIT education in schools. As a discrete subject area, as I pointed out earlier, it can be seen as nascent, yet to take its place or find its voice as a well-established and well-recognised school discipline. However, at the university level, disciplines such as computing science and software engineering and information technology appear to have already passed their prime and to be in decline (Timson 2007) or at least to be in a period of transformation and repositioning.

Chapter 7 by Reid and van den Akker is the second chapter in this volume to focus primarily on CIT teachers. The chapters by Harris and by Reid and van den Akker are complementary in terms of the light they shed on the gender and IT problem. While Harris’s chapter serves to highlight some of the complexities, tensions and potential deficits of CIT as a school subject area, Reid and van den Akker look beyond the disciplinary lens, taking a sociological view of the lives and work of CIT teachers and the effects these have on pedagogical relationships and
potentially on the attractiveness of CIT subjects to girls. Reid and van den Akker report the findings of their analysis of CIT teacher interview transcripts from 12 NSW schools. They focus on how CIT teachers relate to governing systems and structures, to other teachers, to students, and to the local community. Because of the diverse backgrounds of CIT teachers, Reid and van den Akker argue that informal knowledge networks are central to understanding their identities and work practices. They describe how the teacher interviews they examined reveal a range of very different pathways to becoming involved in CIT education. Their analysis is embedded within an understanding of how the social relationships of schooling are framed by globalisation, particularly by the neo-liberal politics of individualism and the economic prerogatives of economic rationalism. In an examination of the interplay between teacher agency and trends towards centralised power structures in schools, they identify a range of sources of teacher agency which reflect the diversity found among CIT teachers.

In their discussion of teacher interview excerpts, Reid and van den Akker highlight the complexity of teachers' lives and the tensions felt by CIT teachers, whose interests in the sustainability of their own subject area, and in the overall morale and fiscal viability of the school as a whole, are often at odds with each other. They cite examples of CIT teachers who restrain their urges to actively recruit students to senior CIT subjects out of consideration for the micropolitics of the school and the desire not to be seen to be 'empire building'. Reid and van den Akker argue that such tensions arise from economic prerogatives that put timetables and budgets (manifesting in, for example, prescribed minimum enrolments for subjects) before relationships and community needs. This chapter provides an example of a teacher who has successfully increased the numbers of girls enrolling in CIT subjects. The teacher at Yellow Robin High School uses what Reid and van den Akker describe as relational strategies to create interest in CIT. She draws on relationships with students and parents, and on community networks, to provide subject and career advice that is consistent with community development agendas. This teacher's approach is consistent with the ethos of the school, which is described as resonating with the character of the local community. Reid and van den Akker contrast the example of the teacher at Yellow Robin with other teachers who used more oppositional strategies, such as providing non-traditional role models, which the authors explain are problematic and ineffective.

These chapters suggest that teachers and their communities need to be at the centre of any reforms or interventions which hope to reinvigorate senior CIT enrolments.

**Students and CIT**

Understanding students' beliefs about and attitudes towards CIT education and careers, and the relationships between such beliefs and attitudes and their behaviours and self-concepts, is critical if we are to understand and respond to the declining
numbers of students enrolling in senior secondary CIT subjects. Chapters by Gannon, Robinson and Davies, Rowan and by Vickers and Ha, all shed light on students’ constructions of CIT as a curriculum area. The chapters by Gannon, Robinson and Davies, and Rowan, have a more sociological and post-structural flavour, as they draw on discursive analyses of student and teacher interviews and engage specifically with discursive constructions of gender and identity and gendered constructions of CIT.

The contribution of the Vickers and Ha chapter is distinctive in that it draws on analyses of the GaIT project’s quantitative data sets (the survey results) and employs psychological constructs to explore the relationship between students’ reported beliefs and their subject choices, focusing more on differences between boys’ and girls’ beliefs and choices, rather than on discursive constructions of gender.

Vickers and Ha examine the complexity of subject choice and the role of factors such as student interest, student enjoyment and students’ perceived utility of senior CIT subjects. They draw on aspects of Expectancy–Value theory (Wigfield & Eccles 2000) in their discussion of the quantitative survey results, focusing specifically on students’ reported beliefs about their ability with computing and information technologies and how this might relate to the selection of senior CIT subjects. To do this, the authors constructed a variable which they term perceived IT ability (pITA), where students with a high pITA score rated their own abilities highly on a combination of low level (e.g. e-mailing friends) and high level (e.g. fixing the computer) computing skills. They then examined the reported beliefs, experiences and subject choices of students with high and low pITA scores, that is, high or low self-assessments of their own ability with computers. The findings of this analysis are telling, both in terms of general CIT enrolment trends and in terms of the gender gap in enrolments.

Drawing on Expectancy–Value theory, Vickers and Ha hypothesise that students with high pITA scores will be more likely than other students to enrol in senior CIT subjects. However, they find that this group of students is no more likely than others to pursue senior CIT studies. In seeking an explanation for this surprising (and potentially worrying) finding, Vickers and Ha report that 70% of the high pITA group consider that they learn more about computers at home than at school. This suggests that, although this group of students might have a high level of expectancy to succeed in senior CIT subjects, the value side of the Expectancy–Value equation is not satisfied in their imaginings of what such subjects entail. This is supported by qualitative analyses reported in other chapters. For example, Robinson and Davies report that ‘many high interest boys were not engaged by the [K–10] CIT curriculum and were often bored and frustrated’ (p. 106). It is also consistent with

10. While these chapters share a broad research paradigm, they draw on different theoretical constructs and make quite distinct contributions, as discussed elsewhere in this chapter.

11. This is a distinction in research paradigm; there is an overlap in the issues raised by each of these chapters and the perspectives are complementary in terms of illuminating the ‘gender and IT problem’ and troubling our understandings of it.
what might be expected, given Downes's analysis (Chapter 4) of the literacy focus in CIT education from K-10, and how this might influence students' imaginings of what is offered in the senior years.

For girls, the pITA picture is even more worrying. Of the high pITA group, fewer were female and there were more girls than boys in the lower pITA group. Girls who did rate their own abilities with computers highly were less likely than boys with similar self-assessments to enrol in senior CIT subjects. This suggests that, for girls, lower expectations for success as well as a lower perceived value of the activity have negative effects on their likelihood of choosing to pursue senior CIT subjects.

In Chapter 6, Robinson and Davies provide insights into the interaction between student subscription to CIT subjects and the identity politics that is played out in schools. Drawing on Judith Butler's concepts of the performativity of gender (Butler 1994), they analyse student interest in CIT in terms of hegemonic discourses of gender that position girls and boys differently in relation to their competence in, and their desire to undertake, certain kinds of CIT tasks and not others. They found that students' accounts of their experience with technology were highly gendered. Girls were far more invested than boys in technologies that could be used to communicate with friends, yet the use of these technologies was constructed as social in nature and unrelated to school CIT learning. Girls with a low interest in CIT education constructed CIT subjects in stereotypical terms (stuck in font of a computer; void of human interaction) and as diametrically opposed to their interests and desires.

Robinson and Davies examine the reported behaviour of those boys and girls who self-identified as 'nerds' and 'geeks', conceptualising these positionings as ones that challenge dominant understandings of masculinity and femininity. They found that the behaviours of students who take up the position of nerd or geek are often challenged and policed by their peer groups, who were highly invested in maintaining hegemonic oppositional readings of gender.

In Chapter 3, Rowan examines the explanations that students and teachers provide for the gender gap in CIT enrolments, both those explicitly stated and those implicit in their talk about girls and boys and CIT education and careers. To frame her analysis, Rowan outlines the dominant understandings of gender that have underpinned the various waves of gender-related educational reform that arose in the 1970s, 1980s, 1990s and onwards. She discusses three main perspectives on gender, as identified in the gender and education literature: that focusing on access and equity, wherein the removal of structural barriers is seen to provide equal educational opportunities to boys and girls; that focusing on the recognition and valuing of girls' difference through the provision of 'girl friendly' approaches and environments; and that seeing gender as performance, whereby performances are influenced by the diverse messages females and males receive from multiple sources about what it means to be a 'girl' and what it means to be a 'boy' — a perspective influenced by contemporary post-structural understandings.
In her analysis of the GaIT interview data, Rowan highlights the extent to which teachers' and students' explanations of the CIT-gender gap align with, or depart from, these perspectives on gender and related explanations of educational differences between girls and boys. She discusses two main explanations, the first being the belief that gender has no effect on subject and career choice; that is, both girls' and boys' decisions not to pursue senior studies in CIT are based on an analysis of CIT subjects, and the CIT industry and careers, that are independent of gender. Associated with this understanding is the view that the gender gap in CIT education and careers is not a problem: previous structural barriers have been removed and the gender difference that remains results from individual students' gender-neutral choices. The second type of explanation she discusses is that which reinforces more traditional perspectives. She found that many of the opinions and explanations in the student and teacher interview data were based on understandings of gender as a manifestation of 'natural', biologically-determined differences; that is, girls were naturally less inclined to be interested in, and to have abilities in, CIT and related educational and career pathways. Associated with this understanding of gender was the view that, for girls who expressed no interest in pursuing senior CIT education, earlier CIT learnings acquired during their junior secondary schooling would be adequate for their needs.

One of the key contributions of Rowan's chapter is her discussion of the significance of the persistence of seemingly (from contemporary feminist viewpoints) outdated understandings of gender, and of how educators and educational researchers might respond to this. Drawing on Michael Goldhaber's concept of the attention economy (Goldhaber 1997), she explains that the low number of girls in CIT educational pathways is not seen as a genuine educational problem by schools, teachers, students and parents, and that in recent times the gender and IT problem has struggled to draw attention to itself. It has received less attention than have other gender-based debates, particularly those issues that have been declared to be 'scandals' in the media, such as boys' literacy levels. Rowan frames the gender and IT problem as one of gaining, sustaining and managing attention, and doing so in ways that do not risk the reinforcement of limiting understandings of gender.

Conclusions: Why is CIT so hard to sell?

The chapters that comprise this book report a number of findings that add to our understanding of why enrolments in senior secondary school CIT subjects are suffering a decline and why girls' interest in particular, which has been historically fragile, is so hard to attract and is waning. In the figure opposite, I provide a summary of the main points emerging from the work reported in this book. I then go on to outline some of the main ways forward that are suggested by the authors.
Why is CIT so hard to sell?

- The focus of K–10 CIT curriculum, together with cross-curricular ICT initiatives, lead to misconceptions about the focus of post-compulsory CIT studies.

- Students with an interest in CIT find both the content of school CIT subjects (those they have had exposure to — in our study, compulsory years CIT) and the pedagogical practices associated with them to be uninteresting and irrelevant. These perceptions tend to colour their expectations of senior CIT subjects.

- Senior CIT subjects are not constructed as a pathway to university studies in CIT. Messages from multiple sources suggest to students who are interested in computing technologies that other subjects would be a more strategic choice.

- Interest in CIT education is associated with marginalised performances of masculinity and is not constructed as appropriate for girls or for most boys. Both students and teachers tend to reproduce outdated understandings of gender, which mitigate against interventions aiming to interrupt limiting notions of what CIT is and who it is suitable for.

- Where teachers and schools have implemented strategies to attract more girls to CIT education, these strategies sometimes further reinforce stereotyped notions.

- As a subject area that bids for a share of post-compulsory student enrolment, CIT does not appear to have a unified group of teachers, at the school or state levels, who might promote the interests of the discipline. At all levels, specific studies in CIT compete with ICT initiatives for ‘air time’. In fact, CIT teachers’ time is often divided between these two competing agendas.

Central to the discussions provided by each chapter in this volume is the importance of attitudinal changes. In the figure on the following page, I summarise the recommendations offered by the authors (often offered independently by multiple authors).

The literature on gender and CIT, and the data and analysis reported in this volume, suggest that limiting beliefs about gender and CIT can be found at all levels of schooling, both where CIT is explicitly being taught, but also in contexts of incidental and informal learning. Reiterating an important point made by Rowan in Chapter 3, no single ‘solution’ can work in isolation. The gender and IT problem requires ongoing attention on multiple fronts. What we have provided here is a basis for developing strategies, programs and interventions which do not fall into the trap of reinscribing old stories about what CIT education is, what CIT careers entail, and
## Ways forward

- Promote information about the content of senior-level CIT to K–10 students, by incorporating some of the fundamental concepts and processes of the CIT disciplines into the K–10 curricula, so that distinctions between the focus and aim of cross-curricular computer literacy initiatives and specialised CIT disciplinary education can be better understood by students. Or better still, so that the literacy and disciplinary agendas are mutually supporting.

- Provide accurate information about employment and career opportunities for CIT graduates.

- Recognise that many students will achieve high levels of computer literacy at home and will need a more challenging CIT program if their interest in the CIT field is to be sustained.

- Emphasise the alignment between senior CIT subject content and the content of university courses in software engineering and information technology.

- Employ and discuss pedagogies that align with work practices in the CIT industry (e.g. collaborative project work).

- Make links between school-based CIT education and activities, expertise and enterprises in the local community.

- Provide opportunities for students (and teachers) to position themselves in multiple ways in regards to computer use by employing a range of pedagogical practices and a wide range of technologies, including group work, project work and the use of new leisure and lifestyle technologies.

- Employ pedagogical practices that disrupt traditional stereotypes by affirming girls’ interest and competence in difficult technical tasks, by affirming boys’ interest and competence in communication and design activities, and by affirming the behaviours and attitudes of girls who express an interest in computing technology.

- Promote alternative images of girlhood and boyhood by continuing to document and to circulate performances that challenge normative understandings of gender and CIT.

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who they might be suitable for. That is not to say that such stories should be swept under the mat, rather, as a starting point for interventions that aim for attitudinal change, students’ and teachers’ own beliefs about gender and CIT ought to be examined within a supportive context in which alternative views and behaviours can be explored.