DIGITAL DIVAS

PUTTING THE WOW INTO COMPUTING FOR GIRLS

JULIE FISHER, CATHERINE LANG, ANNEMIEKE CRAIG AND HELEN FORGASZ

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WITH AMBER MCLEOD

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Dr Julie Fisher is a Professor in the Faculty of Information Technology at Monash University, Australia. She has worked and conducted research in the information systems field for the last 20+ years. For most of this time Julie has researched the area of gender and IT and been part of teams which have implemented intervention programs designed to encourage girls into IT. This work contributed to the design of the Digital Divas research project which she led. Her other research has focused on usability and health informatics. Julie has published widely in leading journals and conferences.

Dr Catherine Lang is an Associate Professor in the Faculty of Education at La Trobe University, Melbourne, Australia. Her research focus since 1996 has been on the under-representation of women in computing, which culminated in the national research project that is the topic of this book. She has published on the topics of student transition to higher education, computing education and pedagogy as well as social networking in education. She is the recipient of several competitive national and university grants and awards in recognition of her research strengths and her teaching and learning abilities. She tweets at @Clang13

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Dr Helen Forgasz is a Professor of education and Associate Dean in the Faculty of Education, Monash University. The focus of her research and teaching is on gender issues and the affective domain in mathematics education; technology use for mathematics learning has been an area of particular interest. Helen is a regular presenter at national and international education conferences. She has edited several books, and has authored numerous book chapters, as well as a wide range of scholarly and professional journal articles.

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FOREWORD

I first became aware of the lack of women in the computing in 1987 when I was a lecturer at the University of Southampton in the UK and we realised we were starting the new academic year with no women in any of our BSc Computer Science classes. This came as quite a shock as in previous years women made up about one third of the class. In 1987 my colleague, Dr Gillian Lovegrove, and I wrote a paper entitled "Where have all the girls gone?" exploring what was happening in the world around us to bring this situation about. One of our conclusions was the advent of the personal computer, which in the 1980's were being marketed as "toys for the boys. This was very off putting for girls thinking about which university degree to apply for as evidenced by the statistics. We hoped it would be a short lived phenomenon but unfortunately this wasn't to be.

Ten years later, Tracy Camp (1997) wrote about the 'incredible shrinking pipeline' referring to the declining numbers of women studying computer science. Eighteen years on little has changed. Despite the ubiquitous application and use of computing in our everyday life, business and education, and the development of devices such as smart phone that we are finding we cannot live without, girls are still significantly underrepresented in computing subjects in schools. With fewer girls showing an interest in computing at school it is not surprising that fewer women are going on to a computing career. The lack of diversity in computing is not limited to Australia, but in fact is present in most Western developed nations is well recognised internationally.

This is a problem that this Digital Divas program seeks to address, and given the statistics published by the National Centre for Women in Information Technology (NCWIT, 2014) it is not before its time. The NCWIT report found that work teams with equal male and female membership have been shown to be more effective and more efficient than single-sex teams, and that when women have engaged in computing, they have been able to

create high-tech start-ups with less funding and fewer failures than the average (NCWIT, 2014).

The Australian researchers who wrote this book found that the barriers to girls contemplating computing careers are established by lower secondary school and so focused this curriculum based intervention on this age group. Their program shows that attitudes can be changed, and they provide a sound framework for others to adapt in similar programs.

Since my early days as a computer science lecturer in the 1980's I have been involved in the movement to encourage more diversity in our subject. If we don't encourage girls into computing, then the number of women who work in IT will continue to decline. I first met Catherine and Annemieke, two of the authors of Digital Divas, at the amazing Grace Hopper Celebrations of Women in Computing in the US. We bonded at the discos, which were an absolute riot! These conferences now attract nearly 3,000 students from around the world, all celebrating being women in computing. As President of the Association of Computing Machinery (ACM) it was my pleasure to continue to support the GHC conferences and to support the development of ACM-Women around the world.

We need the Digital Divas of this world to come together to encourage more girls to sturdy computing and to work in the computing industry. It is for this reason that I applaud the publication of Digital Divas so that we can all share in the work being undertaken in Australia, learn from the research they have done and apply the results in our own context. Digital Divas of the world unite!

Professor Dame Wendy Hall DBE FRS FREng
Director, Web Science Institute
University of Southampton

CHAPTER 1

THE DIGITAL DIVAS PROJECT

Introduction

> Computing is too important to be left to men. (Karen Sparck-Jones: pioneer in information retrieval and natural language processing (1935–2007), in Klawe, Whitney and Simard, 2009)

This slogan from an early pioneer in computing, and the winner of the 2007 ACM-W Athena Lecturer Award celebrating contributions to computer science by women, encapsulates the importance of broadening participation in information technology (IT). In 2015 the lack of women in IT remains a concern to all involved in this influential and empowering industry. The Australian Computer Society [ACS] statistics presented below are a snapshot of this decline of female involvement in IT (ACS, 2012):

> In February 2011, there were 131,059 women in ICT occupations in Australia, 24.10% of the total ICT occupation employment. This was a marginal increase of 0.6% since February 2010, whilst the absolute number of women had increased by over 8,000.
>
> By February 2012, these gains had been reversed, according to the ABS Labour Market Survey, with the absolute number declining to 91,400, at only 19.73% of the total ICT occupation workforce…
>
> … note that the female percentage of ICT courses at university has been below the industry percentage for some years, so ongoing decline in the female ICT working percentage is almost inevitable without specific intervention. (pp. 25–26)

In the 21st century, despite the ubiquitous application and use of information technologies, girls are still significantly under-represented in IT courses and careers. This was an impetus for the research project, funded by an Australian Research Council Grant (2009 to 2011), the title of which is the subject of this book.

The Digital Divas Project was devised by like-minded researchers from three universities, in conjunction with industry partners, who combined their expertise and experiences to deliver an intervention program in secondary schools aimed at changing stereotypical perceptions of the Information Technology suite of courses and careers. It should be noted that both 'IT' and 'ICT' are used through the book in reference to computing or technology. Those we talked with referred to both IT and ICT and these terms are also both used in the literature.

Motivation

> … three requirements for gender equity progress were awareness, concern, and action – recognition of a gender imbalance, belief that the imbalance matters, and doing something to change it. The absence of any one of these prevents progress. (Sanders, 2005, p. 4)

In 2009 we were well aware of the declining interest girls and women were showing in studying or working in IT. This was a concern to all of us involved in this influential and empowering industry. The under-representation of females is presented as a vicious cycle of negative feedback (Figure 1.1), each aspect influencing the other:

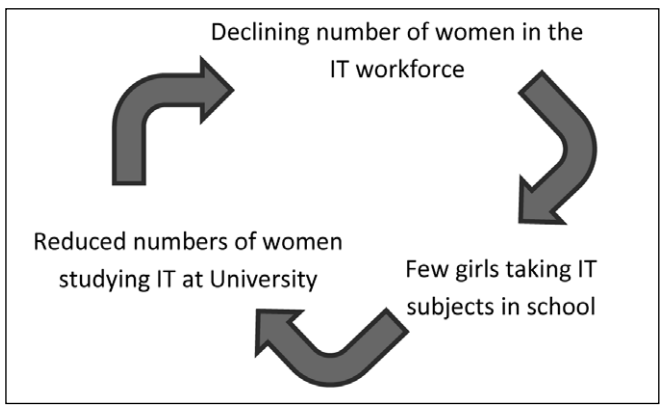


Figure 1.1. The vicious cycle of the under-representation of women in IT

We believed that unless we interrupted this cycle of female non-participation in IT, the reality would be a self-perpetuating prophesy of:

> Girls don't do IT, because girls don't DO IT. (Sandberg, 2011)

The authors, all women working in or having an interest in IT, had observed this continued decline of female participation and, knowing that a career in IT is exceptionally rewarding, could not stand by and ignore the trend. Research presented in the next section clearly demonstrates that improving the number of women in IT not only improves the IT industry in general, but also improves the usefulness of IT for women. Similarly, research indicated that the school experience is crucial in determining student course and career aspiration. For these reasons we researched how to improve and change the situation. We designed our program to be delivered in junior high school to reduce the influence of the stereotype that IT is a career only for boys.

Our multi-disciplinary research team brought with them an extensive skill set and background knowledge in both the discipline of education and its practices, and the various information technology disciplines of schools and universities. Our project was the first longer-term, multi-layered intervention program in Australia exploring curriculum-based strategies to address both girls' lack of interest in studying IT at school and the stereotypical representations of IT careers.

The need for diversity in the industry

The problem of the lack of diversity in IT in Western developed nations is well recognised internationally (Ahuja, 2002; Organisation for Economic Cooperation and Development [OECD], 2007). There are many documented cases of the negative impact this is having on the IT industry and, more broadly, on companies. For example, voice recognition systems in cars that do not recognise women's voices annoy female drivers and are likely to put them off buying certain cars (Carty, 2012); and Wikipedia recognising that its content was compromised because there were insufficient female editors (Stierch, 2011). The lack of diversity in working teams on IT projects needs to be rectified, not just for women in IT but for women in general. Companies with female senior managers have been shown to outperform those without women in leadership positions (Leyden, 2004). Similarly, work teams with gender balanced (50:50) memberships have been shown to be more experimental, more likely to explore new ideas and more efficient than

single-sex teams (National Centre for Women and Information Technology [NCWIT], 2012). Furthermore, despite being a minority, when they have engaged in IT, statistics show that women have founded high-tech start-ups with less funding and fewer failures than the average (NCWIT, 2012).

The statistics and research findings confirm that this influential career path should not be the domain of males only, and indeed needs the female voice and creative outlook to provide a balance in the professional workplace and in the development and management of IT applications. The following quote from the creator of Storytelling Alice, a version of the Alice programming language created with the interest of girls in mind, demonstrates this shared goal:

> If we want young girls to choose to learn how to program computers, we need to deeply understand the kinds of programs girls will be motivated to create and design programming environments that make those programs readily achievable. ((Caitlin Kelleher), Klawe et al., 2009, p. 73)

The continuing shrinking pipeline

Research conducted in Australia found that in general, women want to work in IT and are well qualified to do so (Bandias & Warne, 2009). However, consistent with many other professions, women in IT professions continue to be paid less than men, and there are fewer women in senior management roles (Byrne & Staehr, 2005). Previous research conducted by three of the authors (Fisher, Lang & Craig, 2013), found that women who selected an IT career were happy with their decisions to work in IT. Our research indicated that factors contributing to a satisfied female workforce include: career opportunities, flexibility, respect, professional development, and a future career path. These factors are not limited to IT. However, given that women are often the minority in IT workplaces, it is important to establish work-based networks and mentoring programs to address these factors and further assist women to progress and remain in the workforce.

In particular our study showed that:

- The more women in an organisation, the less female workers felt they experienced discrimination.
- Women value the flexibility usually associated with working in IT, but do see it as coming at a cost that was usually related to promotion opportunities.

- Informal work-based networking activities are preferred to outside of work networking activities.
- If managers actively support women to return to the workforce (usually after a break for child-rearing) they are more likely to stay in the career and indeed with the organisation.

The Statistics

The under-representation of women in IT courses and careers has persisted for the last thirty years (Hawkins, 1985; Kwan, Trauth, & Driehaus, 1985). In Australia in 2010 more women than men were graduating from university, yet not in the IT disciplines. In 2010 it was reported that women represented 55.6% of students enrolled in Australian universities (Department of Education, 2014). In 2012, women earned 57% of all Bachelor degrees, yet in the same year earned only 19% of undergraduate IT degrees (Department of Education, 2012).

A decline in student interest in IT courses (both from male and female students) occurred after the year 2000 as the industry stabilised following the dot-com bubble burst in the late 1990s. IT has grown to where every business and industry is reliant on IT professionals. However, the gender imbalance that was evident at the turn of the 21st century has worsened.

In most IT workplaces males are in the majority. According to the Australian Bureau of Statistics, women make up 45% of the Australian workforce (ABS, 2012) yet only 19.73% of those are employed in IT (Australian Computer Society, 2012, p. 25). The majority of these women are employed in the less technical roles of IT Trainers, Sales Professionals, and Other Information and Organisation Professionals, a classification distinct from ICT Professionals (not further defined), which is 84% male. To further highlight that we are not alone in our concern at the waste of talent of 'half the population', a Victorian government report recently highlighted the challenge faced by the industry to 'increase the level of participation of women in ICT, and be pro-active about recruiting people who are looking for a change in career into ICT roles' (Department of State Development, Business and Innovation, 2012, p. 3).

IT Education: The Pipeline Blockages

Higher education statistics also show a reduced interest in this discipline overall, with women being the most visible non-participants (Department of Education, 2012). This results in insufficient graduates for the workforce and

workplaces are competing to recruit female graduate students to increase the workplace diversity of their organisations.

It is apparent from these statistics that girls are not seeking university level IT education. Table 1.1 reveals the trend in completion numbers of undergraduate IT students in Australian universities over a ten-year period. While the attraction of the career path has almost doubled for male International students and has remained constant for female International students, the number of Australian males graduating from this discipline has decreased by just over 40% and the number of females by closer to 66% (Department of Education, 2012).

	2001		2010	
	Male	**Female**	**Male**	**Female**
Domestic students	6102	2213	3543	736
International students	4717	1841	7290	1852

Table 1.1 Completion count by gender and status in IT Bachelor degree courses 2001 & 2010

In the state of Victoria, where the Digital Divas program was first implemented, secondary school statistics present a similar trend of student disengagement with IT courses. Figure 1.2 depicts the number of applicants who successfully completed the final year (Year 12) IT examinations since 2001 (Victorian Curriculum Assessment Authority [VCAA], 2014). In 2001, there were over 5000 female completions of the final year (Year 12) Information Processing and Management [IPM] subject. This declined to just a few hundred female completions in 2013 despite a redesign of the curriculum and a new subject name, IT Applications (ITA), in 2007. The Information Systems [IS] subject (renamed IT Software Development in 2007) was never very popular with female students; only 73 female students in Victoria satisfactorily completed this more technical subject in 2013, a mere fraction of the total number of female students eligible to complete final year examinations in that same year (27,014). The total number of applicants sitting the final year IT examinations (male and female students) has decreased by 76% since 2001 (VCAA, 2014).

By the time students leave secondary school there is a large gap between girls and boys studying IT subjects and, by implication, those who are interested in an IT career. None of the final-year IT subjects is a prerequisite for any university degree; however, the pattern of declining enrolments is reflected in students' first preference choices for university IT courses, where

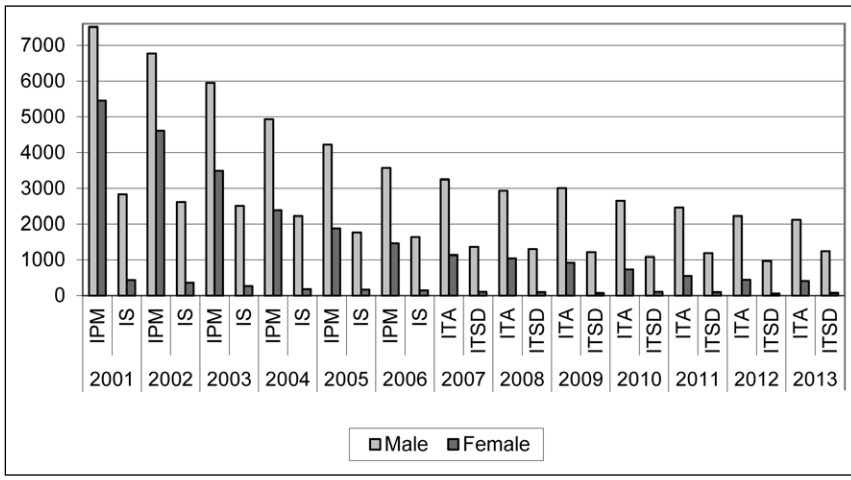


Figure 1.2: Gender of secondary school students who successfully completed the Year 12 IT units in Victoria in that year. Note that the unit names have changed (IPM to ITA, and IS to ITSD in 2007). Source: VCAA, 2014

there has been also been a marked decline (over 67%) of student interest (Victorian Tertiary Admissions Centre [VTAC], 2014).

The dramatic decline in student enrolment in the Victorian Certificate of Education (VCE) IT units as shown in Figure 1.2, has led to reduced opportunities for students to study IT in their final years of secondary school. Schools are reluctant to offer these units to small numbers of students, which has resulted in one-third fewer schools offering the units since 2001; for example 686 secondary schools in Victoria offered Year 12 IT and only 443 in 2011 (VCAA, 2012). This means that even if students did have an interest, their schools may not be able to support a small class; therefore the units are not timetabled.

These statistics show that schooling trends have an impact on the pipeline of students entering IT courses at university, despite the VCE IT units not being a prerequisite for any university degree. This then contributes to the lack of qualified IT graduates and even high school teachers qualified to teach IT. This further supports the imperative for a program such as Digital Divas. The next section provides some background and justification for the program's content and structure.

History of Interventions

Over more than two decades many intervention programs have been designed and run to address the problem of girls' lack of interest in IT (Klawe et al., 2009). Almost all have been short-term programs of less than one week in duration. Research indicates that these types of short-term events that promote the IT profession to girls are ineffective in addressing the longer-term challenge of keeping girls interested in IT beyond secondary school and into an IT career (Craig, Fisher, & Lang, 2008).

Different intervention programs implemented across Australia were investigated through the *Young Girls ICT Into Computing Too* research project funded by the Department of Family and Community Services, Office for Women (Craig, 2006). It was found that fewer than five per cent of schools consciously provided resources to promote IT to girls, or participated in intervention programs. The approach adopted in Queensland through the government-funded *Girls and ICTs Framework for Action 2003–2004 and Girls and ICT Strategy 2005–2008* had demonstrable benefits including a much greater level of activity focused on encouraging girls into computing in primary schools in that state (Craig, 2006).

Within the same project interviews conducted with facilitators of girls-only computer clubs in schools indicated that the programs were considered successful; however, given that evaluations of each program were limited it was difficult to identify what parts of each program contributed to success, and even how success was measured. Many of the programs had been run on an ad hoc basis and were highly dependent on the energy of a motivated individual or champion. There was no consistency in the approaches with the girls or to the materials and activities with which the girls engaged (Fisher, Lang, Craig, & Forgasz, 2007). In another study reported by Craig, Dawson, and Fisher (2009), gender equity programs focusing on the enrolment and retention of female students in computing courses in Australia over the last twenty years were examined. It was found that most programs were short term; that is, conducted over one or two days. Minimal evaluations were conducted, and where more substantial evaluations were undertaken the results were inconclusive.

The history of intervention programs convinced the research team of not only the need for a program such as Digital Divas, but also the need for a robust evaluation of the intervention. Their focus was to improve the participation rates of girls studying IT at school, and subsequently help alleviate the skills shortage in Australia at a time when there was (and

still is) a growing and identified need for IT skills (Department of State Development, Business and Innovation, 2012). The research team was strongly committed to encouraging girls not to limit their opportunities in this rewarding and creative career path by self-selecting out of IT subjects in Years 8 and 9. They were strongly committed to encouraging girls to remain active and interested in IT.

The Digital Divas Program

It is reasonable to assume that school is one place where girls can be encouraged to think and work positively with computers, and that this can be done via appropriate curriculum and teaching practices, or via specific intervention programs. One of the findings in the GetSET report (Clayton, 2005) was that the formal classroom is the most important place for stimulating interest in IT and science. In the same research study, it was reported that many girls are interested in and engaged with IT early in their schooling but that this interest fades as girls reach higher levels, resulting in declining female enrolments in final-year IT subjects and courses.

Newmarch, Taylor-Steele, and Cumpston (2000) suggested that the barriers to girls contemplating IT careers were established by lower secondary school, and that how IT subjects are taught has a major impact on girls' attitudes towards the discipline. Many girls, for example, considered these subjects to be 'too theoretical, rigidly structured and boring' (Newmarch et al., 2000, p. 9). Girls are more positive towards IT when the curriculum incorporates group work or cooperative assignments rather than individual projects. Furthermore, it has also been found that teachers and the teaching approaches adopted have an effect on girls' course and career choices (Roger & Duffield, 2000).

In designing the Digital Divas program we took heed of lessons from research on earlier interventions. The successes and failures described helped us better understand how to design a program aimed at encouraging girls to continue IT studies and to be attracted to IT careers. Within each Australian State or Territory, different ministers, departments, statutory authorities and, in the case of non-government schools, individual schools, have the authority to establish policies and practices for curriculum, resource allocation and utilisation, and teacher professional development[1]. Consequently the approach to IT curriculum varies across Australia. While

1 http://cms.curriculum.edu.au/anr2004/ch2_responsibilities.htm

the content modules for the Digital Divas project were created in alignment with the Victorian Essential Learning Standards [VELS] guidelines (the Victorian curriculum at the time), these were flexible enough to be adapted for different states.

The Pilot

The issues associated with the lack of interest in IT by Australian female students were not dissimilar to those of UK students. Prior to the implementation of the Digital Divas program, a pilot Divas program was conducted, modelled strongly on a UK-based program, Computer Clubs for Girls [CC4G]. CC4G was in operation in the mid-2000s and was reported as a quantifiable success through pre- and post-attitude tracking surveys. These surveys showed that 66% of girls who participated in CC4G said they were more likely to consider a career in technology than previously (Hermon, 2006).

The CC4G program was trialled in one Victorian school by one member of the research team in 2007 (Lang, Fisher, & Craig, 2008) and consistent with the CC4G model, a lunchtime club was organised. Thirteen- and fourteen-year-old girls were invited to attend. The materials used were based on those developed for CC4G and the program ran for 16 weeks. At the end an evaluation was conducted, which included an interview with the teacher and a survey of the girls involved. While the UK program worked well in a club format, this was not the case in the Australian school. It was found that few girls attended regularly. The pilot program highlighted the discordance of a UK program being superimposed onto an Australian school environment (Lang et al., 2008). Further, the materials designed for girls in the UK were not always suitable for the Australian girls. The outcomes of the pilot program informed the larger study. We believed that the materials needed to be modified to suit the Australian context and concluded that a program embedded within a school's curriculum was more likely to be successful because it would have the imprimatur of the school; the girls would be required to attend regularly; and the curriculum would be validated through normal assessment practices.

The Foundations of the Digital Divas Program

Understanding the need for a longer-term intervention that was designed with rigour and had evaluation inbuilt underpinned the Digital Divas project. Some years ago, Eccles (1985) and Eccles et al. (1985) described the 'model of academic choice' as one comprising interacting psychological

and sociological factors to explain gender differences in decisions about mathematics course selection. This model was one of several explanatory models for observed gender differences in mathematics learning outcomes prevalent at the time (Leder, 1992). The Eccles' model has also been applied to explain gender differences in the choice of IT career paths (Zarrett & Malanchuk, 2005). These researchers found that:

> Individuals' choice to pursue an IT career relates to their perceived ability or mastery of the field and its precursors and how much they value it, as well as the culmination of their experiences and subjective interpretations with the subject matter, cultural norms and stereotypes, and the influence of socializers and peers. (Zarrett & Malanchuk, 2005, pp. 75–76)

Since raising awareness and igniting girls' interest in IT and IT careers was one of the main aims of the Digital Divas program, Eccles' model of 'academic choice' (2005) was considered an appropriate theoretical framework for the design and analysis of our program and is presented in more detail in Chapter 2.

The curriculum materials for the Digital Divas were designed to stimulate Australian middle school (Years 8 and 9) girls' interest in IT and their curiosity about IT career paths. Data were gathered over a three-year period and were used to investigate how this longer-term program affected girls' attitudes towards IT and IT careers. The classroom materials developed were also evaluated to determine which of them were the most appropriate to meet the goals of the project.

The final Digital Divas program focused on three spheres of influence. First, the curriculum – which is presented in detail in the next section – was designed specifically for girls, taught in a female-only class and for the duration of one term (10 weeks on average) or one semester (20 weeks on average). This class would be part of the regular school timetable, not a special add-on. The second sphere of influence was the provision of consistent exposure to role models, primarily female university IT undergraduates who supported the teacher in the classroom each week and interacted informally with the students. Also included in this second sphere of influence were visits to the classes by young professional women working in IT, with the aim to close the loop between IT activities in the curriculum and an IT career path. The final sphere of influence was an approach that aimed to normalise the female presence in IT through developing a sense of ownership of the IT space. Students were encouraged to develop ownership

of their Digital Divas class through the creation of their own 'brand'. These Digital Diva brands were converted into artefacts for them to keep – usually a key ring, lanyard, or t-shirt – and the brands were also used in any in-school publicity. Teachers were encouraged to personalise the IT classroom and other parts of the school with posters of the designs created by the students. These three spheres of influence are discussed in more detail in Chapter 5.

Our premise in building the three spheres of influence into the Digital Divas program was that they would have a cumulative effect on students to keep IT on their list of possible future careers, whether in further years of high school by enrolling in IT subjects, or in their course choices for university or further education. While studies have shown that girls generally use IT in similar numbers to boys (Lang, 2007; MORI, 2001) it has also been shown that girls use IT in quite defined ways in comparison to boys, focusing mainly on communication (for example, social networking, email, and word-processing). By senior high school IT does not enter the zone of acceptable careers for all but the most technically focused male students (Lang, 2007).

The Curriculum

The first step in the development of the Digital Divas program was to create teaching modules for the classes; each module consisted of a number of teaching activities with teacher instructions, student instructions and assessment materials, and typically took students between four and five weeks to complete. An overview of the seven modules specifically created for the program is provided in Table 1.2.

Our motivation in developing these curriculum modules was strongly grounded in research and the current Australian social and educational climate, particularly the state of Victoria. However, the curriculum and indeed the Digital Divas program have a relevance to readers in many westernised countries where the gendered lack of interest in IT is also evident.

Topic	Theme	Software/ hardware	Learning objectives/outcomes
Shake the Bottle, Wake the Brand	Branding	Flash or Photoshop Colour printer Internet Google apps (on-line survey) PowerPoint	Creating a Digital Diva identity. Designing and creating logos and slogans using a vector-based program. Understanding why organisations value branding. Including brainstorming, planning, branding and marketing to design a unique logo and slogan to represent Digital Divas for that semester.
Lights, Camera, Action	Communication, collaboration	Video editing software MovieMaker or Premier Pro or iMovie Internet	Creating a movie for a specific audience outside of Australia. Planning, research & design involves script writing, storyboards, mind-mapping, production and evaluation – receiving feedback from intended audience. (Teamwork)
Chef's Delight	Design and creation of an on-line system	Excel Internet	Brainstorming, collecting and analysing data, transferring data into a spreadsheet to create an online system. Creating combo boxes, macros, if statements, formulae, VLOOKUPs, 3D referencing and conditional formatting.
Fab & Famous	Developing a critical eye for media	Photoshop	Looking at how the advertising industry edit and modify images for magazines and commercial products for advertising. Using Photoshop to create a magazine cover that has edited images. Discussing the ethics and morals of models and how women are portrayed in the media.
Mythbusters	Research careers (pairs)	PowerPoint Software to watch external movies .AVI Windows Media Player/ Quicktime	To broaden students' views on how IT is used in different industries. Job opportunities for working in the IT industry. External speakers. Combined with visit to Deakin for Girls IT Day. Busting four myths about IT
Alice	Programming	Alice 3D free software	Storytelling with Alice – Introduction to object-orientated programming. Understanding algorithms and basic programming concepts such as program variable declaration, conditional and looping constructs.
Wiki Wiki	Web technologies	Microsoft Office	Web 1.0 verses web 2.0. What does it mean? And what's the difference? Broaden your IT terminology and compare methods of communication.

Table 1.2 Teaching modules for Digital Divas

The Digital Divas Research

In previous research on IT intervention programs for girls in Australian schools, key reasons why girls were not choosing IT at school have been identified. These reasons include:

- an apparent lack of concern for the gender imbalance in IT participation in subjects;
- reinforcement of IT stereotypes;
- perceptions of computing as a male domain;
- an uninspiring curriculum, including the teaching of programming and word processing; and
- a lack of gender-inclusive resources.

Understanding how other intervention programs worked, as well as their reported successes and failures, helped us design the Digital Divas intervention and research program (Craig 2006; Fisher et al., 2007). Digital Divas was centred on the following key research question:

> *Can a program such as Digital Divas, which includes specifically designed, educationally based materials, change girls' attitudes and perceptions towards IT and IT careers in the longer term?*

To answer this question our program was specifically designed to investigate:

- what encouraged secondary school girls to continue with IT;
- what curriculum materials best engaged middle-school girls;
- whether the involvement of role models has an effect on student attitudes to IT;
- if a targeted program improves girls' confidence with IT use; and
- if a program such as Digital Divas can contribute to redressing the gender imbalance in the IT industry in the longer term, and provide recommendations for policy and practice in schools and elsewhere that support girls' engagement with IT courses and careers.

In designing our program we were cognisant of criticisms of other intervention programs such as: 'Too much of the research into the gender composition of computing includes only formative evaluations (participant satisfaction with aspects of the program) rather than summative evaluations that measure whether predicted outcomes and impact were achieved' (Cohoon & Aspray,

2013, p. 144). The researchers recommended seven criteria they believed were the most important for credible evaluation. Our data collection and program evaluation were based on their recommendations. Details are found in Chapter 3.

To date there has been a paucity of research on how successful a larger, longer-term intervention initiative such as Digital Divas might be in addressing girls' declining interests in IT courses and careers. There is also limited understanding of the types of teaching materials that might best encourage girls to continue with IT. Our contributions to school-level IT curricular resources enabled us to investigate how specifically designed materials can support girls' learning outcomes and extend knowledge and understanding in the field. Ours was the first Australian study that simultaneously investigated many of the factors identified in earlier research that impede girls electing to study IT – the computing discipline, schooling, and individual school factors.

Partner Organisations' Commitment and Collaboration

Our research project attracted considerable support and enthusiasm from diverse organisations in government, the education community and industry, demonstrating widespread recognition of the importance of engaging girls more effectively with IT and of raising their career aspirations.

The Victorian ICT for Women Network [Vic. ICT] provided both monetary funding and in-kind support, including the time of senior women on its board, access to members, and administrative support. The Australian Computer Society [ACS] also provided funding and in-kind support, including the time of one woman with web expertise who worked with the researchers and assisted in the development and support of the internet portal. The Victorian Government Department of Education and Early Childhood Development [DEECD] contributed funds and in-kind support, providing access to teachers, schools, and school facilities to run the program. Further, DEECD provided an education specialist to support the program. She worked with the researchers, and assisted with gaining access to schools and teachers. Netspace, an internet service provider, provided in-kind sponsorship for the participating DEECD schools for extra bandwidth to connect with the internet portal for the 36 months of the project. One secondary college where the first iteration of the program was trialled also contributed funds to the program that the research team used to provide additional support to the PhD student who was attached to the project (see Chapter 8).

Conclusion

The lack of women in the IT industry is a complex issue. The earlier research that informed the development and implementation of the Digital Divas program helped us understand how to design teaching materials and establish classroom practices that would engage girls to think and work positively with IT and to build links between IT uses and future careers in the industry. The program made a significant contribution to addressing the issues faced by young girls early in the IT pipeline.

There have been a variety of approaches taken in the past to encourage more girls to study IT and consider working in the industry. The general lack of success of these programs is indicated by the decrease in the numbers of females studying IT and employed in the industry. The question that motivated us was 'What can be done to make a difference?' We believe that the research findings from the Digital Divas program that we report in this book support the contention that good IT programs need to be embedded in the school curriculum rather than being dependent upon individual teachers' enthusiasm (Fisher, et al., 2007). In addition, we are convinced that a lasting and strategic cultural change is more likely to result if initiatives are targeted early in the education pipeline.

The most tangible outcome of our research study has been to establish a sustainable IT program available for interested teachers to use with girls Australia-wide and internationally. Digital Divas has the potential to improve girls' educational outcomes by positively enhancing their attitudes to IT, and stimulating and expanding their career aspirations to include IT. In the longer term, the viability of the IT industry will be strengthened.

In writing this book we are cognisant that our primary audience for this text is the academic community. Others likely to be interested in the book will be those planning to implement a similar program. Schools and teachers may also be our audience, but to a lesser extent. The structure of the book following this introductory chapter is as follows:

Chapter 2 presents our stance on the importance of evaluation in designing intervention projects, and in particular the theoretical underpinnings that guided the development of the instruments used to undertake the evaluation. It is our understanding that few previous intervention programs, with similar goals to ours, had adopted such rigorous evaluation processes.

Chapter 3 provides detail on how the research was conducted, including the research methods and analysis used. The rationale for selecting the research methods we have used is presented, as well as justification from the

literature for these approaches. Our research collected both qualitative and quantitative data and we present information on the software packages used to analyse our data as well as the tests applied to the data. We used a mixed-methods approach and are confident that this provided a valid and reliable set of results from which our conclusions were drawn.

Chapter 4 presents an overview of the schools involved in the Digital Divas program and a description of the portal designed to hold the materials and support classroom activities. The chapter highlights the diversity of schools that participated in the program, from the perspective of the socio-economic make-up of each. This chapter also reports on post-school outcomes within their cohort and the number of times data was gathered from each school. The chapter concludes with evidence of the ongoing influence of our program, which is still available online and being used in 2015.

Chapter 5 describes and discusses the three spheres of influence we identified as important in implementing a program that sought to change girls' perceptions of IT. The chapter provides an insight into our design, and also presents some evidence within the framework of the three spheres of influence that shows how the Digital Divas program did indeed put IT on the spectrum of these students' future career choices.

Chapter 6 reports specifically on the extent to which we have been able to change the perception girls have of IT. A primary focus is to report on the findings against the assumptions we made at the start when the program was designed (described in Chapter 2). We present data to address our assumptions and also reflect on what has worked and what has not worked based on this data.

Chapter 7 explores the wider impact of the program. Our experience has been that Digital Divas has had an impact beyond the girls it was designed to influence. There was an impact on the schools, the teachers, the curriculum and the school role models, our Expert Divas. The ripple effect of the Digital Divas program is presented in Figure 7.1. The chapter draws again on both the qualitative and quantitative data as well as observations of the researchers.

Chapter 8 is an invited chapter to the book, authored by the PhD student in the program. Her research focused on the influence of the Digital Divas program on the wider school community: that is the teachers of other classes; the other students in each of the year levels; and the parents of these children. The data gathered focused on two specific schools in the program. There were three key findings to this doctoral research: first, that attitudes to IT in the wider community are influential in the success or otherwise

of intervention programs such as Digital Divas; second, there was no clear pattern of change in attitude in the direction desired by the program creators; and third, several unanticipated factors affected the success of the program in these schools. This wider research project clearly shows that the socio-cultural make-up of the school and the parents influenced the desired impact of the program.

Chapter 9 is the final chapter and includes our reflections on the journey we have been through in establishing Digital Divas. The chapter brings together what we have learnt so that others might benefit from our experience, in particular the importance and value of developing an evaluation framework; the value of an extended program to effect change; and the need to work closely schools, teachers, parents, and Expert Divas. It presents what worked and what was less successful in terms of the data-gathering process, and what we would do differently next time.

CHAPTER 2

EVALUATING DIGITAL DIVAS

How Will We Know if the Program Works?

Overview

This chapter describes our position on the importance of evaluation in designing intervention programs, and in particular how we developed our evaluation framework. It presents some of the literature that informed the planning stages and how the research team considered the various inputs to the program, a discussion of anticipated outputs and the assumptions that were made. The chapter concludes with consideration of how we measured the success of the program.

Introduction

Since the 1990s in Australia, there have been many activities aimed at raising schoolgirls' awareness of careers in IT and stimulating their interest in the field. These activities included: the creation and distribution of career videos; conducting 'girls in computing' days or summer camps; and running computer clubs for girls (Craig, Scollary, & Fisher, 2003). Many of these initiatives have been short-term, localised, poorly funded and have depended very much on one key individual usually in schools (Craig, Fisher, & Lang, 2009).

The effectiveness of these interventions is questionable. Evidence suggests that short-term, one-off events targeting girls have not been effective, if the declining rates of women participating in the IT workforce are used as a guide. Research indicates that larger intervention programs directed at a larger population are more likely to be effective than smaller projects (Teague, 1999).

One such program was the UK-based program CC4G. This program was trialled in one school but as explained in Chapter 1 did not meet the needs of an Australian audience. It was clear that there was a need for a specifically designed sustained-intervention program to address factors identified as discouraging girls' participation in IT and that this program needed to be appropriately and effectively evaluated so others could learn from it. The Digital Divas intervention program was brought into Victorian post-primary, middle-school classrooms to meet this challenge.

The Need for More and Better Evaluation

The international GASAT (Gender and Science and Technology) association was established in the early 1980s in response to concerns about issues of gender and science and technology (Harding, 1994). An analysis of the research papers related to gender and computing presented at eleven GASAT conferences held from 1981–2001 resulted in the research described by these papers being categorised according to: access to learning; process of learning; and outcomes of the teaching/learning process.

> The majority of the papers presented focused on various dimensions of the 'access' of females to computers or ICT. Approximately half of this number addressed issues associated with the 'processes' of learning, but a much smaller number documented the 'outcomes' of learning other than those associated with subsequent progression to more advanced courses or to careers in computer science or ICT. (Parker, 2004, p. 5)

Parker (2004) promoted the notion that for social transformation to occur, reports written and presented at such conferences about intervention programs needed to be more precise. Similarly, other researchers have stated that to be influential in bringing about change policy-makers and practitioners require much more specific information:

> An audit of Australian initiatives focusing specifically on females moving into non-traditional areas of work, including ICT, concluded that evaluation of existing or recent strategies 'is generally lacking or piecemeal' (Lyon, 2003, p. 3). One of the report's five recommendations was that there needs to be a 'greater emphasis on evaluation and any initiatives developed … need strategies attached to measure the progress of women and the impact of the initiative' (Lyon, 2003, p. 4).

The research literature also revealed that most evaluations of intervention programs have involved exit surveys only and very few have assessed longer-term impact (Craig, Fisher, Lang & Forgasz, 2011). Reasons for this lack of evaluation of interventions aimed at women and IT have been postulated and include: if quantitative evaluations with no significant changes were found then they were not considered worth reporting (Teague, 1999); and deliberate decisions not to evaluate were possibly due to lack of resources or expertise, or perceived difficulty in doing so (von Hellens, Beekhuyzen & Nielsen, 2005).

With this knowledge the Digital Divas project team ensured that an evaluation dimension for the project was integrated into its implementation, as recommended by Darke, Clewell and Sevo (2002). Similarly, as recommended by Weiss (1998), an evaluation was also considered essential to improve understanding of elements of effective and successful interventions, and to share the results. For the Digital Divas program we adopted an evaluation framework specifically created for women and IT intervention programs (Craig, 2010).

Research Design

A mixed-methods research design was adopted, that is, quantitative and qualitative data were gathered in order to understand and explain the research problem (Creswell, 2008). The details of the research design are presented in Chapter 3. The evaluation of the Digital Divas intervention program was an integral element of the research design. Pre- and post-intervention surveys were administered to the students and the teachers in the Digital Divas classes; and pre- and post- intervention focus groups were conducted with students. Pre- and post-intervention interviews were conducted with teachers; and Expert Divas (female tertiary students enrolled in IT courses who visited classrooms and assisted teachers) were asked to provide reflective comments on their experiences. [Copies of all instruments used in the evaluation can be found in Appendices B, C, D and E.]

Theoretical Framework for the Evaluation Instruments: The Eccles' Model

The goals of the evaluation of the Digital Divas program were closely aligned to the aims of the program itself, which were described in Chapter 1. We next describe the basis for our evaluation model and how it was designed.

The Eccles' model underpinned the contents of the evaluation tools and is discussed first.

In her overview of the history of the model, Eccles (2005) summarised its theoretical basis as follows:

> Drawing on work associated with decision making, achievement theory, and attribution theory, we hypothesized that educational, vocational, and avocational choices would be most directly related to individuals' expectations for success and the importance or value they attach to the options they see as available. (p. 7)

In essence, it is an 'expectancy-value'[2] model that ascribes an individual's academic enrolment decisions from the interaction of expectancy for success and the perceived value of the particular academic choice. Expectancy for success and perceived value will have been influenced by a range of associated and interacting factors including: the cultural milieu; the behaviours, self-concepts, attitudes and expectations of socialisers, and the individual's interpretations of them; and the individual's academic history and interpretations of it in terms of attributions for success and failure,[3] self-concept of ability/achievement level, and perceptions of task difficulty. A schematic representation of the Eccles' model is reproduced below (see Figure 2.1).

Eccles' model provides insights into the stereotyped perceptions of IT that the Digital Divas program aimed to challenge. Eccles' model illustrates the interplay between socialisation factors and their effects on career preferences and employment outcomes; in our case, the impact on choice to pursue further studies in IT and consider IT as a career path. In Figure 2.1 it can been seen that the Eccles' model postulates that it is the cultural milieu (society, family, school, etc.) in which a girl finds herself, the beliefs and behaviours of members of this milieu, including their views of the place and role of women in IT, and the girl's perceptions and interpretations of these views and behaviours, that contribute to the development of her personal goals and perceptions of ability in IT. Also contributing to her self-perceptions are her previous experiences of IT and prior achievement, which feed her memories and feelings about IT. Overlaying this is the perceived 'utility and value' (Eccles 2005, pp. 10–11) of participation in this non-traditional field for

2 Expectancy-value theory evolved from the early work of psychologists, including McClelland and Atkinson, who researched achievement motivation.

3 Bernard Weiner's attribution theory involves three causal dimensions: locus of control (internal/external); stability (stable/unstable); control (controllable/uncontrollable).

women, and the girl's expectations of success in the field; these are mediated by the value associated with participation and the personal cost of doing so. In summary, the Eccles' model reflects the influence of social and cultural capital (Bourdieu, 1977) on perceptions of self-efficacy (Bandura, 1997) and belonging.

The evaluation framework is described next.

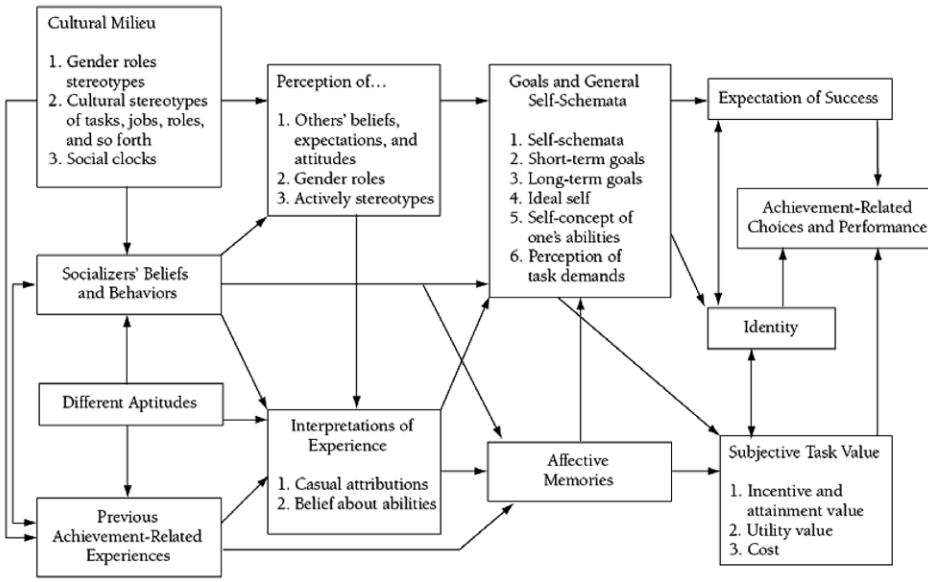


Figure 2.1. Eccles et al. model of academic choice (2005 version p. 8)
The arrows in the figure show which inicators inflluence each other and the direction of influence. The double-headed arrows signify that the indicators influence each other.

The Evaluation Framework

Program evaluation is defined as assessing social intervention programs and involves carefully collecting information about a program in order to make necessary decisions about the intervention (McNamara, 2007). A broad reason for conducting program evaluation suggested by Rossi et al. (1999) is to 'provide valid findings about the effectiveness of social programs to those persons with responsibilities or interests related to their creation, continuation, or improvement' (p. 3).

There is a large body of literature on evaluation models and frameworks to assist in the process of determining the success or otherwise of social

programs. An evaluation framework will provide key stakeholders in social programs with the knowledge required to conduct useful evaluations. This will make it more likely that evaluation will take place, sound judgements can be drawn, and results will be disseminated.

Craig's (2010) framework was specifically created for the evaluation of women and IT intervention programs, and as a chief investigator on the Digital Divas project, it was logical to implement this framework to guide the evaluation of the Digital Divas program. Craig's framework (see Figure 2.2) was developed drawing on the literature relating to logic models (discussed below).

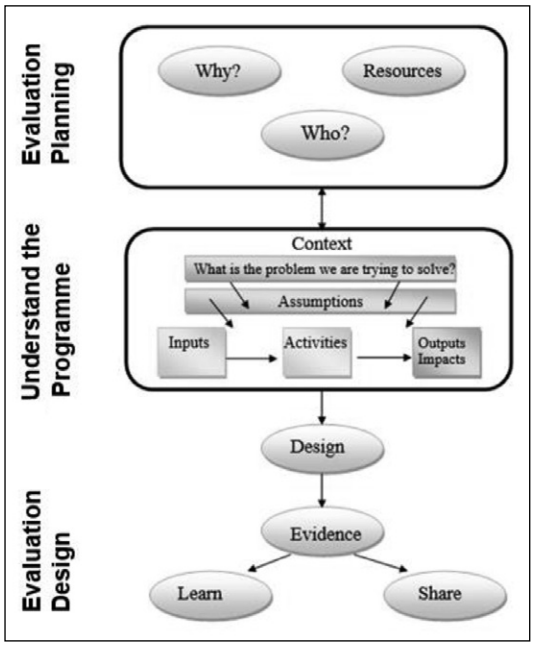


Figure 2.2. Digital Divas Evaluation Framework
(Craig, Fisher & Dawson, 2011)

Table 2.1 is also based on the result of earlier work by Craig (2010) and proposes guidelines for evaluating intervention programmes.

Bickman (1987) describes a logic model as a 'plausible, sensible model of how a programme is supposed to work' (p.5). There is some argument that it is not possible to be sure that activity X causes output Y; however, Owen and Rogers (1999) suggest that program causality is central to this framework. They also suggest that there is no basis for developing intervention programs unless program initiators use causal thinking.

Phase	Description
Evaluation Planning:	
Why	At the start of designing an intervention programme consider the need to undertake evaluation of the programme: Why evaluate the proposed programme?
Who	Who requires the outcomes of any evaluation? Who will be the evaluation team? Will all stakeholders including multiple team members be involved?
Resources	What resources are available for the evaluation (e.g., volunteers, expertise, time, money, equipment)?
Understand the Program:	
Context	What is the problem the programme sets out to solve? What change is expected after the implementation of the programme? Create a logic model showing the programme inputs, activities and expected outcomes/impacts. What are the assumptions (or theories) that will lead from the programme activities to the outcomes/impacts? Are the assumptions realistic? Over what time period are changes expected to occur? What level of change is required to define success?
Evaluation Design:	
Design	Describe how the evaluation will be conducted and the evaluation activities in the context of why the intervention programme is needed. Design the evaluation activities. What is being measured, how and when? For example: • The participants – who will be involved. • The results of the programme: the short and medium term outcomes in participants' knowledge, skills or behaviour. • The longer term outputs/impacts. • How the link between change and theory will be evaluatiod?
Evidence	How will the data be analysed? What evidence is needed and is it credible for assessing change?
Learn	How will the results be used in future?
Share	How will the lessons learned be shared? How will evaluation results contribute to the gender and IT literature and theory?

Table 2.1. Guidelines for evaluating intervention programs (Craig, Fisher & Dawson, 2011)

A logic model can support planning, implementing, and evaluating programs and shows a theory of action (UWEX, 2003). It will show the logical relationships through the sequence leading from the resources invested in the program to the required results or impact. It can be shown with a graphical picture in a variety of ways, showing the logical connections between the program's inputs, outputs, outcomes, and impacts.

The logic model designed for this project had guidelines (see Table 2.1) to support its implementation; however, effective evaluation cannot be

guaranteed just by the implementation of any formal evaluation framework or model. Chen (1990) argued that the evaluation instruments (e.g., surveys or interview scripts) were critical. The questions used must be appropriately constructed so that they measure what they are intended to measure, are practical and provide useful answers. The adoption of guidelines does not alleviate the necessity to work within the constraints of a particular program, such as a lack of resources and time limitations, factors that commonly limit the ability to undertake effective evaluation.

Applying the Evaluation Framework to the *Digital Divas* Intervention

The three sections of the evaluation – planning, understanding the program, and evaluation design – and the components of each are discussed below in terms of how the evaluation was conducted.

1. Evaluation Planning

There are three key components in planning an evaluation: why, who, and resources. As there are many possible reasons why an evaluation may be conducted, it is necessary to understand what the motivation for a particular evaluation may be. For the Digital Divas program it was established that the purpose of the evaluation would be to check the program's underlying theory of change, the change expected from the implementation of the intervention, and then to be able to inform the wider community under what conditions the intervention had the desired effects, and for whom. The stakeholders in the Digital Divas program included: the participating schools and students, the organisations who partnered with us in the research project, as well as the computing industry community. All members of the project team were involved in the design and analysis of the evaluation, with the majority of the implementation being carried out by two members of the team. The numerous resources required to undertake the evaluation – expertise, access, finance, and time – were included in the program budget.

2. Understanding the Program

The problem we set out to address was the lack of secondary school girls choosing to enrol into IT courses at university level. Therefore the goals of the Digital Divas program were to:

- design materials that would engage girls as part of the middle-school curriculum;

- raise awareness and ignite girls' interest in IT and IT careers;
- increase girls' confidence and positive attitudes towards IT;
- identify the factors that influence the program's implementation; and
- create (longer-term) sustainable programs for schools.

The expected change that would result from implementing the intervention program was an increase in the number of girls undertaking computing subjects in later years at the participating high schools (and then ultimately in higher education).

The way the program was expected to work, from the inputs required to run the activities to the generation of the anticipated outputs, and the embedded assumptions, were refined and confirmed with the project reference group made up from the major stakeholders in the program.

Assumptions of the Digital Divas Program

For the program to have the expected outcomes, we made a number of assumptions that underpinned the program:

1. The curriculum modules we designed would excite the participants, engender greater self-efficacy and deliver positive messages about IT.
2. By participating in Digital Divas the girls will acquire knowledge that challenges the prevailing stereotypes/myths within society that computing is boring, technical, involves working alone, and is the domain of males.
3. That a wide range of IT careers would be presented that involved analysis, development, programming, designing, and problem-solving aspects of IT, not just the use of computers as tools.
4. That the role models present accessible choices of computing careers.
5. That the teacher delivering the program would make explicit the links between the activities the girls were undertaking and their real world significance (e.g., Alice is not just a game but is an example of programming).
6. That any increase in motivation/enthusiasm for IT would be maintained from the time the Digital Divas program ended to the time the girls needed to make further subject selections.

7. That the wider community (school, parents, other teachers, and other students not participating in Digital Divas) would be supportive of the program and those participating in it.
8. That the students who selected IT-based subjects in later years at high school would be more likely to consider a higher education course in IT.

Inputs Required

To implement a successful program the following five key inputs were required:

1. A school that was supportive, had a champion for the program at the executive level, was prepared to be innovative and flexible with the timetable, and had appropriate IT resources. Appropriate technology was defined as being relatively up-to-date, reliable, and supported by good internet access.
2. A motivated, committed, creative, passionate teacher skilled in IT was required to run the program.
3. Undergraduate female IT students (Expert Divas), who were committed and motivated, had good IT skills, empathy with the students, and could be positive informal role models.
4. Guest speakers who were appropriate female role models, and
5. Appropriate curriculum modules that were engaging for participants.

Activities to be Conducted

The Digital Divas program was developed to be of at least one semester's duration. It was designed to be delivered as an elective at a pertinent grade level and delivered in a single-sex class. It was not specified that the teacher needed to be female; however, this was a common occurrence in the program. At least one guest speaker was invited per semester to present their story to students, and an Expert Diva (a female undergraduate IT student) attended at least one classroom session every week.

Outputs Anticipated

The Digital Divas program activities were designed to generate the following short-term outputs for the participating girls:

- excitement about the Digital Divas program, which translates into more excitement about IT;
- a more positive attitude towards IT;

- greater confidence using IT;
- broader knowledge and awareness of IT careers;
- an appreciation of the relevance of IT studies; and
- to ensure IT is not discounted as a possible subject to be studied in future years.

In the medium term it was expected that the girls would seek further information about IT options and that they might consider selecting IT units at higher year levels within their school. The longer-term outputs of the Digital Divas program were expected to be that the program would be sustainable within the school and that the girls:

- could envision themselves in IT careers;
- were more confident and self-sufficient with technology; and
- would consider selecting an appropriate IT higher education course.

3. Evaluation Design

Design

The framework and guidelines described above were used firstly as tools for the development of the program, the construction of the aims and goals underpinning it, and then to guide the design of the evaluation (data-gathering tools, and analyses), as well as the order of deciding what was to be measured and when it needed to be done.

Survey items and interview questions were developed by the evaluation team. The Eccles' model of academic choice, previous research findings on gender and IT, modified versions of items from pre-existing instruments, and personal experience informed the development of the items and interview questions. [Copies of all survey instruments, focus group and interview protocols are provided in the Appendices to this book]

The curriculum materials developed for the Digital Divas program were designed and developed by one of the participating teachers who was employed as an educational developer for the duration of this task. Most of the curricula were trialled in this teacher's class prior to implementation in the wider program.

Evidence: The Data Gathered

Appropriate and credible evidence to be gathered and analysed included the following:

From participating schools

- To contextualise each school, information was collected on the size of school, gender-ratio, ethnic makeup, and type of school (government/Catholic/independent, co-educational/single-sex, year levels offered), socio-economic status of the families (ICSEA), and specialities of the school (e.g., music, science).
- Past academic performance of students as measured by: VCE success, percentage moving to higher education, or employment.
- What quantity of technology was available in the school (e.g., laboratory setting / laptop program, physical set-up of computer laboratories where appropriate).
- Ratio of computers to students.
- Technical support available in the school.
- Perceived status of computing within the school, blocking of IT subjects, current school offerings of IT subjects, and cross-curricular IT activities at all levels.
- Types of IT training and/or support programs offered to staff.
- Each school's history of girls selecting IT classes at senior level, and record of students going on to post-secondary IT courses.
- Technology available for conducting the Digital Divas program.

Our impressions of the school context were confirmed in an interview with the Digital Divas teachers within the school.

From participating teachers

- Surveys were completed by teachers prior to the commencement of the program covering their background in IT, their perception of computers in their school, their knowledge of the Digital Divas program, etc.
- Surveys were completed by teachers again at the end of each semester regarding: any inhibitors or enablers for the delivery of the Digital Divas program; their perceptions of the girls' engagement with the Digital Divas materials, the guest speakers, and value of the Expert Divas; what worked and what did not; and what improvements could be made.

- Some of the teachers were interviewed at the end of each semester to gather more in-depth information on issues canvassed through the surveys.

From participating girls

- Surveys were completed prior to and following the Digital Divas program to measure changes in attitude, confidence, motivation, perception of skills, engagement with IT, awareness of IT careers, and the identification of messages about IT that came through from the program.

- Focus-group interviews, or individual interviews, were conducted with some participating girls at the end of the semester. Focus groups were also conducted twelve months later to collect reflections on the program and to look at the medium-term outcomes for the girls.

From the Expert Divas

- Ongoing reflections by Expert Divas were collected at three points in time throughout the semester: weeks 3 and 12, and at end of semester.
- Focus groups were conducted with all Expert Divas at the end of the semester regarding their interactions with the girls, the relationships they established with the girls, and the types of support the girls asked for; for example, did they ask about the Expert Divas' university studies or ideal career, possible careers in IT, or about being a geek?

Also of interest from the Expert Divas' perspectives were: what inhibited or enabled the delivery of the program; perceptions of the girls' engagement with the Digital Divas material; what worked and what did not; what improvements could be made; whether they felt that they added value to the girls' experience of Digital Divas (if so, in what way/s); and the type of support (if any) they provided the classroom teacher.

Other considerations

We were interested to know whether the wider community (parents, teachers, and students in the year level but not in the Digital Divas program) was supportive of the Digital Divas program and of the students involved. A PhD student was recruited to look into this area.

We considered it critically important to disseminate the findings of the Digital Divas program, including the negative aspects as well as the positive effects. We planned for the lessons learnt from the Digital Divas program to be shared within relevant IT and education research contexts, and with professional organisations. We were concerned that we could justify the interpretations, judgments, conclusions, and recommendations made in relation to the program. We wanted the results to inform new iterations of the Digital Divas program, and to be able to confidently use the results from the multiple implementations within different schools to inform and guide IT educational policy and teacher professional development.

Conclusion

In this chapter we have described the research background informing the evaluation framework adopted for the Digital Divas program, and the theoretical underpinnings that guided the development of the instruments used to undertake the evaluation. A mixed-methods research design for this dimension of the project was employed. From our knowledge and the literature it was apparent that few previous intervention programs, with similar goals to ours, had adopted such rigorous evaluation processes. It was our belief that the identification of those aspects of the program which worked best and met our anticipated goals, as well as what was less successful, provides better information for those planning future interventions. More specific recommendations for policy, classroom practice, and teacher professional development may emerge when the positive and negative aspects of the program are assessed and interpreted with integrity.

More details of the research approach used for the project are discussed in the next chapter.

CHAPTER 3

RESEARCH DESIGN

Evaluating the Program

Overview

This chapter describes how the research was conducted and the data analysed. The approach we have taken underpins the results presented in later chapters. Our data collection included both qualitative and quantitative data employing a mixed-methods approach. We provide details on the data collection techniques employed and analysis of the data, as well as the ethical considerations when conducting research involving children. We also discuss our rationale for selecting these techniques.

Introduction

The first stage of our research was to build an evaluation framework. This framework was described in detail in Chapter 2. In this chapter we describe how the data were gathered and analysed based on the components described in our evaluation framework and our assumptions.

Our research was situated both within the information systems [IS] and education domains. Our methodological stance was interpretivist; that is, we focused on people and the 'social world' rather than the natural world (Cecez-Kecmanovic, 2011). We did not set out to test hypotheses or expect our findings to be replicable as is common with positivist research (Cecez-Kecmanovic, 2011; Shanks, 2002). As highlighted by Shanks (2002) in his description of positivist research, we were not independent of the phenomena being investigated; we were closely involved with the schools, the teachers,

the Expert Divas, and the girls themselves. It can be argued that much of the research conducted in both IS and education has a focus on the 'social world'. A reflective paper published by the then editors of the *Information Systems Journal* wrote: 'Because we [Information Systems researchers] are concerned with people and organisations as well as technology, our research approach is rarely purely 'scientific'. We cannot repeat our experiments unless they concern technology alone' (Avison, Fitzerald, & Powell, 2001, p. 13). This was particularly true in our case.

Interpretive research approaches are particularly valid when looking at rich phenomena that cannot be easily described or explained by existing concepts or theories (Walsham, 1995). Our philosophy in designing our data-gathering was that one approach would not provide us with the depth of understanding we sought about the Digital Divas program as well as effectively evaluate the intervention. In the words of Miles and Huberman (1994), 'we have to face the fact that numbers and words are both needed if we are to understand the world' (p. 40).

Mixed-methods Research

Our research used a mixed-methods approach, which is one that gathered and analysed both statistical data and qualitative data (Venkatesh, Brown, & Bala, 2013). Mixed methods can help in answering complex questions where both qualitative and quantitative methods are required (Hesse-Biber & Johnson, 2013). A question such as why girls are or are not interested in studying IT is multifaceted and complex. We needed an approach that would allow us to explore our questions in-depth. Employing a mixed-methods approach can be challenging, given it involves integrating the findings from both qualitative and quantitative data in what Venkatesh et al. (2013) call 'meta inferences'. What is important and challenging is ensuring the different approaches complement each other, validating the data-gathering methods used (Greene, Caracelli, & Graham, 1989; Miles & Huberman, 1994; Salomon, 1991; Venkatesh et al., 2013).

Approaches Used to Investigate Interventions

The techniques and tools we used to gather data are consistent with the approach taken to evaluate other intervention programs. The majority of programs we found used pre- and post- surveys, with some employing techniques such as interviews, focus groups, and observations.

The first reference we can find to an intervention program aimed at encouraging girls to consider computing was a paper describing a workshop for girls conducted at the University of Glasgow in 1987 (Watt, 1988). The workshops were described as 'a great success' and 'a very worthwhile experience' (Watt 1988, p. 114); however, the criteria used to measure 'success' were not reported.

Many short-term intervention programs to encourage girls to consider IT have used survey instruments to assess the outcomes (see for example (Buxton, 1992; Christie & Healy, 2004; Clark, Pickering, & Atkins, 1991; Clayton, Beekhuyzen, & Nielsen, 2012; Craig, Lang, & Fisher, 2008; Graham & Latulipe, 2003)). Different longer-term interventions in situ, such as Computer Clubs for Girls [CC4G], and the use of mentors and support networks for women studying IT, have used a range of evaluation methods; rarely, however, has more than one method per study been reported. Heo and Myrick (2009), who evaluated an out of school club, used pre- and post-interviews and surveys, as well as observations. Pre- and post-surveys were also administered by Doerschuk, Liu, and Mann (2007) to assess the effectiveness of a summer camp for girls. Longer-term interventions have generally involved a greater variety of data-collection techniques, for example Clayton and Lynch (2002) reported on a number of strategies implemented in Queensland, Australia, to increase the number of women studying IT. They also assessed the effectiveness of the programs by reviewing enrolment data in IT courses. Similarly, structured interviews, focus groups, and surveys were used by Staehr, Martin, and Byrne (2000/2001) to assess the effectiveness of a support program for female tertiary students.

Selection of Schools and Participants

The research was funded by the Australian Research Council (ARC) and industry partners [an ARC Linkage grant]. Such studies require the researchers to work with their industry partners in undertaking the research. The Victorian government department responsible for education, the Department of Education and Early Childhood Development [DEECD], and one of the participating schools, were two of the five industry partners and provided funding for the study as outlined in Chapter 1.

Selecting Schools

The support from the DEECD included distributing information about Digital Divas to schools within Victoria and inviting them to participate. This occurred at the start of 2010 and 2011. Schools contacted the researchers and were provided with further information. The information included details of how the program would be run, the support that would be provided, and our expectations for participation. The school principal had to agree to run Digital Divas as an all-girls class for at least one school term (approximately 10 weeks). Those schools formally agreeing to be involved sent one or two teachers, who would teach the program, to a training session. At the training session it was again reinforced that the program had to be run in an all-girl class. In a couple of cases it became evident that this was not possible and the schools withdrew from the study. All other schools agreed to participate and accepted the conditions we set.

In all, nine Victorian government schools agreed to participate; six were co-educational and three were single-sex schools. In the final year of the study, a single-sex independent school in Sydney, New South Wales, also ran the Digital Divas program.

Selecting Teachers

The selection of who would teach the Digital Divas program was made by each school. We did not specify the background or gender of who would teach the class; we were happy for the school to make the decision. Given the complexity of running a school and organising classes, it was clearly more appropriate to leave this in the hands of the schools. A female teacher was allocated the class in all but one school.

Selecting Girls

We did not suggest how schools should organise the Digital Divas classes. All schools decided to offer Digital Divas as an elective. In some cases the classes were run with girls from more than one year level in the same class. Most of the participating girls had self-selected to take Digital Divas. In some cases, however, the teachers told us that there were girls in their classes who had not been able to select any other elective and had ended up in the Digital Divas class or had been 'forced', for other reasons, to take the class; this, however, was rare.

Selecting Expert Divas

One of our key underpinning beliefs was that girls needed to be exposed to, and hear from, women studying IT at tertiary level (Chapter 5 describes the philosophy of the program in more detail). The Digital Divas program therefore involved a role model (Expert Diva) who attended one class each week. The female role models were drawn from currently enrolled tertiary IT students. We called for expressions of interest from female students studying IT and asked the women to complete a short survey as to why they might want to participate as Expert Divas. The potential Expert Divas were interviewed and those selected were matched with a school based on the school's location and the timing of classes. The women selected as Expert Divas were paid for their time.

Techniques and Tools for Data-gathering

As mentioned in Chapter 2, the design of our evaluation framework, data-gathering and analysis were guided by the seven criteria needed for an evaluation to be credible identified by (Cohoon & Aspray, 2006, p.144). These criteria are:

- Designing a convincing way of measuring outcomes
- Ensuring a large data sample (more than 10)
- Using measures that are appropriate
- Including pre- and post- surveys, a control group or some form of comparison
- Having more than one data-collection point
- Using suitable analysis techniques
- Ensuring research that has integrity

In this section we outline the different tools and techniques we used for gathering data and analysing the results. We have organised this around the different groups involved. There is little reported research on the views of others who were not the direct targets of the interventions (this is discussed in more detail in Chapter 7). Our primary data-gathering therefore included the girls, the teachers, the Expert Divas, and our own observations.

Copies of all the data-gathering instruments are found in Appendices B, C & D.

The Girls

Conducting any research on children requires consideration of a number of factors including the suitability of the data-gathering techniques to be used, ethical considerations, and how to ensure the validity of the gathered data (Parr, 2010). We took a 'child-centred' perspective (Christensen & Prout, 2002). We recognised the girls as people with their own views and biases. We also adopted Christensen and Prout's (2002) 'ethical symmetry', that is, when a researcher uses the same approaches whether the participants are adults or children. There are no particular research methods that should be used, '[R]ather it means that the practices employed in the research have to be in line with children's experiences, interests, values and everyday routines' (Christensen & Prout, 2002, p. 482). Our university ethics requirements were that the girls, as well as their parents (or guardians), were required to give consent to participate and could withdraw at any time.

Data on the impact of the intervention on the girls were gathered using pre- and post-survey surveys, focus groups, and observations.

Pre- and Post-surveys

Consistent with similar studies, we used pre-and post-survey surveys to identify and explore girls' views and perceptions of IT, IT careers, and stereotypes before and after they had experienced the Digital Divas program. We collected 265 pre- surveys and 199 post- surveys from the girls. Note, not all girls were available to complete the post-survey. The purpose of the surveys was to understand the extent to which the Digital Divas intervention had changed the girls' perceptions of IT. Questions were drawn from a number of previously validated survey instruments (for example, see Murphy, Coover, & Owen, 1989; Fogarty, Cretchley, Harman, Ellerton, & Konki, 2001) and were consistent with pertinent elements of Eccles' model of academic choice.

The pre-survey included the following:

- Items requiring Yes/No responses covering questions relating to computers at home, and the girls' use of computers and applications at home and at school.
- Items with five-point Likert-type response formats (1 = weak, 2 = below average, 3 = average, 4 = good, 5 = excellent) exploring girls' computer self-efficacy.

- Items with five-point Likert-type response formats (1 = Strongly Disagree, 2 = Disagree, 3 = Not Sure, 4 = Agree, 5 = Strongly Agree) exploring a range of attitudes towards computing including: beliefs about teachers and parents, careers, boys' and girls' skills with computers, and gender-stereotyping of IT.
- Open-ended items seeking opinions on careers in IT.
- The request to draw a picture of someone in the computer industry using a computer.

The post-surveys included open-ended questions exploring the girls' reactions to the Digital Divas intervention, in particular changes in their perceptions. Many of the items presented in the pre-survey were repeated so that we could conduct statistical tests to determine changes in perceptions and attitudes. The girls were asked to provide their names on the surveys so that it would be possible to compare pre- and post- responses; however, this did not always happen.

Both the pre- and post-surveys were completed in hard copy. In the first year of the study we asked teachers to have the girls complete the surveys and then send them to us. This proved problematic, with delays in returning surveys. We found that it was more effective to have a researcher oversee the administration and collection of the surveys. This approach gave us more control over the process, ensuring that the surveys were completed by all the girls participating in the research at the same time. Even though most pre- and post-surveys were completed in class time, for a range of reasons not all girls completed both surveys; in most cases this was due to absences on the day they were administered.

In line with good survey item design practice (Neuman, 2003, p. 68–287), the items were carefully designed to ensure that the girls would understand their meaning. The sequence in which the questions/statements were presented was important. The survey was divided into sections. Demographic data was collected at the start. This was followed by items probing self-perceptions of computer competence and the girls' use of computers at school and at home. A sequence of items related to attitudes towards, and the stereotyping of, computing, its study, and involvement in computer-related careers followed. The students were then asked to draw a person working in the computing industry, and describe what the person was doing. Finally, there were open-ended items seeking

the girls' views on what they would, and would not like, about working in the computer industry.

The surveys were designed to be scanned electronically to maximise accuracy of data entry. Copies of the pre- and post- student surveys are found in Appendix B.

Focus Groups

Focus groups are increasingly seen as a valuable tool in social science research, particularly when combined with other research techniques. Neuman (2003) describes a focus group as 'a special qualitative research technique in which people are informally "interviewed" in a group discussion setting' (p. 396). They are particularly useful when exploring people's ideas and perceptions. The value of focus groups is that participants are exposed to the ideas of others in the group, often triggering new recollections and bringing forth new perspectives (Stahl, Tremblay, & LeRouge, 2011), and they can feel more empowered to speak than, for example, in individual interview settings (Neuman, 2003, p. 396). In our case, focus groups were a more effective mechanism for gathering qualitative data from girls than interviews. In small groups the girls were more likely to express their opinions than they might otherwise have been individually (Souza, Downey, & Byrne, 2012).

How a focus group is designed and managed is important, with a limited number of participants (Williamson, 2002c). Too many participants and some voices will not be heard; too few can result in insufficient discussion. Typically a focus group will consist of between six and twelve participants and last for between 60 and 90 minutes (Neuman, 2003, p. 396). Management of a focus group has to be undertaken carefully to ensure one or two members of the group don't dominate the discussion and that everyone has an opportunity to contribute their views (Neuman, 2003; Williamson, 2002c, p. 396).

At each participating school we ran two or three pre- and post- focus groups with three to six girls in each group. A total of 31 pre- focus groups involving 134 girls and 30 post- focus groups involving 108 were conducted. Girls had to agree to participate during school time, therefore at least two focus groups were run to accommodate when the girls could participate. The focus group discussions were recorded and transcribed later.

Factors included in the Eccles' model of academic choice shaped many of the issues explored in the focus groups. In the focus groups that were held prior to the girls undertaking the Digital Divas program we explored their

current use of computers and applications at home and at school. The girls were encouraged to discuss their views on the use of computers by boys and girls and who was more likely to have a career in IT, thus triangulating the survey data and providing deeper insights.

The purpose of the focus groups after the girls had completed their Digital Divas class was to assess any changes in attitude, particularly changes in stereotypical views on women and IT, and if they were now more likely to consider a career in IT, again providing a deeper understanding.

To understand the extent to which the program had resulted in a change long-term, additional focus groups were held in four schools with 33 girls who had completed Digital Divas more than 12 months prior. One set of focus groups was held at one school with girls who had participated in Digital Divas two years after the program. Our goal had been to do this with girls from all schools. Unfortunately, despite our best efforts it proved difficult to track the girls; in some cases the teachers had moved on, in other cases the teachers did not recall which girls had been involved.

A copy of the focus group open-ended questions can be found in Appendix D.

Observations

All classes were visited weekly by an Expert Diva (female tertiary IT student). The Expert Divas provided weekly reflections on what was happening in the class, what the girls were working on, what they did in the class, and how engaged the Expert Diva thought the girls were with the work. Classes were also visited at least twice by a member of the research team and notes were written up after each visit. The observations provide us with another perspective on how the intervention was running, the quality and effectiveness of the modules of work, and the girls' reactions to the program.

Teachers

As for the girls, we gathered data from teachers using pre- and post-surveys (18 pre- and 10 post- surveys were conducted), observations, and interviews at the beginning and the end of the program.

Pre- and Post-surveys

Surveys were completed by each teacher prior to teaching Digital Divas and again shortly after the program finished. The surveys were completed in

hard copy and scanned for data entry. The teacher pre-survey was in sections and included the following:

- **About you:** personal and demographic data were sought: sex, qualifications and teaching experience, self-efficacy with computers (Likert-type response format: 1=low to 5=high), and the year level/s involved in the Digital Divas intervention at the school.
- **Computers in your school:** information was sought on the organisation of computers and IT offerings in the school.
- **Your views on girls, boys, and ICT:** the teachers' perceptions about the capabilities and attitudes of girls and boys with respect to IT. The teachers were also asked to explain their responses.
- **The Digital Divas program:** The teachers were asked why they had agreed to teach in the Digital Divas program and what they thought success would look like.

The post-survey for teachers consisted primarily of free-text responses to questions relating to the Digital Divas intervention including: how students had been selected into the class; which teaching modules they had used with their student; and if their perceptions of the more and less successful aspects of the intervention, including if they believed it had been of benefit to the girls. In addition we asked them to comment on their Expert Diva and the role she played and what they might change in a future delivery of the intervention.

Copies of the teacher pre- and post- surveys can be found in Appendix C.

Interviews

Given the importance and influence of the classroom teacher on student attitudes, it was important to explore the teachers' views more widely. Eleven pre- teacher interviews (note, not all teachers were available for the pre interview) and 13 post- interviews were conducted (note, some schools ran the program more than once with different teachers). The semi-structured pre-interview protocol focused broadly on how IT was viewed and taught within the school; issues around the implementation of the program; and how teachers thought girls might react. In the post-interviews we explored the impact of the Digital Divas program and how the program could be improved in future. Each interview lasted 30–40 minutes and was recorded.

Copies of the pre- and post-teacher interview open-ended questions can be found in Appendix C.

Observations and Informal Feedback

Members of the research team observed lessons at times convenient to the teacher. Informal feedback was simultaneously gathered from the teachers. Notes were kept for later use.

Expert Divas

Eight Expert Divas were appointed to the program, some were involved in more than one school. Each week the Expert Divas were requested to complete a weekly reflection in which they recorded their observations for the week. We asked the women to provide us with information on what had and had not worked in the lesson they attended, their contributions to the class (i.e. what they did), and how engaged they thought the girls were with the materials. They were also invited to make any other comments they deemed relevant.

The Expert Divas were interviewed at the end of their time in the role. We conducted 13 interviews (those Expert Divas who participated more than once were interviewed more than once). The semi-structured interviews explored their thoughts on how well Digital Divas had worked in the particular classroom and school they were in, and what they thought had and had not worked. They were also asked to reflect on their experience, what they liked and did not like, and what they had learned. The interviews took approximately 30 minutes and were recorded.

Schools

It was important to collect data about each school. The data came from two sources: publicly available information from the MySchool website (http://www.myschool.edu.au/), and specific information provided by the principal.

The information provided included:

- the ethnic make-up of the school
- the socio-economic level of the school
- the sex breakdown of students in the school, including the number of girls taking IT subjects or electives at the different year levels

- the number of students enrolled in Year 12 in that year (final year of schooling)
- the school's academic performance in: National Assessment Program – Literacy and Numeracy [NAPLAN] at Years 7 and 9; and Victorian Certificate of Education [VCE] achievements in the final year of schooling.
- computer facilities in the school, including the ratio of students to computers
- how computing was taught in the school, at which year levels, and if computing was compulsory at any level and/or offered as an elective

Chapter 4 provides more details on each of the schools and the statistics relating to the factors described above.

Visits to each of the schools also provided an opportunity to observe and note key features of the school environment and the classrooms.

It should be noted that focus groups were not conducted in one school. In two schools the class size was very small. Not all Expert Divas completed their weekly reflections.

Data Analysis

For the analysis of the quantifiable data included in the student and teacher surveys, we used the Statistical Package for the Social Sciences [SPSS], a software package commonly used for statistical analyses by social science researchers.

NVivo was used to code and then to assist with the analysis of all qualitative data including the open-ended responses in the surveys. We used a grounded-theory methodology, specifically that described by Bryant and Charmaz (2007) and Urquhart (2013), to categorise the responses. Saillard's (2011) interpretation of this is that 'Categories are grounded in the data thanks to the line-by-line coding but still a category is part of the analytic thinking of the researcher. Raising a code to a category is an analytic process.' Our research began with defined assumptions around which the survey, interviews and focus group questions were built. We therefore had some ideas of the likely categories that guided the initial coding decisions; we then allowed the data to 'speak for themselves'.

Analysis of Quantitative Data Using SPSS

To meet the goals of the study and answer the research questions, descriptive and inferential statistics were used in the analyses of the quantitative data. As appropriate, mean scores, modal scores, and/or frequency counts were calculated to describe the data sets.

Depending on the response format type, parametric or non-parametric statistical tests were conducted to compare response patterns. Independent groups' t-tests and analyses of variance (ANOVAs) were used when the response data were interval and we were interested to know if there was a statistically significant difference in mean scores. Chi-squared tests were used when data were categorical or ordinal to identify if response distributions differed. Some Pearson bivariate correlations were also conducted to explore the relationships between particular variables (items) of interest. As is common in the social sciences, a p-value of .05 was the level of statistical significance adopted. If responses were found to be statistically significantly different, the meaningfulness of the difference was also examined.

Paired t-tests were used to compare the mean scores on identical items on the pre- and post- surveys to determine if there had been a change in students' or teachers' measured response to these items (e.g. attitudes or beliefs) as a consequence of the Digital Divas intervention. It should be noted that paired t-tests can only be conducted on the responses of those participants who complete both the pre- and the post-surveys. Thus the number of responses analysed using paired t-tests was less than the number of participants completing the pre-survey, and also less than the number completing the post-surveys as some students completing one or other of the surveys did not complete the other.

Analysis of Qualitative data using NVivo

NVivo is a well-recognised tool for analysing qualitative data (Davidson, 2012; Gibbs, 2002, p. xxiii). It facilitates, in a systematic way, the coding of a range of data types that can later be analysed. In contrasting quantitative and qualitative data analysis, Gibbs (2002, pp. 10–11) argues that qualitative analysis involves researchers managing their data as they move between data sets and compare data. Data, apart from text, could consist of codes, memos, annotations, etc. Davidson (2012) describes five 'interlocking stages' when considering qualitative data and technology. These stages are 'creating data; organising data; primary responses; secondary responses; curation' (p. 4).

Organising the data involved identifying which interviews and which free-text questions from the survey data we would code. These were brought into NVivo for coding. The team had to agree on the high-level nodes and sub-nodes we would use (see Figure 3.1, next page). The decisions were based on the research questions and assumptions detailed in Chapter 2.

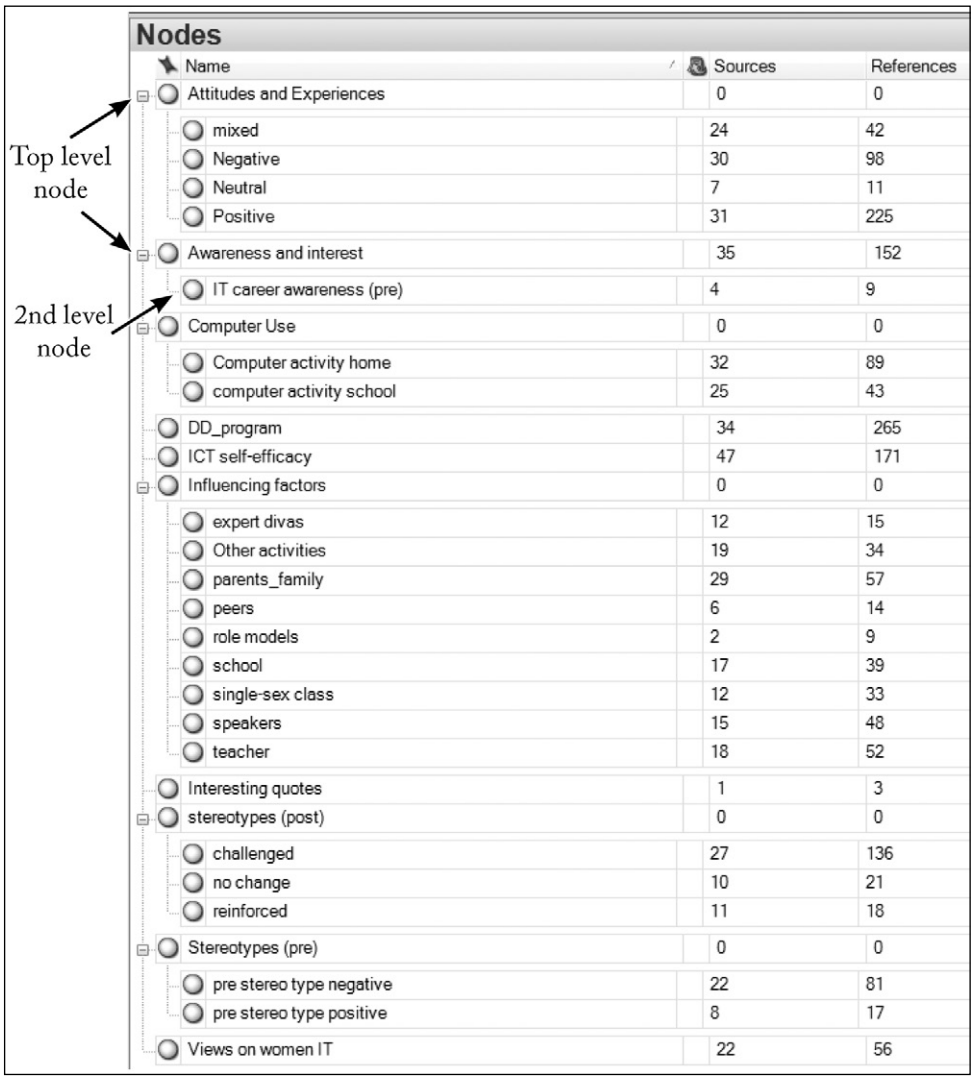
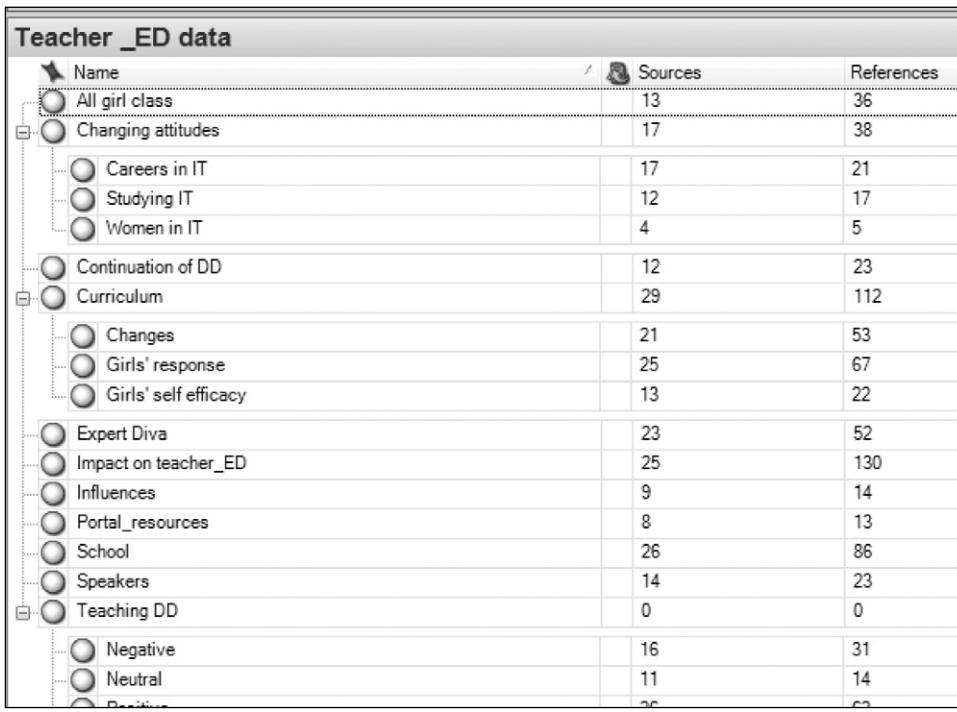


Figure 3.1 Screen shot of nodes and sub-nodes[4]

4 NVivo screen shots reproduced with permission from QSR International.

We agreed to create a different set of nodes for data from the girls as distinct from data from the teachers and the Expert Divas. We then looked at mechanisms for linking and analysing the data we had and to consider ways of visualising the outcomes (See Figure 3.2).



Teacher _ED data

Name	Sources	References
All girl class	13	36
Changing attitudes	17	38
Careers in IT	17	21
Studying IT	12	17
Women in IT	4	5
Continuation of DD	12	23
Curriculum	29	112
Changes	21	53
Girls' response	25	67
Girls' self efficacy	13	22
Expert Diva	23	52
Impact on teacher_ED	25	130
Influences	9	14
Portal_resources	8	13
School	26	86
Speakers	14	23
Teaching DD	0	0
Negative	16	31
Neutral	11	14

Figure 3.2 Nodes for coding teacher and Expert Diva data

Critical to the validity of the data analysis process is how the coding is managed and how the data are interrogated (Welsh, 2002). As described by Ho and Frampton (2010), the reliability of the coding can be assessed by examining the consistency with which team members code the same text. Three of the researchers coded all the data. After discussion, agreement was reached on the nodes to be used. It is recommended that a code book be written, which we did: it detailed the nodes, the meaning we gave to each and examples of text coded to that node. Table 3.1 (next page) is a segment of the code book.

Three of the researchers independently coded the same three interviews. A coding comparison query was run to establish the inter-coder reliability (Gibbs, 2002; QSR, 2013, pp. 236–237). The results indicated that we

had more than 90% agreement on the codes. During the coding process each researcher kept a diary in which reflections on the data, questions and suggested changes to nodes were made. Any recommendations for changes were discussed by the team.

Code	Definition	Example
Attitudes and experiences (aggregate) Positive - Negative - Neutral - Mixed	Mixed was where phrase included both negative and positive comment	Positive: *'Like it's a good thing to learn stuff'* Negative: *'Too complicated'* Neutral: *'Depends on what you're doing'* Mixed: *'Think the teacher should teach us more about programs we would use'*
Awareness and interest • IT career awareness (pre) • IT Career (post-)	In IT – general knowledge of IT and of women in IT. IT careers Select as a future career Knowledge of technology Level of knowledge of type of careers. Possible career, wider understanding of what an IT Career was	*'There are lots of women in IT'* *'realised IT is not just programming'* [will you do IT] *'no, I have higher goals'* *'to like repair computers and stuff'* *'IT certainly did broaden our horizons a bit.'* *'Before Digital Divas, we would have thought, IT, no. I might go over and do something else. Now, after it, we've gone, "Hey, that's actually not a bad idea."'*

Table 3.1 Example from the code book

To interrogate the data, queries were run within NVivo. These included:

- Matrix coding queries enable a cross-tabulation of selected items. For example, to explore if the curriculum excited girls' interest a matrix code query was run looking at the node 'Attitudes and experiences' (positive, negative, mixed and neutral responses) and the node 'DD_Program'.
- Word frequency queries allowed us to identify the most frequently used words including at the node level. For example, a word frequency was conducted on the node IT Self Efficacy and identified that the word 'confidence' was the most frequently used word.
- Text search queries were undertaken to identify individual occurrences of words. For example, how often in the word 'women' was used in the post- survey responses.
- It is also possible to interrogate data at the individual node level. For example, to understand the impact speakers had on the girls from

all the schools we explored the text coded to the node 'Influencing factors' and sub node 'Speakers'. This enabled us to identify a theme or a pattern by counting, for example, the number of positive or negative responses (Miles and Huberman 1994, p. 253).

Research Design and the Evaluation Framework

As discussed and described in Chapter 2, we believed an evaluation framework was important for us to be able to measure the impact of the Digital Divas program. An important component of any evaluation framework is the assumptions on which the program is built. Table 3.2 briefly describes our assumptions and how the outcomes of these assumptions were evaluated.

Assumption	Mechanism for evaluating outcomes
The curriculum modules we designed would excite the participants, engender greater self-efficacy and deliver positive messages about IT.	Pre- and post- surveys with girls and teachers, observations, focus groups, teacher interviews and Expert Diva reflections and comments.
By participating in Digital Divas the girls will acquire knowledge that challenge the prevailing stereotypes/myths within society that computing is boring, technical, involves working alone, and is the domain of males.	Pre- and post- surveys with girls and teachers, observations, teacher interviews and focus groups.
That a wide range of IT careers would be presented that involved analysis, development, programming, designing, and problem-solving aspects of IT, not just the use of computers as tools.	Design of the modules and value of the speakers in schools based on feedback from interviews with teachers.
That the role models present accessible choices of computing careers.	Interviews with teachers and Expert Divas.
That the teacher delivering the program makes explicit the links between the activities the girls are undertaking and their real-world significance and why that is important.	Post- surveys with teachers, interviews with teachers, observations and reflections of Expert Divas.
That any increase in motivation/enthusiasm for IT is maintained until the girls need to make further subject selections.	Focus groups 12 months and longer after girls have completed the program.
The wider community are supportive of the program and those participating in it.	Outcomes of the research conducted by the PhD student.
Girls who undertake IT-based subjects in later years at high school will be more likely to consider a higher education course in IT.	Not possible to establish because the project ended before such evaluation could be made.

Table 3.2 Assumptions and evaluation

Chapter summary

> It is not enough to implement a program or service – it is imperative we know if it has made a difference. (Slatter, 2003 p. iii)

Without conducting a well-considered and well-designed evaluation of Digital Divas, we would not have been in a position to draw meaningful conclusions. Our evaluation framework served as an important guide and reminder, ensuring that the outcomes of the assumptions we made could be evaluated. Using software tools such as SPSS and NVivo enabled us to organise our data effectively and analyse it carefully. In this chapter we have provided a detailed discussion of the research approach we took for data collection and analysis guided by the seven evaluation criteria described by Cohoon and Aspray (2006).

We used the qualitative data to further explain and enrich our understanding of the quantitative results. We are confident that the approach we took provides valid and reliable results from which conclusions could be drawn.

CHAPTER 4

BACKGROUND

Our Schools and the Digital Divas Portal

Overview

In this chapter we provide an overview of the schools involved in the Digital Divas program and the portal designed to hold the materials and support classroom activities. The chapter highlights the diversity of schools that participated in the program; diversity from the perspective of socio-economic make-up of the students; single-sex and co-educational schools; attitudes to technology generally; and IT offerings within the school. In the course of our research we gathered a range of data from sources such as the Department of Education and Early Childhood Development 'My School' website, demographic data directly from the schools and our own knowledge and observations regarding the schools. Also, during the process of interviews other background information was obtained. The chapter also provides a brief overview of the portal designed to support the project: our rationale for establishing the portal, how it was managed and run and how it was used by the schools to support classroom activities.

Introduction

The Digital Divas program was officially conducted in a total of 10 schools over three years from 2009–2012. Our aim was to gather data from each school on the first iteration of the program in that school, and some schools on subsequent iterations depending on whether there had been a change in delivery mode, or teacher. Schools were recruited into the program through

a variety of measures. We sent an invitation to all government school principals through the mailing lists of the project partner Department of Education and Early Childhood Development (DEECD). We mailed information to independent schools in metropolitan and regional areas. We followed up with telephone calls to principals. We also promoted the program through our various universities' faculty marketing sites. Our grant was awarded in mid-2009 and the program ran at Bartik in Semester 2 of that year and Semester 1 of 2012; however, it took two semesters to gain Ethics approvals from our universities and the DEECD to run it in other schools and to finalise the survey tools, so data-gathering began in earnest in Semester 2, 2010.

In this chapter we provide a summary overview for each of the schools that participated in our program. Most of the data were gathered from the My Schools website or directly from the school. It should be noted that the majority of these schools continued to run the Digital Divas program as an elective in their curriculum after the first iteration and that the name of the school is an alias, as mandated from the Ethics approval process, to prevent any individual student or teacher being adversely affected by our research. The sustained impact of the program will be discussed later in this chapter and in more detail in the final chapter of this book.

School Summaries

The school profile information presented here is a summary gleaned from the profile provided on the My School webpage (www.myschool.edu.au) in June 2014. Each school has been given an alias drawn from the surnames of significant women in computing (Appendix A), so the individual school URLs are not provided deliberately to prevent identification. The statistics provided on the current socio-economic status of each school (ICSEA) as well as the percentage of students continuing in higher education are as published on this site.

Bartik Secondary College is an exciting learning community where the students are encouraged to strive for excellence in all that they do. The school provides an innovative junior school curriculum that integrates English, Humanities and IT. The Year 8 and 9 curriculum includes a wide range of electives that enable individualised learning pathways including opportunities for student support and acceleration. The school curriculum at Years 10, 11 and 12 provides opportunities for extended learning through

advanced placement and university enhancement studies. The school is proud of the many student leadership opportunities it provides. The school has a large population of over 1500 students with the gender composition almost equal. The post-school outcomes of the student cohort in 2013 were:

67% of Bartik students continued their education at university,

20% at TAFE facilities,

7% went on to employment.

The ICSEA was 1070 (noting that the average is 1000).

Bartik was the first school to trial the Digital Divas program in 2009. Data was gathered for this research in Semester 2 2010 and Semester 2 2011. In response to an email query it was confirmed that the program ran in both semesters in 2012.

Clarke Girls' Secondary College has a reputation for excellence in the provision of education. The My School profile reports that the school provides a strong focus on all students working to achieve their individual best, on challenging themselves, and on taking advantage of any opportunities that come their way. The school provides a diverse curriculum that enables all students to develop their practical, creative, academic and sporting skills. The school had an enrolment of 1000+ students in 2013. The post-school outcomes of the student cohort in 2013 were:

74% university

10% TAFE

3% employment

The ICSEA was 1137 (noting that the average is 1000).

Clarke only ran the program once, in Semester 2 2010. However, in 2013 the new head of IT at the school made contact to obtain the curricula from the website, indicating an interest to trial the program one more time.

Forsythe Secondary College is a relatively small school that had just over 240 students enrolled in 2013. The school has a proud history that dates back to the late 1920s. It caters for a diverse cultural community. The school aims to provide all students with the necessary skills and experiences they will need to meet the challenges and opportunities of the future. There is a strong emphasis on building student skills in the areas of

literacy and numeracy. At Years 7 and 8 all students study a language other than English as well as music. Students in Years 9 and 10 choose from a range of elective subjects in the Arts, LOTE, Technology and Humanities in addition to their core studies. The post-school outcomes of the student cohort in 2013 were:

56% university

35% TAFE

3% employment

The ICSEA was 930 (noting that the average is 1000).

The Digital Divas program was first delivered in Semester 2 2011. Forsythe indicated via email in 2012 that it was continuing to deliver the program.

Goldstine College is relatively new, having seceded from a larger school in the last decade to become a standalone secondary school (Years 7–12). The school provides a broad curriculum to support all students' academic and career aspirations. It conducts a selective-entry accelerated learning program for academically gifted or talented students. The school has clear expectations around student behaviour, the wearing of the school uniform, as well as striving for strong academic performance. The school population in 2013 was nearly 1300 students with male students slightly outnumbering female students. The post-school outcomes of the student cohort in 2013 were:

59% university

27% TAFE

8% employment

The ICSEA was 978 (noting that the average is 1000).

Data was gathered from Goldstine in two semesters at the request of the school, Semester 2 2010 and Semester 1 2011. We are not aware of the continued offering of the program to students due to a lack of response to our inquiries.

Holberton Senior College offers comprehensive programs for students in Years 10–12 through a broad range of VCE studies, VET certificates and VCAL. The school is a young school but it has grown quickly with just under 1000 students in 2013. The gender composition of students was skewed, with

male students making up approximately 60% of the student population. The school reports that its students come from varied social, economic and cultural backgrounds. It recognises and values the diversity of its community in an outer-eastern area of Melbourne. The post-school outcomes of the student cohort in 2013 were:

15% university

43% TAFE

20% employment

The ICSEA was 958 in 2010 (noting the average is 1000) and not reported in 2013.

Data was gathered from Holberton in two separate semesters due to a change of staff teaching the program, Semester 2 2010and Semester 1 2011. In response to an email in 2012, Holberton indicated that aspects of the Digital Divas program were being utilised in a new elective to engage girls in IT through image manipulation. They had called the unit 'Supermodels'.

Koss College is located in a rural town in eastern Victoria. It is a non-traditional school that supports students who have had difficulty engaging in regular school programs. It offers a personalised curriculum focused on employment outcomes or technical education pathways rather than higher education. In 2013 there were less than 50 students at the college. Koss College is outside the formal education system and the post-school outcomes of students are not reported. The ICSEA for the student cohort was 990 in 2010 (noting the average is 1000) and not reported in 2013. Koss College delivered the Digital Divas program in Semester 1 2011. This was the only rural school where data was collected. It was an opportunistic placement because of contacts through the Digital Divas research team. The program was delivered to students with no Expert Diva support.

Mayer College is located in outer-eastern Melbourne. It draws students from the local region and has large grounds, however the buildings are standard Education Department stock. The college has just under 1000 enrolments, and the gender balance is almost equal. The school curriculum supports academic and vocational programs and has a strong sporting program. The post-school outcomes of the student cohort in 2013 were:

43% university

33% TAFE

18% employment

The ICSEA was 983 in 2013 (noting the average is 1000).

Mayer College delivered the Digital Divas program in Semester 2 2011.

McAllister Girls' High School is a government selective-entry school for girls in Years 9 to 12. It draws students from all over Melbourne metropolitan area, although it does not have a boarding component. It prides itself on the high achievements of its students in state-wide exams. The school educates just under 1000 students who come from a wide variety of cultural and socio-economic backgrounds. The post-school outcomes of the student cohort in 2013 were:

94% university

0% TAFE

0% Employment

The ICSEA was 1165 in 2013 (noting the average is 1000).

McAllister has continued to keep the Digital Divas program in the school curriculum in 2012. It was offered to Year 9 and Year 10 girls in two separate classes and the data for this research was collected in 2010 and 2011.

Moffat College is a school in Melbourne's western suburbs that promotes its TAFE media program on its website, as well as a formalised science focus in partnership with a local university. The school had almost 900 students in 2013 with almost a 2:1 male to female ratio. The post-school outcomes of the student cohort in 2013 were:

38% university

38% TAFE

15% employment

The ICSEA was 995 in 2013 (noting the average is 1000).

Moffat delivered the program in Semester 2 2010 and we have no information on whether the program was continued.

Spertus College was the only interstate school that participated in the Digital Divas program. It is an independent Catholic Secondary School in suburban Sydney. The school has several campuses, and while some junior school campuses are co-educational, the senior school is girls only and houses

over 1000 students. The school is located in large historical buildings with extensive facilities that are well maintained. The ethos of the school supports broad curriculum offerings for the students complemented by strong pastoral programs. 126 students were awarded Senior Secondary School Certificate in 2013. Post-secondary school destinations are not recorded on the website.

The ICSEA ranking is 1146 (noting the average is 1000). This was the only interstate school where we collected data.

School Recruitment Process

The recruitment materials sent out to encourage schools to participate in the Digital Divas Program provided them with the background and justification for conducting a girls-only elective and stated that each school would be provided with the following:

- Training for any teachers involved in Digital Divas.
- Modules and materials for two terms of work per year – including assessment options.
- Mentors, undergraduate or postgraduate students studying an IT course at one of the involved universities (named Expert Divas). Mentors provided support and help in the classroom weekly. Note: all held a 'Working with Children' clearance.
- Guest speakers sourced from women employed in the IT industry.
- Access to any of the data that we collect as a result of the project that the school might be interested in.

There were also conditions for running the program. We were adamant that participating schools needed to:

- have an identified class or time where the program could run for at least one term, not as a lunchtime or after-school club;
- have a teacher prepared to participate and embrace the broad aims of the program;
- understand that the program is focused on girls, so the classes should be girls only for the purpose of the program and the research outcomes;
- use the modules that were provided;
- allow research activities to take place including interviews, surveys and observations with the class and teachers. (Note: the university

and DEECD required formal ethics approval which included parental permission for any student involvement);

- contribute $3000 per year to the project if they were an independent school. This money would be used to cover the costs of student mentors (Expert Divas) travelling to the school and participating on a weekly basis in the class and the production of the 'bling' designed and produced by the girls such as lanyards and key rings. This contribution was not required from government schools because the DEECD had contributed cash and in-kind support to partner with us through the grant and part of these funds were used to pay the Expert Divas.

Given the above requirements we had several instances of schools inquiring to run the program and then withdrawing. Several independent schools were not able to commit to the required monetary contribution, others could not commit to the requirement that the class be only female. In other instances we could not support the program due to the geographical location of the school precluding our ability to source an Expert Diva. There was interest in the program expressed by interstate government schools; however, the Education Department of the state would not accept Victorian DEECD ethical clearance and so prevented the implementation of the program there. Only schools that met all the required criteria and had the required ethical clearances were included in the data-collection process.

Observations of Each School

We were able to gather data from ten different schools over a three-year period. While the majority of the schools were government schools, they varied in their socio-economic status, as well as their approach to teaching Information Technology as a future career path for their female students. Next we provide information on the schools in the following order: Bartik, being the first school involved in the program and integral to its curriculum development, followed by the two high ICSEA-ranked Melbourne-based single-sex schools Clarke and McAllister. Next we describe the three outer-eastern suburban schools that participated and which have a reported below average ICSEA: Goldstine, Holberton and Mayer. Two outer-western schools will be presented together, Forsythe and Moffat, because of locational and demographic similarities. The final two schools are unique in their settings and will be discussed individually, Koss in regional Victoria,

and Spertus, an independent high ICSEA-ranked inner-Sydney school, our only independent school in the sample and our only interstate school.

Bartik

Bartik was our first school and one teacher was highly involved in shaping the curriculum development of Digital Divas. The school's principal embraced the idea of the Digital Divas program from the outset, providing support at school council, with parents and staff, and validating its worth. She allowed the precursor program to be trialled as a lunch-time club in her school (Fisher, Lang, Forgasz and Craig, 2009). IT was taught across the curriculum with significant professional development programs offered to staff and an expectation that it be both a stand-alone subject and embedded in other disciplines. The Bartik school principal nominated an experienced female IT teacher with prior industry experience to take the Digital Divas elective. This teacher became an integral part of the Digital Divas program and contributed significantly to the development of the teaching modules. The school was in a well-established suburb and had such a good reputation that there was a waiting list for Year 7 students to attend.

Clarke and McAllister

The experience of the teacher and indeed the wider school support for Digital Divas at Clarke Girls' Secondary College was not as positive as that at Bartik. While the teacher was excited and sought out the program, it did not appear to the research team to be a valued program in the wider school curriculum. The Digital Divas teacher had not studied IT but had taught it for three years and was keen to engage more girls at middle-school level so that they would select the subject in senior school where currently there was not enough interest for an IT class in the curriculum. Clarke had the highest socio-economic ranking of the government schools in the Digital Divas sample and is situated in an established inner-metropolitan suburb. It is a highly valued government single-sex school. The teacher reported that there was limited cross-curriculum teaching of IT and the career path was not strongly promoted in the school. IT was compulsory in Years 7 and 8 but an elective in Year 9, with little to no interest past Year 9. Despite running the class for one semester there was no reported flow-on to create a Year 10 class and indeed little further interaction with the Digital Divas program until 2013 when a new IT teacher in the school contacted the Digital Divas team to gain access to the curricula.

McAllister is a selective girls' school in inner Melbourne. This means that students must pass an entry exam to be offered a place. It has a rich history of academic excellence and often tops the state in final Year 12 results. The most prominent feature of the reception area of the school is the gilt-edged portraits of past principals, alongside honour rolls, reminding the visitor of the history of this school. The names on boards document the school's transition from a predominantly Anglo population to its present very multicultural population where 87% of students are from language backgrounds other than English. McAllister is often described as a 'free private school' because it maintains similar standards to the best fee-paying independent schools, and until relatively recently was the only government-supported selective-entry school for girls in the state. The teacher reported that the girls wear the uniform with pride. Commencing at Year 9, competition for a place at McAllister is fierce, with approximately 300 places available to the 1300 or so girls who sit the entrance exam (there are a few discretionary places). Unsurprisingly, the school's VCE results consistently surpass those of most other schools. While it is reported that some other government secondary schools are resentful that McAllister is able to 'cream' the best and brightest from their schools, there is a policy that no more than two per cent of each school's population will be offered a place at McAllister each year. McAllister ran the program for one term only the first time, then in subsequent years in two classes, Year 9 and Year 10, for a semester. The research team supported data collection on more than one occasion and Expert Divas were provided for classroom support on at least three occasions. McAllister continued to offer the Digital Divas curriculum to middle-school students in to 2013 after the conclusion of the Digital Divas program. The teacher reported that graduates from McAllister typically aim for prestigious university courses in medicine and law; however, the school values IT and there is an expectation that it be taught across the curriculum. The teacher nominated to deliver the Digital Divas program had studied IT but had only taught it for one year. She loved teaching the class and was very enthusiastic about the program. She reported that the students were generally very computer literate but often did not choose to study the subject. Similar to students at Clarke, IT was not perceived as a desired career path.

Goldstine, Holberton and Mayer

These three schools are located in similar geographic and socio-economic areas. Melbourne's eastern suburbs are a growth corridor, with a high level

of private home-ownership resulting from new housing estates. Goldstine is a newly purpose-built school with large landscaped gardens. It offers a selective-entry program for academically gifted or talented students. The selective-entry program makes it a popular choice of school, with parents seeking a strong academic focus for their children. The school also offers the Victorian Certificate of Applied Learning (VCAL) that provides students with employment-focused pathways, and Victorian Education and Training (VET) that prepares students for trade pathways. The school was recruited to the Digital Divas program through an email campaign. The initiative came from the IT department, not the principal. During the two years when the program was offered we had no contact with the principal despite email communication from us. IT units are part of the Year 12 curriculum; however, in lower year levels IT was not a stand-alone unit until Year 9. The IT teacher reported that it was believed that students had more than adequate IT skills when they started at Goldstine, so no IT was offered before then, yet when she encountered the class in Year 9 she believed the students' IT skills were weak. The IT teacher was very keen for data to be collected a second time from her school because she believed she could deliver the curriculum better a second time around. The Digital Divas research team agreed and we collected data from this school twice.

Holberton Senior Secondary College provides classes for students in Years 10, 11 and 12 in a similar geographic and socio-economic area to Goldstine. The environment of the school is changing and new buildings were under construction when we visited, consequently many classrooms were portables or relocatable buildings. Over the course of the Digital Divas program there were two different teachers at Holberton. The first teacher in 2010 expressed disturbingly low expectations of these students. Comments were made such as: 'These students don't want to learn'; 'They will only become hairdressers and chefs', and she told the Expert Diva not to worry too much about preparing for the class 'because the girls don't value learning', clearly indicative of a problematic culture of low expectations for students. The second time the unit was delivered the new teacher had a much more positive outlook and a rapport with her class. The Expert Diva noticed that she presented as very relaxed, often engaging in a manner more like a peer than a teacher. The new teacher reported that the students really enjoyed the curriculum and that by the end of the unit she felt the girls' attitudes had changed and they were now more aware of IT careers. The teacher hoped that by running this elective unit more students would be open to studying IT in Year 11.

Mayer College is similar to Holberton and Goldstine in that it is located in an outer-eastern Melbourne suburb. The Mayer community rates slightly less than average in ICSEA but also slightly higher than Holberton and Goldstine. Similar to Holberton, a large part of the school consists of portables or relocatable buildings. The reception area houses a range of displays, suggesting the valuing of diverse activities. This school already had some single-sex classes, so implementing another for Digital Divas was not perceived as an issue. Part of the school's strategic plan is to continue to develop an e-learning environment that results in improved effectiveness with the aim of becoming a leading school in Melbourne. It offers a broad and diverse range of subjects including music, arts, IT, science and sports programs. Its website features photos of paintings, sporting activities, and food technology. The teacher was enthusiastic about encouraging girls to study IT. She was experienced and came from an IT background. She reported that the school had poor and unreliable IT infrastructure and poor integration of IT across the curriculum. She overestimated the prior knowledge or lack of consistent knowledge that the girls had of IT. Data was collected once from Mayer, and on a visit from the research team it was noticed that the curriculum had been adjusted to be presented in a more static and less creative format. For example, the Healthy Menus module was designed to be an interesting and interactive way to introduce students to spreadsheet applications using formulas, macros and exploration. At Mayer it was delivered as a PowerPoint presentation. When an inquiry was made as to why this change had been made the teacher reported that the maths teacher did not want the IT teacher to introduce spreadsheets in Digital Divas because he had them in his curriculum the following semester. This suggests a silo approach between disciplines and a lack of understanding of one of the core tenets of the Digital Divas curriculum: to create interest through engaging topics, not to teach applications per se. The researcher visiting did point this out to the teacher, but could not influence change, highlighting a factor that we had no control over, how schools delivered or adapted the curriculum we had created.

Forsythe and Moffat

These schools are both located in Melbourne's western suburbs, an area known for large migrant populations and low socio-economic status. Moffat College is the lowest ICSEA-ranked school in the Digital Divas cohort. Significantly, the first program referred to in the school's promotional material is the Technical and Further Education (TAFE) media program,

giving the impression to the researchers that expectations are high for students to pursue TAFE pathways. The college promotional material also emphasises that there is an 'extensive range of subject and program choices. Two significant curriculum priorities of the college are the sciences and the arts. There is an outstanding instrumental music program, as well as a comprehensive sports program and many opportunities to be involved in the performing arts, student leadership and community service.' The school has only 36% female students because another secondary school very close by is an all-girls' school. This school also has a very low computer to student ratio of 1:6.

The Digital Divas teacher reported that the school promoted and supported IT and it is taught cross-curriculum. Professional development programs are offered to staff to improve their IT skills. IT is offered at Year 12; however, there is no data on whether the class runs each year. Students are positive about IT and the school opens the computer labs at lunchtime. This is not unexpected given that the school population was two-thirds male. The Moffat teacher was new to teaching IT when she undertook to teach Digital Divas. Her background was in outdoor education. She was, however, confident and capable with technology as well as enthusiastic about teaching Digital Divas. She said it was a new experience for the girls with many learning new applications. The classes were not always in a computer room (three out of five), allowing time for discussion of issues and planning of projects. She introduced some of the Digital Divas modules to a single-sex boys' class and reported that they really enjoyed it. She also reported that her students appreciated the all-girl environment, and that the curricula challenged them sufficiently enough to change their attitudes to computing in general.

Forsythe, also located in the western suburbs, is a relatively small all-girls school with an 85% mix of students from a non-English-speaking background. The history and tradition of the school is evident in the reception area. Through the green corridors on the way to the classroom, walls are mostly devoid of displays of any kind. The IT coordinator's email prior to starting the program provided some insight to the school IT culture. He stated 'We need something like the Digital Diva program at the school to lift the profile of IT and make it more relevant to the middle school girls. Our numbers studying VCE IT are steadily falling. We are a netbook trial school and have a very healthy computer to student ratio.'

The Forsythe website describes a 'diversity of social, ethnic and language backgrounds'. The school outdoor environment is pleasant, with a large

courtyard and lots of green space. The researchers observed that it was very obvious that the school attracts a high number of girls of the Islamic faith and that a number of these girls were not allowed to participate in the class. On one visit one girl said very loudly 'my father would kill me if I was to go into IT' and she was Muslim. The IT coordinator commented: 'students at the school perform lower than state averages.'

On the same visit it was observed that there appeared to be a perpetuation of low expectations. In the classroom it was observed that the girls lacked interest in the class, few were working and the teacher was happy for them to sit and chat, play with their mobile phones or look up other websites. The teacher had no prior IT teaching experience and Digital Divas was his first class. His background was as an art teacher. Despite having teacher instructions provided in the Digital Divas curriculum, the teacher decided not to follow this and taught his own ideas. He reported that he struggled particularly with the programming modules but was happy with what he did do and would have liked to have covered more modules had there been time. Despite this he commented that the girls were working on computers during lunchtime and he believed they were gaining confidence. He indicated that he planned to run Digital Divas again because there was enough interest from the students in the next year for a class. He thought that this was because the current students had positively promoted it to the next year level through word of mouth. He was keen to enthuse girls and give them confidence in IT.

Spertus

Spertus was the only interstate school included in the Digital Divas project. The connection was made through a research colleague at a Sydney university. As part of that university's program students are encouraged to participate in outreach activities. The Expert Diva role was an opportunity for one of this research colleague's students to connect with a local secondary college. On visiting the college the researchers were impressed by the large grounds, immaculate gardens and the historic Spertus buildings. It was obvious that Spertus was a highly regarded, exclusive independent girls' school and has the highest ICSEA rating of all the schools in the Digital Divas program. The teacher of the Digital Divas unit was enthusiastic about the program and came from a multi-media background. The classroom walls were decorated with student work from the modules. There was strong evidence of student engagement with the materials. The teacher reported that there was a strong push from parents for their daughters to study IT and one of

the students emphasised this point, saying 'you have no idea what is like to come from an Asian family'. The school has an open policy to student use of smartphones and smart devices. Year 7s have iPads and Year 9s have laptops which are available on trolleys in class sets to facilitate use in various classes. The teacher reported that professional development was limited and while all teachers have access to iPads, they don't all have their own. IT was often integrated in the wider curriculum offerings and not always as a separate course.

Koss

Koss is an independent college with a lower than average socioeconomic status, situated in regional Victoria. It has a vocational focus and was considered an important inclusion in the Digital Divas program to determine if the curricula could be beneficial to re-engage disengaged students. The school has limited ethnic diversity and VCE is not offered, so no students go on to university from this institution. The teacher reported that many students are from backgrounds where families have been unemployed for generations, and there was often a lack of stability at home. Home computer access is not the norm. She reported that the employment expectation of most students is an apprenticeship or in retail. The students were generally aged between 15 and 21 and have had less than successful experiences in the traditional school environment. Students are eligible for Youth Allowance if they attend the school and the perception was that this was their primary motivation for attendance, rather than for education or skill-building. The Digital Divas teacher reported that there was low staff expectation that students would complete their studies, with one senior teacher saying to the students: 'We don't care if you don't get your VCAL certificate, if you end up in an apprenticeship or doing Certificate III in hairdressing', perpetuating the low expectation of success.

Limited use was made of IT in the school and the infrastructure was poor; for example, no printer was connected to a computer so students had no opportunity to print their work. They also had no facility to save work on a central server because there was no network; this is the only school in the sample where this was the case. The Digital Divas program provided the teacher with extra resources such as USBs for the students to save their work, as well as a small budget for printing student posters externally. The Digital Divas teacher was experienced, confident and enthusiastic with a background in teaching IT to adults as well as school students. She reported

that she had used parts of the curriculum in a boys-only class and that it engaged them too.

The Development of the Digital Divas Portal

The original Digital Divas portal was designed by our first Expert Diva, who was at that time in her final year of university. It was created in open-source software (Joomla) and the design and colour schemes were a combination of her initiative using the winning logo derived from a design from the student in our first class who won the branding module. On graduation this first Expert Diva continued in a part-time capacity with the project as our web developer. In this role she developed a user manual with teacher instructions, Expert Diva instructions and student instructions. Modifications to the portal were made as the program progressed.

The portal was designed with a public front page (www.digitaldivasclub.org) with several subsidiary pages. These were:

1. More Information – this page provided further details for interested schools and included any media or press releases. It provided information for industry speakers. This page was publically available (i.e. not password-protected).
2. Digital Divas Team – this page primarily was for administrative purposes linking to a university portal where the researchers had password access to share operational documents and information between the team.
3. Teachers – this page linked to the teachers' portal. This is where the modules were uploaded. The teachers from the schools who signed up to the program had password access. We anticipated that they would download modules in zipped files. Instructions were provided in a user manual for this.
4. Students – this page linked to the student portal. Each school in the program had their own 'school' page that the teacher managed. For confidentiality reasons it was important that the schools were not listed on the public site, so this second-level link was where the actual schools running the program were listed and linked as required. Teachers had permission to upload work and manage their own sites.

Each school had an area where the teacher could manage student enrolments, discussion boards and blogs. The Digital Diva's web developer interacted with the teacher and relieved them of the task of enrolling their first class onto the site. She also visited each teacher at their school at least once to guide them through administration tasks such as enrolling a new student, or changing a password when students had forgotten theirs.

The web developer was integral in training the teams of Expert Divas as the program grew. These training sessions were conducted at the university. All of the Expert Divas were currently studying an IT degree so were usually computer literate and able to provide teacher support on a regular basis. The Expert Divas training session also allowed them to connect with each other. When the original web developer gained full-time employment there was a handover to one of the most technically proficient Expert Divas, who continued to manage the back end of the portal. During the life of the program we had several web developers and in one instance this was a male. He quite proudly called himself the first 'Expert Dude' in the program.

As the program developed, in 2010 and 2011 we also ran teacher training sessions at the university in the school holidays to introduce new teachers to the portal, and to reinforce the aims of the program. On the first of these occasions we invited our educational developer, who was also the first teacher to run the program at Bartik, to explain how she delivered the program and managed the portal. A user manual was developed and given to each teacher to guide them through basic administration tasks.

The Bartik teacher remained the most engaged with our portal, using it for posting activities and encouraging the Expert Divas to interact with the students through weekly blogs. She also used a variety of free online tools to create short videos for students to review and guide them through tasks such as creating a macro in Excel. Other teachers interacted with the portal in varying degrees; some left it for the Expert Diva to manage and others only accessed it to download the materials, which they would then put on a school intranet for students to access. Over time the Digital Divas team added a page to the portal titled 'Extra Resources', to take full advantage of new sites and tools that became available over the life of the project. Updates were emailed to teachers and they were also encouraged to keep us informed if they found anything useful too. School-to-school interaction via the portal did not develop, neither did a teacher discussion group.

A year into the project our ACS Linkage partner's personnel changed and the new person volunteered to take on the role of web manager to guide the web developer on streamlining the original site and manage interactions

with the schoolteachers. The professional experience of the web manager contributed to the professional appearance and accessibility of the portal. She was also integral in advising us on the best way to streamline the site prior to opening it up for public access at the conclusion of the program.

Figure 4.1 The portal with open access http:www.digitaldivasclub.org (at 14 Nov 2013)

The portal as it currently stands has the original graphics, and acts as repository for the project materials. The modules are easily accessible for any teacher who wishes to download them (see Figure 4.1 below).

Google Analytics code was added to the site to enable us to track access statistics. This provided some insight such as major spikes in access when the program was featured in the wider media, or after one of the team presented at a conference. Figure 4.2 clearly shows the increased traffic as reported by our Expert Dude in response to three media events.

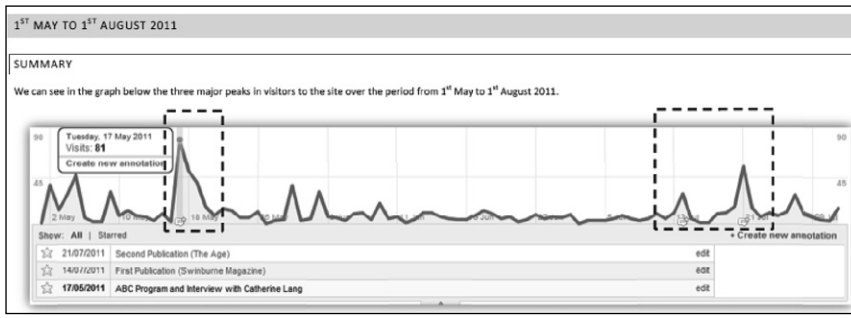


Figure 4.2: Google Analytics report

Conclusion

The impact of the Digital Divas program continues to grow. One year after the conclusion of the grant metropolitan, country and interstate schools approached the research team to gain access to the materials and inquire about what support was needed to run the program. Two were government schools from regional Victoria, one a Catholic school and the other an interstate girls' college. Access to specific modules has been requested by individual schoolteachers, such as one who believed that the Healthy Menus model was a better way to teach student spreadsheets than that traditionally used, as well as by researchers from New Zealand. We also know that it is still running in many of the schools. The portal and the materials have been available since late 2013 to any school that wishes to run the program; the password protection on the modules has been removed.

CHAPTER 5

SPHERES OF INFLUENCE

Overview

This chapter will describe and discuss the three spheres of influence we identified as important in implementing a program that sought to change girls' perceptions of IT. The three spheres of influence we identified and built into the program were: 1) a curriculum designed to excite girls' interest in IT; 2) the use of role models to highlight that girls can, and do, do IT; and 3) enabling the girls to see that being part of the IT discipline is acceptable and normal, a concept we called 'Normalising the IT environment for girls'. From the outcomes of previous research we knew that to have success, a multifaceted approach was needed and this is validated by our results.

Introduction

The aim of the Digital Divas program was to change girls' perceptions of computing, gender, and IT careers. To take the girls from a position of being uninterested in IT and having negative perceptions to a more positive perception of a career in IT required a multi-layered approach. The program brought together three spheres of influence: an engaging, accessible curriculum; female role models; and an intention to make acceptable and 'normalise' the IT environment as a more welcoming space. The three spheres of influence were presented through a lens of careers in IT. The spheres coalesced into one program (see Figure 5.1).

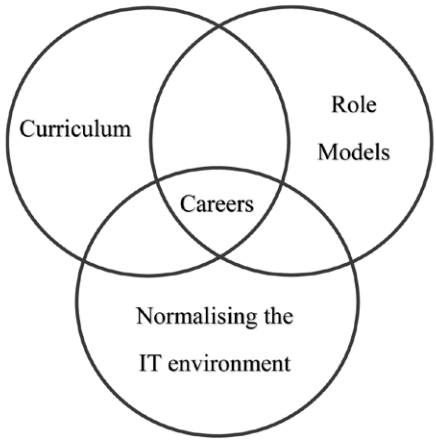


Figure 5.1. Digital Divas spheres of influence

The Three Spheres

1. Curriculum Sphere

The first sphere of influence focused on the curriculum for the program. Our curriculum was devised in consultation with educational specialists, with the aim of capturing the interest of girls aged 13 to 16 (school Years 8, 9 and 10). The classroom teacher who participated in the pilot was employed as the educational designer to develop seven curricula in consultation with the research team. Our focus was to maintain girls' interest in IT through a curriculum focused strongly around the interests of girls at this age. The curriculum was designed to build computing self-efficacy through scaffolded project activities called 'challenges', while ensuring the activities were as collaborative as possible to promote teamwork. Students were encouraged to work in self-selected groups to help create a relaxed, club-type atmosphere in the classroom. A resource from one of the researcher's universities that met the above aims made up the eighth module of the Digital Divas program.

To make it possible for a classroom teacher to incorporate the materials directly into their classes it was also necessary to adhere to the three strands of the Victorian Essential Learning Standards (VELS) for this age group (Level 5 & 6): Thinking, Creating and Communication.[5] This authenticated

5 VELS was the curriculum delivered in Victorian government and catholic schools from 2005 to 2012 (http://www.vcaa.vic.edu.au/Pages/foundation10/curriculum/previouscurricula.aspx). In 2013 the AusVELS provide the Australian Curriculum in Victoria (http://ausvels.vcaa.vic.edu.au/)

the educational value of the program and enabled schools to embed the subject in the regular school timetable, not as an after-school or lunchtime club, or one-day event. Important lessons from the CC4G pilot program were that a lunchtime club was not very successful in an Australian school setting and that any intervention needed to have the legitimacy of a regular school program. Equally, the CC4G program recommended that it was important 'not to rely solely on extra-curricular activities … but also to consider more the role of the IT curriculum and how such activities can link with it' (Fuller, Connor, Johnston & Turbin, 2008, p. 81).

The program was initially developed so that it could be conducted in one semester of the school year, which usually consisted of two 10-week terms. The eight modules of work were designed to provide flexibility to the teacher to expand further on a topic or reduce what was taught, with the expectation that no more than three modules would be covered in any one semester. The modules were developed independently of the year level at which it would be taught so that they could be adjusted for girls in Years 8, 9 or 10. The modules were also written with the knowledge of the software applications readily available in secondary schools in Victoria and those freely available on the internet. The modules were created to be independent of each other and hence could be delivered in any order apart from two recommendations outlined in the next paragraph. Therefore it was possible for teachers to choose the modules which they thought would work best with their students, to run it for an extended period of time, or in different year levels.

The Modules

In the teacher orientation session the Digital Divas team strongly recommended that each Digital Diva program commence with the 'Shake the Bottle, Wake the Brand' module. The 'Shake the Bottle, Wake the Brand' module enabled the girls to create a Digital Divas identity (logo and slogan) for the group. This activity contributed to the normalising of the IT environment because teachers were encouraged to print the students' logos and put them up around the classroom. The module involved brainstorming, planning, branding and marketing concepts to design and create a club logo and slogan and enabled the girls to understand why organisations value branding. A vector-based program was recommended and freely available to help with designing the club logo, and the issue of copyright was introduced and explained. The Digital Divas brand and associated slogans were voted on within the group, and the winning two entries at each school were used to create key chains, lanyards, posters and in one case t-shirts,

and distributed to all participants in the elective, further promoting the club concept. This 'bling' was also used for advertising in the wider school community.

It was also recommended that each offering of the program incorporate the 'Mythbusters' module, preferably as the last module covered. 'Mythbusters' was developed to broaden students' views on IT careers and break down the many stereotypes that are associated with IT. The objective of this module was for the girls to deliver a presentation after researching computing careers or computer use in a career of their choice. Students created a 'Day in the Life of an IT professional' story, in which they would 'bust' a number of myths. This was then presented to the rest of the class, parents and in some cases other teachers using software such as Microsoft PowerPoint or Prezi.

Teachers were free to choose from any of the other modules and present them in any order they desired. A summary of each module is presented in Chapter 1, Table 1.2; however, following is detail about the curriculum and activities of the most popular modules. The 'Fab & Famous' module incorporated aspects of design, fashion, diet, make-up and ethics in advertising. Students were encouraged to investigate how photographs were modified in advertising and the associated ethics of this practice. Also how magazine images were digitally enhanced, drawing on film clips freely available on the internet (see the 'Dove – Evolution Commercial' YouTube video 2006[6]) that illustrate how a young girl's features are digitally enhanced to appear on a billboard. The students had access to video cameras and digital editing software (e.g. Photoshop and MovieMaker) to produce their own three-minute commercial, which was later showcased as an end product. At all times the process of being engaged in the activity overrode the teaching of specific computing applications. As researchers we acknowledged that this module could be seen as reinforcing gender stereotypes; however, we deferred to the greater experience and knowledge of the classroom teacher who we had employed as an educational designer, who assured us that the students would be very interested in this topic. The underlying objective was designed to promote early successes with IT applications and positive creative experiences to build stronger self-efficacy in students. We anticipated the activities could also build persistence and resilience and influence future computing courses and career decisions. Research has shown that there is a strong link between perceived self-

6 https://www.youtube.com/watch?v=hibyAJOSW8U

efficacy and its effect on confidence and persistence in the education and career choices of females in science (Kelleher, 2007). It was extrapolated from this research that self-efficacy is important to student experiences when being introduced to computing in a classroom environment.

Another module titled 'Chef's delight' introduced spreadsheet software to develop an online, interactive restaurant menu. Students collected and analysed components of healthy eating and restaurant menus and collated the data using spreadsheets for their own 'restaurant'. They created formulae, combo boxes, macros, IF statements, vlookups, conditional formatting and 3D referencing to produce interactive pricing for menu combinations and to alert the customer to the calorific value of meals. This activity enabled students to master and gain competence with the advanced features of a spreadsheet software program commonly used in schools (such as Microsoft Excel) through a creative and authentic task. In most school curricula numbers and formulae are the domain of maths classes. While gaining greater understanding of healthy foods was the focus of this module, reinforcing and developing mathematics concepts was also an outcome. In turn, this competence and expertise was expected to improve students' IT self-efficacy while capitalising on the topical issue of healthy eating.

As illustrated by the descriptions of these modules, engagement with the curriculum was created by focusing on what was of interest to girls of this age (e.g. image, fashion, diet) before introducing students to the concepts of programming via the Alice storytelling programming language. Alice is free software developed at Carnegie Mellon University (http://www.alice.org), which incorporates visual programming methodologies designed to capture the interest of girls (Kelleher, 2007). There were introductory activities involving physical objects (e.g. hats, umbrellas) to explain methods in object-oriented programming, as well as an introduction to algorithms with hands-on making of peanut butter sandwiches. These physical activities allowed the girls to be introduced to elementary programming concepts via interactive, collaborative hands-on sessions. Initially it was thought that the Alice programming language could be used to create the 'Day in the Life of an IT professional' story, but in many classes this proved to be beyond the time available or the capacity of the teachers or students. However concepts such as iteration, selection, and sequence in programming were introduced. In the more advanced classes students used the objects within the program to create their own story with a moral. They learned how to add music to

Alice and presented their final product to the class and invited guests at the end of unit; however this was not the norm.

Prior research showed that students report computing classes as being boring (Anderson, Lankshear, Timms & Courtney, 2008). With this in mind, all of the eight modules' activities were designed around a product or output, rather than teaching any computer application in isolation. Furthermore, the curriculum modules challenged students to complete tasks individually and in groups. This approach was positively received:

> It was really good. Like Alice and Flash and Photoshop, you know it was different to what we have on our computers at home. So a good experience, yeah. [Student]

> So they seemed to really love that one (Fab & Famous module). They loved manipulating the pictures, they loved talking about models and what's been done to them and they really, really did engage with that which I found very surprising. [Teacher]

A full list of the eight modules was provided in Chapter 1 and the resources are freely available for download from the Digital Divas website (digitaldivasclub.org). Students' responses to the curricula and various modules are provided in more detail in Chapter 6.

2. Role Models Sphere

The second influence which was woven into the Digital Divas program was one of 'closing the loop' between doing things on the computer and what an actual computing career might entail. It focused on dispelling the stereotypes of IT being a boring 'geeky' career and into something that could be of interest to girls and normal for them to consider. A lack of visible and appropriate female role models in IT has been recognised as contributing to the gender imbalance of the profession. Additionally a lack of mentoring can inhibit the progression of females along the pipeline to a successful IT career. The literature shows strong support for the strategies of providing appropriate role models (Ahuja, 2002; Ashcraft, Eger & Friend, 2012; Barker & Aspray 2006; Clayton et al., 2012; Cozza, 2011; Gras-Velazquez, Joyce & Debry, 2009; Miliszewska & Moore, 2011) and incorporating mentoring (Craig, 1998; Trauth, Quesenberry & Huang, 2009; Klawe, Whitney & Simard 2009; NCWIT, 2010). Consequently the second layer of influence was to encourage informal mentoring by engaging female university students

studying IT (aka Expert Divas) as classroom assistants and more targeted role-modelling opportunities by bringing professional IT women into the classroom as guest speakers.

Stereotypes are our thinking about other people and produce our expectations of how they will behave (Aronson, 2004). So, for example, if IT careers are seen by girls as the providence of geeks then you must be geeky (not normal and not cool and not feminine) to be in IT. 'Stereotype threat' is when unflattering stereotypes exist and such a stereotype with negative associations may then influence our behaviour (Steele & Aronson, 1995). So girls may not go into IT if they don't want to be part of the geeky/uncool/solitary group that they perceive exists. The program therefore tried to dispel these stereotypes.

Expert Divas

Female university students studying an IT course at university were assigned to each instantiation of the Digital Divas program in each school. They were paid for their participation in the program, and attended a training session where expectations were outlined and instructions provided on the program, the portal and the student's responsibilities. One Expert Diva attended each school on a weekly basis, usually for one double period if that was possible. Their role was to act as informal role models for the girls, to assist the classroom teacher in managing the program and in doing so help to normalise the perception of a female IT expert.

Each Expert Diva was provided with a pro-forma to guide their introduction to the class. They were specifically requested to tell their own story during their first lesson with some background on how and why they became interested in IT. It was hoped they would outline their commitment to their IT studies, thus promoting positive perceptions from the outset. At times the Expert Divas also became the classroom facilitators, encouraged by the teachers to introduce the introductory programming sessions, for example. This supportive and collaborative approach also contributed to the desired image that no-one needs to be expert in all areas of computing, not even the classroom teacher.

> Oh I think it's fabulous. It gives the kids someone else to ask questions about, their career path, what they study, how hard was it to get into. [Classroom Teacher]

The Expert Divas sent weekly reflections on their interaction with the class to the researchers; this provided us with further rich qualitative feedback

on the program. Almost invariably Expert Divas found their roles to be very satisfying and rewarding, with most reporting extremely positive experiences in post- interviews, and most expressing a desire to continue with the program should the opportunity arise. For example:

> Helping the girls with their work and forming a fun relationship with the class, praising their achievements, all the while showing them that it's not overly hard, it's fun, and it's possible! It was fantastic to see how proud the girls were of their work when they really put effort in. Being a role model for the students is also a great feeling when they start to open up, talk and ask questions about not just their own work, but what I do myself at uni. [Sally_ED]

It became apparent from the data that most of the Expert Divas were motivated to participate because they themselves had a positive experience studying IT, and saw the need to encourage more girls to study IT and to pursue a career in the field.

> I was attracted to the idea of computing as it is something that plays a large part in my daily activities and this is what influenced me to further explore the world of IT. [Li_ED]

> I see myself in a rewarding IT-based career. I see myself not only at a desk job but in a role which incorporates both my love of computing and my need for a creative channel. [Natali_ED]

In some schools the Expert Divas were allocated the role of managing the student blogs, providing another opportunity for near-peer mentoring (Ashcraft et al., 2012, p. 58). This was part of the module called 'Wiki Wiki' and included an exploration of changing technology used on the World Wide Web, such as wikis and blogs. This led to the introduction of 'blogging' in the club environment. The impact of these interactions was evident in the feedback data. The secondary school girls reported that one of the most beneficial outcomes were the informal interactions that occurred with the Expert Divas. Many of the girls in the class had not previously met anyone who had chosen to pursue an academic degree in computing. The interactions with the Expert Divas proved beneficial in increasing student understanding of computing as an academic discipline, as well as combating perceptions that computing careers were only suitable for male 'geeks'.

Another benefit from the program that we did not anticipate was the growth and empowerment provided to the university students through their

Expert Diva roles. While this aspect of the program will be discussed further in Chapter 7, at this point it is worth noting how these young women gained personally from working in the classroom each week. The classroom teacher often supported their development and allowed them to introduce activities and explain concepts in their own words (and in some cases via actions) to the students. This comment in the reflective blog of one of the Expert Divas is an example of this growth:

> My favourite thing is that you watch the kids grow, and… We are walking into the room now and they get excited when they see us, and tell us what's happening at school, and what's happening between their friendship groups. So there are still interactions, but the girls are pretty comfortable with telling us that they've got problems, or something, so we are really growing together as a group. (Sally_ED)

Invited Guest Speakers

This aspect of the program was important to allow the students to hear the stories of young professional women who had decided on an IT career. A conscious effort was made to bring in speakers who had different roles in the computing industry. There was a business information systems university graduate working for a large corporation, a network administration expert who had gained a technical computing diploma qualification after a Health Science Bachelor's degree, and a software programmer who worked in a well-known multinational company that the students were all familiar with. All our speakers gave their time willingly to come to the schools and present to the girls. All felt passionately about encouraging more women into the profession.

The speakers were encouraged to talk about their secondary school experiences and what influenced their career choices. The sessions were held informally in the classroom, and in some schools the girls captured the talks on hand-held digital cameras. The videos were then placed on the Digital Divas portal to be used later as a reference tool for the 'A day in the life' unit.

We were aware that a report on the UK girls' computer club programs (e.g. CC4G) found that while their club had been beneficial, students did not appear to build a connection between the use of various computing applications and future careers (Fuller et al., 2009). In designing this aspect of the Digital Divas program, we specifically linked the guest speakers with the research project around 'A day in the life', to further emphasise careers

and applications. Student comments on the unit survey reflect the benefit of the invited guest speakers, for example:

> She was talking about her experience in IT, and obviously how she's become successful. She's on channel 7, channel 9? She does the morning show, and does all the related IT work. And just her coming and speaking to us, like … Even though some people say there are not a lot of jobs in IT, she actually made us realise there's heaps, and heaps, and heaps. And that you can be really successful out of it one day. That's what I liked. [Student]

> That women can do IT and we can do it well. [Student when asked what she had learnt from the speakers]

> Like we've had a lot of speakers and the stuff they've been saying was really interesting, but imagine going there and watching it happen, that would be even better. [Student]

> … the speakers were fantastic, really got some of the girls engaged which was wonderful. [Classroom Teacher]

When the unit was taught for the first time at Bartik Secondary College two-thirds of the class commented that they would now consider an IT career, and when asked why wrote comments such as: 'Every day is different apparently. I love fixing things and helping people'; 'the travelling'; 'being creative and every day would be different'; 'Programming games or animation'; 'Just learning about and using computers for many different things'. These comments confirm that this aspect of the program had succeeded to some extent in changing student perceptions about the career path.

Feedback from both teachers and girls following the presentations clearly demonstrate that these women fulfilled a vital role in our program and provided a crucial link between what happens in the classroom and what happens in the workforce. As well as showcasing the breadth of possibilities relating to IT careers, it appears that these women were successful in dispelling persistent myths and stereotypes associated with IT. In addition, many of these women described the experience in positive terms, and felt encouraged to volunteer for future presentations.

3. Normalising the IT Environment Sphere

During the three years of conducting the program the third sphere of 'influence' underwent a number of name changes. Initially it was called 'showcase/celebration' (Lang, Craig, Fisher & Forgasz, 2010) but it has now morphed in to 'Normalising the IT environment' as we recognized exactly what we set out to do with the 'celebrations'; showing girls that it is acceptable and normal to be interested in computing and allowing the girls to claim ownership of the space.

Our purpose was to enable students to own the Digital Divas program within their school setting. The girls were able to make the decisions about aspects of the program such as the 'bling' (key rings, lanyards, t-shirts, posters featuring their logo design) as visible outcomes of the program. They created, printed and displayed colourful posters to identify Digital Divas in the computer classroom, a space normally not decorated with these types of images. One student commented 'I liked that we all got to design our own logo, how the symbol of Digital Divas was created by the Digital Divas'. We encouraged teachers to put student designs up in different parts of the school including the computer rooms, to normalise the space as female. A 'club' atmosphere was reinforced with cooperation, collaboration and discussion encouraged as we attempted to make the class a positive and welcoming experience.

In one school we conducted an end-of-semester celebration with the school principal, media and, of course, parents. This enabled the students to showcase their work and celebrate being part of the Digital Divas program. Unfortunately this type of celebration did not become the norm in the other schools, with too many obstacles preventing it from being conducted.

The other two influences supported the concept of normalising the IT space. The engagement of students in creative and interesting activities was achieved through a curriculum that spanned multimedia applications, research, and spreadsheet applications, and was designed in a purposeful manner to create activities that were perceived as engaging by the majority of the students. Our overriding objective was not to teach IT through applications but demonstrate how it can be taught through interest (food, image, creativity). The programming language focused on storytelling using a tool that was created specifically to capture the imagination of young girls. A comment on the feedback survey reflected the positive aspect of using Alice; when asked what was the best aspect of the course one student wrote, 'Doing the Alice project, I feel that I have found something that I am good at'.

Conclusion

Through their relationships with the Expert Divas girls heard true stories of 'real' women in technology and gained a sense of increasing the visibility of young women in IT. This was further reinforced through the 'a day in the life' as part of module 5. These initiatives helped make IT 'normal' for girls and help them visualise themselves and other women in an IT career.

In this chapter we have provided insight into our design thinking when we created the Digital Divas program, our three spheres of influence. The centre point of these three spheres, as displayed in Figure 5.1, is putting 'Careers in IT' onto the possible future career options for these students because evidence from earlier research clearly indicated that IT is often not considered in future career choices (Lang, 2012). From the outcomes of previous research we know that to have success a multifaceted approach was needed and this is validated by our results. Whether this approach was successful is presented in Chapter 6.

Images of the girls' work and other photographs taken during our program are presented in the final report and can be found online at

http://digitaldivasclub.org/vic/webfm_send/8.

http://digitaldivasclub.org/vic/sites/default/files/2010-Digital-Divas-Presentation-VITTA-conference.pdf

CHAPTER 6

CHANGING GIRLS' PERCEPTIONS OF IT

Overview

In this chapter we report on the extent to which we have been able to change the perception girls have of IT. Our primary research question was to explore if a program that included specifically designed, educationally based materials could change girls' attitudes and perceptions towards IT and IT careers in the medium and in the longer term. The chapter includes the results of the analysis of the qualitative and quantitative data. We report our findings against the assumptions we made, which were discussed in detail in Chapter 2. Results from the analysis of both the qualitative and quantitative data are used to argue whether or not each assumption we made was supported by the research. This chapter also reflects on the effectiveness of our framework for evaluating Digital Divas.

Intervention Programs as a Mechanism for Change

Early intervention programs focusing on girls and IT assumed that the reason girls were not interested in IT was because they did not know about IT careers or how exciting a career in IT can be. In previous research that we conducted we found that many of the early intervention programs (and a number of later programs) focused on promoting IT careers (Craig, Lang, & Fisher, 2008). We reported that between 2001 and 2008, for example, there were six large scale 'Go Girl Go for IT' days run across Australia, with a specific focus on exposing girls to IT career options. A similar program 'Technology takes you anywhere' ran in Queensland four times during this same time period. Interventions focusing on careers are not unique to

Australia. Klawe, Whitney and Simard (2009), for example, reported on a range of similar programs run in the USA.

A few reported intervention programs have involved schools. Many of those running these programs, it can be assumed, believed that if girls were given hands-on experience working with IT they would become more interested in further IT study. For example, Doerschuk, Liu, and Mann (2007) reported on how they partnered with local schools to run a computing camp for girls focusing on hands-on IT activities. Paolo, Sivilotti, and Demirbas (2003) ran a workshop for 11- and 12-year-old girls to teach one specific aspect of computing. A program to increase young girls' confidence in IT was described by Clayton (2006). Their program, which included teachers, ran different activities for girls including putting together a computer.

The only program similar to Digital Divas, also a longer-term program, was CC4G, which we briefly discussed in Chapter 1. This program also aimed to change girls' perceptions of IT as a career, and it ran in schools with teachers as facilitators (Fuller, Connor, Johnston, & Turbin, 2009). The aims of CC4G assumed that through a school-based program running for an extended period of time, girls' attitudes to IT would change (Fuller et al., 2009, p. x). In particular, their model (p. x) identified how CC4G could influence this change through the inclusion of activities that were fun, and introduced the girls to new IT programs.

Enablers and Inhibitors of Intervention Program Success

For Digital Divas we also assumed that better career awareness would encourage girls to take up an IT career. But we also assumed that girls' perceptions were that IT was boring and was for boys, and that the roles the teacher and other role models play were important. In summary, the findings associated with the following assumptions (reported in detail in Chapter 2) of girls' experiences with Digital Divas that we report on next are:

1. Girls would find our materials exciting, engendering greater self-efficacy
2. Girls would learn new skills and stereotypes would be challenged
3/4/5. There would be a greater awareness of IT careers encouraging girls to take further IT study, teachers and role models would promote IT careers, and would help the girls make the link between the activities and career options

6/8. The enthusiasm for IT would be maintained after the program and the girls will consider further IT study.

Assumption 7 related to the wider community support for the program. Data on this were not formally gathered through the project; however, as is detailed in Chapter 8, a research student did explore this assumption.

As would be expected there were factors outside our control that had an impact on the effectiveness of the program. We understood that we could not control some of these, but there were others that we had not considered. We briefly discuss these factors and issues together with the findings below. More details on each school and school environment are provided in Chapter 4.

Teachers and Schools

The literature highlights the inter-relationship of students, the home, schools, and teachers and the impact this has on learning outcomes – achievement, attitudes, and future study in a subject. As early as 1970, Flanders (1970) claimed that '[T]eaching behavior is the most potent, single, controllable factor that can alter learning opportunities in the classroom' (p. 13). More recently, based on an extensive literature review, Hattie (2003) identified that student characteristics explain 50% of the variability in achievement, the home 5–10%, schools 5–10%, and teachers 30%. Hattie (2003) claimed that '[I]t is what teachers know, do, and care about which is very powerful in this learning equation' (p. 2). The attitudes, beliefs, and expectations of the classroom teacher are also critical. These beliefs, particularly those that relate to pedagogical approaches, do have an impact on classroom teaching (Prestridge, 2010). Seminal research by Rosenthal and Jacobson (1992) highlighted the influence of teacher expectations of students. Known as the 'Pygmalion effect', Rheem (1999) encapsulated the findings of Rosenthal and Jacobson as follows: '… when teachers expect students to do well and show intellectual growth, they do; when teachers do not have such expectations, performance and growth are not so encouraged and may in fact be discouraged in a variety of ways' (p. 1).

We assumed that the teachers teaching Digital Divas had computer skills and were confident users of IT, that they had a background in teaching computing or a background in IT, and that they willingly elected to teach the program. This was not always the case. In chapters 4 and 7 we describe the diverse backgrounds of our teachers. In summary, of the 14 teachers who taught Digital Divas, four did not have an IT background and two were new to teaching but had studied IT. One teacher had very low expectations of

her Digital Divas class; another was unenthusiastic about taking the class, although this did turn around by the end of the semester; and one teacher did not teach all the modules and modified those that he did teach. Most of the teachers, however, were very enthusiastic at the start of the intervention and our post- interview data show that all enjoyed teaching the program. There is also some evidence in the literature that female IT teachers have a positive effect on girls' attitudes to IT (Meelissen & Drent, 2008). In our case it was difficult to assess the impact of teacher gender as there were only two male teachers and comparisons could therefore not be made.

The teachers were asked questions about the school they worked in, the ratio of computers to students, the attitude of the school to IT, and the extent to which IT was promoted in the school. We found that four schools strongly supported the use of technology, offering professional development for staff and promoting the use of technology in teaching across the school. In two schools, there was very poor technology infrastructure, and in one of these schools the level of staff IT literacy was, not surprisingly, very low.

Our schools varied significantly in a number of other respects. We had schools with students from a high socio-economic status (SES) and schools whose students were from low-SES households (further details on SES data for schools can be found in Chapter 4). The nature of the schools varied. Some were co-educational; others were girls only. There was one selective-entry school and one private school. In some schools a high value was placed on IT and teaching IT, which was often reflected in the subject offerings in the last two years of secondary schooling; this was not the case in all schools. Further, in all schools the teachers who taught the Digital Divas program were allocated to the classes, that is, they were not volunteers. We found that the teachers' individual backgrounds and attitudes influenced the outcomes of the program.

Of the 14 teachers who completed the teacher survey, ten considered their computing skills to be 'moderately high' or 'high', but four indicated that their skills were only 'moderate'. While 11 teachers said their enjoyment of teaching IT was 'moderately high' or 'high', three indicated it was only 'moderate'.

In general, the teachers' views about gender issues and IT reflected the traditional male stereotype. For two of the three items on the teacher survey about gender issues, a majority of teachers indicated that there was no difference between girls and boys or that it might depend on circumstances. However, while some teachers indicated that compared to girls, boys were more confident with IT (5), boys were more competent with IT (5), and

boys were more interested and enthusiastic about IT (7), none said that these characteristics were more likely to be found among girls.

Overall, we found that the teachers' individual backgrounds and attitudes did have an influence on the outcomes of the program.

Our Results

As detailed in Chapter 3, significant amounts of data were collected consisting of survey data, interviews, focus groups, weekly reflections and observations. Table 6.1 provides a summary of the data collected.

Data type	Participants
Girls	
Pre- survey	**265**
Post- survey	**199**
Pre- focus groups (31 conducted)	**134**
Post- focus groups (30 conducted)	**108**
Focus groups one–two years later (12)	**33**
Teachers	
Pre- survey	**18**
Post- survey	**10**
Pre- interviews	**11**
Post- interviews	**13**
Expert Divas	
Weekly reflections	**8**
Post- interviews	**13**

Table 6.1. Summary of data collected

Given the lack of homogeneity and the impact this had on the assumptions we made, we considered that combining the data from all the schools was not the only approach to take for drawing robust conclusions. We have, therefore, when relevant, also included discussion of the results for schools that were clearly different from the 'average'. Two schools were excluded in the reporting of individual school results: Williams because only nine girls participated in the Digital Divas class, and Clarke because no post-survey data were submitted to us.

As detailed in Chapter 3, the quantitative data were analysed using SPSS. Of the students participating in the Digital Divas program in the ten schools, 265 girls completed the pre-survey and 199 completed the

post-survey. There was a series of 33 items, which was repeated on the pre- and post-surveys. In all, there were 183 students who completed both the pre- and post- surveys. For these 33 items, students responded to each on five-point responses formats – Strongly Disagree (1) to Strongly Agree (5). Mean (average) scores greater than three therefore indicate agreement with statements (the larger the score, the stronger the agreement); scores less than three indicate disagreement (the lower the score the stronger the disagreement).

The responses of the 183 students were used to gauge overall short-term changes in views following the experience of the Digital Divas program. Clearly there were differences in the outcomes by school. In the discussion of the findings that follow, overall changes are presented and discussed, and schools that varied greatly from the general patterns are also highlighted (except for Williams and Clarke, as discussed earlier).

The results of the qualitative data – focus-group interviews – are also presented with respect to each of the assumptions.

NVivo was used for the analysis of the qualitative data; 134 girls participated in the pre-program focus groups, and 108 in the post-program focus groups. Thirty-three girls participated in the follow-up focus groups, 12–24 months after their participation in the Digital Divas program.

Consistent with the literature on evaluation (detailed in Chapter 2), we designed an evaluation model within which we identified a number of assumptions that were described above. In the next sections we provide the details of our results, which are organised around these assumptions. We draw on both the qualitative and quantitative data.

Assumptions and Findings

Assumption 1. Girls would find our materials exciting, engendering greater self-efficacy

The findings related to the first assumption are presented in two parts. First we consider the impact of the Digital Divas program materials in exciting the girls and further stimulating their interest in IT, followed by findings on the effects of the program on the girls' confidence and self-efficacy with computers. Quantitative data from the pre- and post-surveys as well as qualitative data from the post-survey's open-ended items and focus-group interviews are presented.

Digital Divas Materials and Interest in IT – Pre- and post-survey comparisons

Several of the common items on both the pre- and post-surveys were designed to gauge students' general interest in IT. In Table 6.2, the items and the mean scores on the pre- and post-surveys are shown. Paired t-tests were used to determine if the difference in the pair of mean scores for each item was (statistically) significant; t-values and levels of statistical significance are shown. It should be noted that we used the conventional probability level of <.05 to claim statistical significance. When mean scores were statistically significantly different, the direction of the change in mean scores is also indicated in the table.

No.	Question	Mean (pre-)	Mean (post-)	t	Sig	Change
7	I think computing subjects are very interesting	**3.49**	**3.24**	**2.97**	**<.01**	Agree less strongly
18	I don't understand how some people can get so involved with computers	**2.56**	**2.61**	**.58**	**ns**	
19	I enjoy thinking up new ideas and examples to try out on a computer	**3.33**	**3.18**	**1.84**	**ns**	
31	I like to play around with the computer	**3.98**	**3.87**	**1.41**	**ns**	
33	Using a computer makes learning more enjoyable	**3.86**	**3.72**	**1.92**	**ns**	

Table 6.2 Pre- and post-survey means, and t-test results for items gauging interest in IT.
ns = not statistically significant

The data in Table 6.2 reveal that the girls were quite positive about liking and enjoying working with computers, and that their interest did not change after the Digital Divas program. The pre- and post- survey data show that they generally agreed that they enjoyed thinking about new ideas to try out on computers (Item 19), liked playing around with computers (Item 31), and that using computers made learning more enjoyable (Item 33); they disagreed with not understanding how some people can get very involved with computers (Item 18). For all of these items at the individual school level, there were slight variations in views evident by school; however, none of the differences were statistically significant.

There was only one item on which the students' views changed significantly after the Digital Divas program: they agreed less strongly that computing

subjects were interesting (Item 7). For this item, in each school but one (Mayer), the directional change in views on Item 7 was the same; at Mayer there was a very weak trend for an increase in the level of agreement.

In summary, the students viewed computers and their use to be interesting, but after the Digital Divas program, they became slightly less enchanted with computing as a subject to study. Interestingly, there appears to be a disconnect between their enjoyment of the Digital Divas materials highlighted in the next section and the girls not wanting to continue with formal study of computing in future.

Post-survey responses about the Digital Divas program and curriculum

Using a matrix-coding query for the post-focus group interview data, we identified 265 positive comments on the curriculum that students experienced, 38 negative comments, and 14 mixed comments. When asked what they didn't like about Digital Divas most girls said there was nothing they didn't like. In the post- survey they were also asked if they enjoyed being in the Digital Divas class overall (yes/no). Of the 198 girls who responded to this question, 172 (87%) said that they had enjoyed it, and 26 (13%) girls said they had not.

The words the girls used to describe the Digital Divas curriculum highlight how the materials excited their interest. A text search on the words 'fun' and 'enjoy' was conducted on the focus-group data. The text search found that these words were used 190 times.

Many girls said they enjoyed learning new programs and learning more about programs such as Excel and Photoshop. These quotes are representative of what the girls said:

> I learnt more ways I can use the computer. Because I already knew how to use some of the programs but I've learnt more.

> I also enjoyed Digital Divas, it was fun, that's why I enjoyed it. I liked working with Photoshop especially to edit images and I learnt how to use the presentation tool and I think it would help me in the future as well. So I could use what I've learnt here.

A text search of the qualitative responses from the post-survey found the words 'fun' or 'enjoy' were used 249 times (in a positive way) to describe the program or its content. Examples of the comments are.

> Going on Photoshop because it was fun

Playing with computers, it was fun

I enjoyed learning what different tools could do. Photo editing

… it was fun and interesting

How to do a menu because Vlookup was fun

I learnt that it can be fun and involve girls

That IT isn't just for boys and that it's fun.

Confidence and Self-efficacy with Computers

Increasing the girls' confidence and self-efficacy in using IT was an important aspect of what we were trying to achieve with the Digital Divas program.

The pre- and post-surveys included a number of items gauging students' confidence with computers in general, and their self-efficacy with aspects of working with computers. The results of the t-tests to compare the girls' views prior to and after experiencing the Digital Divas intervention are shown in Table 6.3.

The data in Table 6.3 reveal that for all but two items confidence and self-efficacy measures were similar before and after the Digital Divas program. The girls strongly agreed that they were confident using computers for communicating with people (Item 4). They agreed that they could master anything on the computer needed for school work (Item 9) and found it easy to teach themselves to use a new computer program (Item 12). They disagreed that they felt nervous learning something new on the computer (Item 16) or that they avoided using the computer if they could (Item 21), and they neither agreed nor disagreed that they had to work hard for long periods of time to complete a task successfully (item 30).

Following the Digital Divas program, we found that the girls agreed less strongly about feeling confident using computers at home (Item 27) – an unexpected finding. It was very encouraging to find that while they initially agreed that they panicked if something went wrong with the computer, after the Digital Divas program they disagreed with this (Item 2).

No.	Question	Mean (pre-)	Mean (post-)	t	Sig	Change
2	If something goes wrong on the computer I panic	**3.12**	**2.78**	**3.72**	**<.001**	agree to disagree
4	I am confident using the computer for communicating with people	**4.38**	**4.42**	**.56**	**ns**	
9	I am confident that I can master anything on a computer that is needed for school work	**3.79**	**3.77**	**.31**	**ns**	
12	I find it easy to teach myself how to use a new program	**3.50**	**3.51**	**.15**	**ns**	
16	I feel nervous when I have to learn something new on the computer	**2.30**	**2.29**	**.15**	**ns**	
21	If I can avoid using a computer I will	**2.00**	**1.99**	**.13**	**ns**	
25	I have to work hard to do well in computing	**3.30**	**3.16**	**1.60**	**ns**	
26	I am good at fixing computer problems	**2.95**	**2.94**	**.16**	**ns**	
27	I feel confident using computers at home	**4.41**	**4.28**	**2.12**	**<.05**	less strongly agree
30	I will work at a computer for long periods of time to successfully complete a task	**3.60**	**3.48**	**1.30**	**ns**	

Table 6.3 Pre- and post-survey means, and t-test results for items gauging confidence and self-efficacy with computers.

ns = not statistically significant

In the post-survey the girls were asked if their confidence in using technology had changed and to explain further if it had. Of the girls who answered the question, 67 (34%) said 'no'. Of these 67 girls, 17 (26%) wrote they were already confident before they participated in the program, for example, 'I was already good with computers' and 'I was already amazing with computers'. The majority of the girls who answered this question (128: 76%) indicated that their confidence had improved. Many mentioned that they were more confident in a range of the software programs they had learned to use. Others made comments such as:

I'm not afraid to try out new things

I try to do things I haven't done before

> I used to be a bit reluctant exploring other programs because I simply didn't know how to use it (sic).
>
> I don't get so frustrated
>
> I'm more confident using the computer now and find it easier to try new programs
>
> I have a better idea on how things work. If not I try my best

At the focus-group interviews held after the Digital Divas program, the girls were also asked if they were more confident with computers after doing the program. The majority said they were. A matrix-coding query found 42 instances where the girls indicated that their confidence had increased as a result of Digital Divas. The girls made comments such as:

> I'm more confident doing tasks, like 'Can you go make me a poster' or something, I'm more confident doing that because I can do it better now.
>
> … at the start of the year I didn't know how to do anything on the computer except Word and Paint, but now I know other things. I don't know how to use them properly, completely, but I have a little bit of an idea of it now. So I could try and do it, where before I couldn't.
>
> It gives you more of a confidence boost. Every time you're on a computer then you kind of think I've probably used this before. After you've used a lot of programmes you get the hang of learning how to learn new things.
>
> Well yeah, a lot more I think, quite a lot but not sort of the things we've done, so it's kind of just like broadened the amount of knowledge I have about computers and stuff. So that's pretty good.

One girl provided an example of the change in her as her confidence in IT had grown since the program saying, Well, I'm more confident to say to my mum, 'Yes, I know how to do that' because usually before I'd just say, 'Mum knows all. Hail to almighty Mother.' Yes, I'm confident to say, 'Yeah, I know how to do that. I can fix this'.

Summary of Findings Related to Assumption 1

There can be little doubt that many of the girls participating in the Digital Divas program gained from the experience. Quantitative measures indicated

that confidence with various aspects of computing had increased; on some measures there was no change. For those who participated in the focus groups, there were also very positive reactions to the materials and computing challenges they had encountered during the program.

Assumption 2.

Girls would learn new skills and stereotypes would be challenged.

Assumptions 3, 4 and 5.

There would be a greater awareness of IT careers encouraging girls to take further IT study, teachers and role models would promote IT careers, and would help the girls make the link between the activities and career options

In the focus-group interviews, and in some of the comments on the post-survey, the girls' responses overlapped on these four assumptions. We are therefore reporting the findings associated with these assumptions together.

Pre- and Post-survey Data: Challenging Stereotypes (Assumption 2)

One of the main aims of the Digital Divas program was to challenge myths and stereotypes, particularly gender stereotypes, associated with using computers and working in the computer industry (Trauth, Quesenberry, & Huang, 2008). The pre- and post-surveys included 11 items to gauge students' beliefs about these stereotypes. The mean scores and results of the paired t-tests are shown in Table 6.4.

In general, the girls participating in the Digital Divas program rejected the traditional stereotype of male superiority with computers (Items 5, 10, 11, 13, 22, & 23). As can be seen in Table 6.4, before and after the program the girls disagreed that boys were better than girls at working with computers (Item 22), more suited to work in the computer industry (Item 13), or that girls were better than boys at setting up new computers (Item 23). They neither agreed nor disagreed that girls found it easier than boys to work with new computer programs (Item 11).

After completing the Digital Divas program the girls disagreed significantly more strongly than before that boys were better than girls at fixing computers (Item 5). They agreed much less strongly that girls were more likely than boys to ask for help when working on a computer (Item 10). These were positive changes and signal the success of the Digital Divas intervention. The trends were generally similar when the responses were looked at for individual schools; it was only in the extent of the change that differences were noted.

No.	Question	Mean (pre-)	Mean (post-)	t	Sig	Change
3	People who work in computing work alone	2.48	2.09	5.54	<.001	Disagree more strongly
5	Boys are better than girls at fixing a computer	2.42	2.22	2.26	<.05	Disagree more strongly
10	Girls are more likely than boys to ask for help when they are not sure what to do next when working on the computer	3.29	3.09	2.32	<.05	Disagree more strongly
11	Girls find it easier to work with a new program than boys	3.09	3.08	.08	ns	
13	Boys are more suited than girls to work in the computer industry	2.45	2.37	.84	ns	
17	I would like it if people thought of me as a computer geek	2.03	1.95	1.00	ns	
22	Boys are better than girls at working with computers	2.15	2.08	.89	ns	
23	Girls are better than boys at setting up a new computer	2.59	2.58	.174	ns	
24	A person who works in computing often makes a lot of money	3.27	3.40	1.82	ns	
29	People who are really good at computing are popular	2.65	2.61	.64	ns	
32	Kids who are good with computers are admired	3.04	3.11	1.01	ns	

Table 6.4 Pre- and post-survey means, and t-test results for items about stereotypes associated with computers and working in the IT industry.

ns = not statistically significant

Other common items on the pre- and post-surveys were designed to gauge the girls' views on various myths and stereotypes associated with working in the computer industry, some of which are often thought to dissuade females from the field: that people work alone (Item 3), being considered a 'geek' (Item 17) and unpopular (Items 29 and 32), and that the job is financially rewarding (Item 24). For these items, the data in Table 6.4 reveal that before and after the Digital Divas program the girls disagreed strongly with wanting to be considered a 'geek' (Item 17) and that those who are good with computers were popular (Item 29); they were neutral whether admiration was associated with kids who are capable with computers (Item 32). The Digital Divas program involved the students often working collaboratively on tasks, and post-survey scores

indicated that they disagreed significantly more strongly than before that people who worked with computers worked alone (Item 3). For Item 3, students' views at each school changed similarly. School by school, trends similar to those of the whole sample were evident for Items 17, 29, and 24. For Item 32, however, the views of girls in some schools changed in different directions. At Goldstine and Perlman, the girls initially agreed that kids who are good with computers are admired; after Digital Divas they disagreed with this statement, a very encouraging and significant change if they initially associated being good at computers as referring to boys. At McAllister, the girls' initial agreement with the statement was significantly stronger after Digital Divas; this change may be partially attributed to McAllister being a single-sex, selective school in which girls' achievements are celebrated.

The pattern of student views and changes in views following their experiences in the Digital Divas program that are evident for this set of items are generally positive. They point to the success of the Digital Divas program in meeting its goals.

Pre- and Post-survey Data: Careers and IT (Assumptions 3, 4, and 5)
Assumptions 3, 4 and 5 all relate to the extent to which the girls were more aware of IT careers and options as a result of the Digital Divas program and are therefore being dealt with together.

There were three common items on the pre- and post-surveys exploring the girls' IT career interests (Items 14, 20, and 28) and only one common item about future studies of computer subjects (Item 6). In Table 6.5, the items and the mean scores on the pre- and post-surveys are shown, together with the results of paired t-tests.

The data in Table 6.5 reveal that the Digital Divas program may not have had the desired impact on girls' future IT study and career plans. Before and after the program they indicated that they did not want to work with computers (Item 28) or want jobs specifically in the computer industry (Item 20). After the program, they disagreed significantly more strongly than before about wanting jobs working with computers (Item 14) or with wanting to study computing subjects in years 11 and 12 (Item 6).

No.	Question	Mean (pre-)	Mean (post-)	t	Sig	Change
6	I want to study computing as part of my VCE (grades 11 and 12)	2.63	2.19	5.09	<.001	stronger disagreement
14	I would like a job working with computers when I finish studying	2.74	2.54	2.39	<.05	stronger disagreement
20	I would like a job specifically in the computing industry after I finish studying	2.38	2.31	.79	ns	
28	I would like a job working with computers when I leave school	2.66	2.56	1.14	ns	

Table 6.5 Pre- and post-survey means, and t-test results for items about studying computing subjects and working in IT in the future

ns = not statistically significant

The patterns of responses to some of these four items were different in some schools.

- Both before and after the Digital Divas program, Spertus students were very positive about wanting to study computing subjects in Years 11 and 12 (Item 6), and wanting a job with computers in future (Item 14). However, the extent of agreement to both items decreased after the program.
- Prior to and after the Digital Divas program, Mayer students agreed to wanting jobs with computers in the future (Item 14); there was no change in score from pre- to post- survey. On the pre-survey, they agreed that they wanted to study computing subjects in Years 11 and 12, but after the program they did not want to do so; this change was statistically significant.
- Holberton students' views about wanting to study computing subjects in Years 11 and 12 (Item 6) or wanting jobs with computers in the future (Item 20) were extremely negative to begin with and did not change after the Digital Divas program.

Open-ended Survey Questions and Focus Group Data: Career Trajectories and Stereotypes

While overall the Digital Divas program did not appear to have positively affected students' interest in studying about or working with computers, some of the individual students participating in focus group interviews had encouraging things to say about the impact of the Digital Divas program on their potential career.

The pre-focus group data indicated that prior to the girls undertaking Digital Divas the majority of girls had a negative attitude towards computers and/or a career in IT. There were 99 negative comments relating to stereotypes and only 15 positive comments. This was also the case with the pre-survey results where the girls were asked what they would like about a job in IT. Of the 247 girls who answered the question, 53 (21%) indicated there was nothing they would like, they wouldn't like a job in IT, or they did not know or were not sure.

In the pre-survey they were also asked what they would not like about a job in IT. Of the 246 girls who answered this question, most answers could be categorised as follows (number of times mentioned and percentage shown in parentheses):

- the job would be boring (sitting around all day): (105, 43%)
- physical problems (eyes, no exercise, stressful): (45, 18%)
- technical problems: (12, 5%)

Many girls simply said they had no interest in working in IT, five girls mentioned working alone, and two mentioned being seen as a geek. The stereotyped characteristics of IT jobs mentioned above are among those that we hoped would be challenged by participating in Digital Divas.

Following the Digital Divas program, the post-focus group data indicated that the views of 39 girls had changed about stereotyped characteristics of working in the computer industry, and with respect to the myths about IT and women. The responses focused on the opportunities women had in IT, that the job was not just about sitting at a desk programming, that there are many different jobs in IT, and that there was flexibility. The following quotes illustrate the changes in these girls' thinking and perceptions:

> I didn't really think IT was for girls and then this class has really like changed my thinking completely.

> They make a lot of money. And like they work from home, like you can choose to work from home if you want, you can stay home but you get paid heaps. And then you can travel as well. Like you get paid to travel, to go to meetings and stuff and yeah, it was all right.

> There's a lot of women in IT. That's good, like there's a lot of jobs for women in IT, that's good. And you're going to need IT in most jobs anyway…

> We learnt a lot about stuff from different perspectives of people who work in IT, so like the creative people were interesting.
>
> That women can do IT and we can do it well.
>
> And you can design like websites and stuff. You can make them more interesting than normal websites and stuff.
>
> I reckon like if girls actually started knowing what we've learned and working with computers in the IT … like with others and stuff, I guess they would actually like it as well.
>
> To me I just think that sometimes the boys think they're better than the girls on the computer, so sometimes they're just annoying.
>
> Well last time I thought it was guys and being kind of like geeky types, staring at the computer all day with coffee, and just like hours of coding and not sleeping at all. Now it's like you can go out, flexibility, talk to people face to face, not through computers, and not coding the whole time.

Seven girls said their views had not changed.

In the post-survey the girls were also asked if their ideas about girls and computers had changed (Yes/No) and, if they had changed, how. Of the 193 girls who answered this question, 98 (51%) girls said 'yes', with comments such as:

> Doing this subject I've learnt there's a lot of career opportunities in the IT work field.
>
> I now know a lot of jobs involve women and computers.
>
> I never realised computers are so much fun.
>
> Before, I didn't really see girls with computers going together that much, but now I know IT can be a domain for girls.
>
> This program has shown me that computers are not only for men, but women can enjoy technology as well. I know this because I have enjoyed the program.

However, 93 girls said their ideas had not changed. What was interesting is that of these girls, 37 said they already knew girls were good at IT or that girls were capable of doing whatever they wanted to do.

There were no specific survey questions related to the teachers and the extent to which the girls made the link between the activities in the Digital Divas program – the classroom computer-related tasks, visiting speakers, and presence of the Expert Diva – and IT careers. In the post-survey the girls were asked if they had learnt about jobs/careers in IT (Yes/No). There were 191 girls who answered this question and the data indicated that 138 said they had learned about careers and 53 girls said that they had not.

Comments from the post-survey and the post-focus groups highlight what they learned. Many girls commented on learning that IT was more than sitting in front of a computer; some recalled what those jobs were and others commented on the range of IT opportunities they had learned about. Examples of what was said included:

> I learnt about the careers, such as animators and game designers and programmers.
>
> I learnt there are a vast variety of jobs/careers in IT like design and website building. It wasn't how I imagined it to be.
>
> Doing this subject I've learnt there's a lot of career opportunities in the IT work field
>
> There was this chick that did planetariums and that was pretty cool because it wasn't just sitting at a computer but her job involved IT and that was all right.
>
> There is more designing as compared to what I initially thought.
>
> IT also has many designing aspects.
>
> I learnt that there are many different aspects of IT that I haven't considered and that there are many IT jobs that involve art.

There were 21 direct references to the guest speakers and/or the Expert Divas in the girls' responses to the question about career options in the post-survey. A number of girls also made reference to the careers that the guest speakers, women working in IT, who came to the schools had talked about; one speaker, for example, was involved in the bionic eye project and

another two were games designers. The students indicated overwhelmingly that they enjoyed having an Expert Diva in the class to help them with their activities. The inclusion of guest speakers, women working in IT, coming out to the schools also made a significant impression on the girls.

For many girls participating in the Digital Divas program, the experience changed their views about some of the negative stereotyped aspects of working in the IT industry, perceptions of poor working conditions, and the opportunities, flexibility, and range of work options on offer.

Summary of Findings Related to Assumptions 2, 3, 4, and 5

There was strong evidence that new computing skills were developed through participation in Digital Divas, and some of the stereotypes associated with the field were challenged. Even before the program began, the girls' views did not reflect strong endorsement of the gender stereotype; after the program they were even less convinced of males' superiority with computers. The experience of working collaboratively throughout the Digital Divas program appeared to reinforce the students' views that computing professionals do not work in isolation.

It was disappointing that for the cohort as a whole, interest in studying computing subjects in the final years of schooling and IT career aspirations were not as positively affected by the experience of the Digital Divas program as we had hoped. As shown in the focus-group data, for some individuals, however, the program had enthused them to think more about their own future career paths and in particular a career in IT. There were very positive signs of recognition that computing was a field open to women and that there was great variety in the types of jobs available. The participating girls were in the early years of high school; longer-term, the Digital Divas experience may well have an impact on them and shape career aspirations.

Assumptions 6 and 8: The Enthusiasm for IT Would Be Maintained After the Program

In the post survey the girls were asked specifically if they would consider further study in IT. Of the 189 girls who responded, 30 (16%) said that they would. They were also asked what they would not like about a job in IT. Of the 183 girls who responded, most said that they did not want to work in IT, without further explanation. Using the same categories as above, we can see that there were changes in terms of what they thought about an IT career:

- the job would be boring (sitting around all day): 55 (30%) down from 43%

- physical problems (eyes, no exercise, stressful): 11 (6%) down from 18%
- technical problems: 8 (4%) down from 5%

None of the girls mentioned working alone and only one mentioned being seen as a geek.

In the focus groups, the girls were asked if they would choose an IT subject in the following school year; 29 girls said they would, 15 said no they would not, and 14 were not yet sure. Interestingly, eight girls said they had already chosen an IT subject. Digital Divas was mentioned as one factor in their decisions to study more IT, for example:

> I wouldn't have chosen it [IT subject] if I didn't do the Digital Divas.

> We learnt so much about women in IT and what role they play in IT and everything, and it actually made us consider doing IT after university and in the university.

> By doing Digital Divas we actually considered doing IT in university because in [school name] everyone says medicine, engineering. That's their stereotype. By doing Digital Divas we actually had an opportunity to learn about IT and careers in IT and everything. That was just great.

> Digital Divas has definitely helped me pick the IT classes.

Follow-up Focus-group Results

In almost all research investigating the effectiveness of intervention programs involving girls and IT, the value of the program was assessed immediately after the running of the program. While this approach can provide a perspective on the extent to which something has changed from the start to the end of an intervention program, it is not useful for determining if the impact is sustained over the longer term.

In order to assess the extent to which the Digital Divas program had effected a more sustained change in girls' attitudes and motivation for studying IT or pursuing an IT career, focus groups were held with girls in four schools one or two years after they had experienced the program. Data were collected from 11 focus groups involving 33 girls. While we cannot draw any hard conclusions because of the limited number of girls who we were able to contact and invite

to participate in the focus groups, they do provide some insights into how sustained the lessons from Digital Divas were.

The girls were asked if they were now considering an IT career. Thirteen girls said they were, 12 said maybe, and five said no. Several girls mentioned that IT was part of most careers they would be doing. Some of the comments the girls made include:

> Yeah, well, it is very interesting and usually, before Digital Divas, we would have thought, IT, no. I might go over and do something else. Now, after it, we've gone, 'Hey, that's actually not a bad idea.'
>
> I realised I really enjoyed doing the Digital Divas tasks and that's where my interests were.
>
> I thought I did and then I just realised it was definite that I was interested in that because I was just a bit interested before.
>
> I'm considering it but I'm not sure if that's going to be an actual possibility. I have an interest in IT and learning how to use computers and all that kind of stuff.
>
> I'm not really sure yet. I like IT and stuff but since I was young I've wanted to be something, so I've still got that idea.

The answers the girls gave indicated that they continue to have a broader idea of what an IT career might be. Several mentioned specific aspects of IT work; four mentioned web design or graphic design, and another mentioned games design.

> Maybe I'm thinking of doing digital designing, maybe getting into an advertising industry where I can use creativity to create adverts and stuff like that.
>
> I think as well, potentially, I could … in the sense of incorporating the technology we have and the design element because I'm really interested in using different designs with website designing particularly and advertising and marketing and things like that.
>
> I think Digital Divas opened up the possibilities of what maybe I could do because I wanted to do something with law before and I guess it's

kind of opening up to something maybe to do with IT and law and privacy and everything.

I was thinking about something to do with forensic science, and the IT side of that.

Conclusion

There were a number of assumptions underpinning the design and implementation of the Digital Divas intervention program. The research data does provide evidence that the program was successful in a number of ways. For the entire sample of girls, the quantitative data revealed that the girls found the program materials interesting and their confidence with computers had either been enhanced or not changed (Assumption 1). By engaging with the Digital Divas program materials, they developed new skills, and as a consequence of their experiences some of the stereotypes had been challenged. In particular, their beliefs about girls' capabilities with computers and place in the world of IT were reinforced (Assumption 2). While there was clear evidence of greater awareness of the range of jobs associated with careers in the IT industry, the Digital Divas experience had not, as hoped, further stimulated interest in future studies of IT subjects or working in the computer world for the entire sample. The focus groups, however, revealed that the opposite was the case at the individual level, with many girls indicating that after the program careers in IT were certainly possibilities for them (Assumptions 3, 4, & 5). The effects of the Digital Divas program in the medium term were explored in the follow-up interviews with participating girls one to two years after being in Digital Divas. These girls were able to reflect positively on their experience and how their views had changed as a result. For many, future study or careers in IT were now a possibility (Assumption 7).

Early in the chapter, research on the pivotal role played by teachers in affecting students' learning outcomes was presented. As discussed elsewhere in this book, the research team did not have control over which teacher was assigned to take the Digital Divas class in each school. It was assumed that each teacher would have appropriate computing skills, would be excited by the prospect of being involved in the program, and would hold positive views about girls and their capabilities with computers and potential to work in the IT field. These assumptions did not hold up for all teachers. We believe that this might partially explain the findings that were inconsistent with expectation.

CHAPTER 7

THE RIPPLE EFFECT

Overview

This chapter explores the wider impact of the Digital Divas program. Although, as with most intervention programs, our focus was on the girls, we found that our program had an impact beyond that of the girls it was designed to influence. There was an impact on the schools, the teachers, the curriculum, our school role models and our Expert Divas. The chapter draws on both the qualitative and quantitative data as well as our observations.

Background

Intervention programs are primarily aimed at changing a given situation (usually social), with outcomes designed to have an impact on or improve the situation of a specific group of people (Mastropieri et al., 2009). Rarely do intervention programs consider or aim to improve the condition of others outside the target group. It is, however, very likely that in the case of most interventions there is a ripple effect. That is, others connected to the target group in some way are influenced or changed as a result of a social change or intervention. Much of the research on IT intervention programs has only described the impact of the intervention on the target group; seldom do we see documented the impact on others who might be connected to the program. There are a few examples we have been able to identify.

Clayton, von Hellens, and Nielsen (2009) noted from their research into one intervention program that parents recognised, after the program, that they needed more information about IT careers – presumably so they could discuss this further with their daughters. Another group of researchers, reflecting on the outcomes of an IT camp to promote IT careers to girls,

recognised the value of a community partnership for delivering a successful program and the role of schools (Choudhury, Lopes, & Arthur, 2010). An intervention designed by Nelson and her team (Nelson, Quinn, Marrington, & Clarke, 2012) identified first-year university students who were likely to fail and provided support to these students. Although not the target of the intervention, Nelson et al. (2012) reported very briefly on the impact on other stakeholders such as the academic and professional staff at the university. The impact reported was primarily focused on the value the other stakeholders saw in the program. Each of these examples highlights that intervention programs can, and often do, have a ripple effect.

In the case of our program, the intervention was intended to change girls' awareness of IT to improve their career options by opening up the possibility of a career in IT. As discussed in Chapter 6, the impact of our intervention on the secondary school girls who participated was evident. However, at the conclusion of the program it became clear that the Digital Divas program had had an impact beyond that of changing girls' attitudes to IT.

Before starting the Digital Divas program we extensively reviewed the literature reporting on intervention programs conducted in Australia and elsewhere. We found only one long-term program (that is a program which ran for more than a few days or over a couple of weeks) involving a significant number of girls, 'Computing Club for Girls' (CC4G) (Fuller, Connor, Johnston, & Turbin, 2009) in the UK. Girls participated in an out-of-class computer club on a weekly basis. Initially the program was restricted just to girls; however, later boys were included. Unfortunately there have been few papers published on this program. The final report (Fuller et al., 2009) includes details of the research conducted on the program, which consisted of interviews with the participants but no-one else. There are no details as to the impact the program might have had more widely.

Evaluations of intervention programs, as we have described in Chapter 2, have also typically focused only on the girls themselves and have not reported on any wider impacts, which is not surprising given girls are the target (see for example Watt (1988), Doerschuk, Liu, & Mann (2007), Paolo, Sivilotti, & Demirbas (2003), and Heo & Myrick (2009)). This is consistent with our own research of Australian intervention programs (Craig, Dawson, & Fisher, 2009), from which we established that the majority of programs aimed at girls were evaluated through surveys of the girls after the event but did not include others. Given that almost all intervention programs run for a very short period of time, it is not surprising that there is little reported on the impact of such programs beyond their target audience – the girls.

Impact of the Digital Divas Program

The girls participating in the Digital Divas program were involved for a significantly longer period of time than other similar interventions. Also, because we were able to collect data over several years, we have been able to explore the wider impact of our program and/or influence the program has had on others. We collected data from teachers through interviews, surveys and meetings; interviews and weekly reflections from our Expert Divas; and our own observations on our visits to each school. We next discuss each of the groups on whom the program had an impact.

Teachers

It is not surprising that research has established the importance of the teacher on learning outcomes in all areas as well as in the context of IT use (Cox & Marshall, 2007; Geer & Sweeney, 2012; Levin & Wadmany, 2008). Research by Levin and Wadmany (2008) highlighted the importance of the teacher's experience with technology in the classroom and the need to ensure teachers have the necessary technology skills and experience to be effective. Miranda and Russell, (2011) found that in the classroom '... the strongest predictor of reported teacher-directed student use might be teachers' belief about the instructional benefits of technology' (p. 317). Further, they found that teachers who had experience with technology and saw the benefit of technology in their classrooms were more likely to encourage their students to use technology (Miranda & Russell, 2011). A UK report examining teachers and successful use of IT in the classroom found that 'The extent to which individual teachers are committed to integrating IT, and how this commitment relates to that of the school as a whole, can have a significant impact on the degree to which IT can be integrated by those teachers' (Scrimshaw, 2004, p. 6).

What is important therefore from our perspective is that even if the teachers who participated in our program were not experienced in IT, their enthusiasm and use of the technology was likely to have an impact on the extent to which the girls engaged with technology.

As discussed above, the background, quality and attitude a teacher brings to a classroom is likely to have an impact on the learning outcomes. If a teacher is enjoying what they are teaching it is more likely that the class will enjoy the experience. It is therefore of value to explore the extent to which teachers were able to influence both the program and how it was delivered. All of the teachers said they enjoyed teaching the program and would like

School	Teacher characteristics
Bartik Secondary College	**Alice** had a strong IT background; she had taught IT for eight years and enjoyed it. She contributed significantly to the modules. She taught Digital Divas to four different classes over a period of three years. **John** taught Digital Divas for one term as a relief teacher. He has an IT background. He taught only a limited part of the curriculum.
Clarke Secondary College	**Jane** had not studied IT and was a science teacher; she had, however, taught IT for three years. She was enthusiastic to take the class but there was limited school support. Jane struggled with teaching the modules; however, the class managed to complete three.
Forsythe Secondary College	**Stephen** was an art teacher and not an experienced IT teacher; Digital Divas was his first IT teaching experience. He did not use all the modules and in some cases taught his own material. Stephen struggled particularly with the programming aspects but was happy with what he did do.
Goldstine Secondary College	**Jay** had a strong IT background and has taught IT for four years; however, her background is as a humanities teacher. Although the school thought students had IT skills she believed the students' IT skills were weak. Jay enjoyed teaching Digital Divas and the modules. She found it challenging to keep students interested but persisted with the modules.
Holberton Secondary College	Both teachers had an IT background and had taught IT for six years. Both also taught art. **Di** was the first teacher to teach Digital Divas in 2010 and conversations with her suggested a disturbingly low expectation of the students. She taught at least three of the modules. **Deanne**, the second teacher, had a much more positive attitude and rapport with her class. She loved teaching the class and managed to complete most of the modules.
Koss Secondary College	**Alysa** was IT-savvy and enthusiastic and had taught IT for two years. She was enthusiastic about the curriculum; however, given the cohort of students she was only able to work through and teach a couple of modules.
Mayer Secondary College	**Melanie** was enthusiastic about getting girls into IT; she has experience and an IT background although most of her teaching was in the humanities area. She had taught IT for two years. She wanted to get more girls into IT and saw Digital Divas as a way to do that. She taught several modules but modified two of them to less interactive formats.
McAllister Secondary College	Both teachers had studied IT but this was their first year teaching IT. **Ellie** was the IT coordinator who had a mathematics teaching background. **Lee**, who taught Digital Divas twice, had a background as a language teacher. Both teachers loved teaching the class and were very enthusiastic. Both taught most of the modules in the program.
Moffatt Secondary College	**Jen** did not have an IT background and this was her first year teaching IT. Her background was in outdoor/physical education. She knew the applications she was teaching and was very technology-savvy. She was enthusiastic about teaching the class and covered many of the modules.
Spertus College	The teacher had a design and technology background and had taught IT for 12 years. She was enthusiastic about taking the class and the class covered many of the modules.

Table 7.1 Teachers of Digital Divas

to teach Digital Divas again. There were many positive comments relating to their experience. Many of the teachers mentioned that they thought there was more they could do in the class, that they felt they needed to learn more and some indicated that they wanted more time for the class than they were allocated by the school.

In this section we provide an overview of the background and the attitude of the teachers. Table 7.1 summarises the background each of the teachers.[7] As is evident, a number of our teachers did not have an IT background. This, however, did not appear to affect the delivery of the program. What was clear from our observations and interviews was the enthusiasm the teachers brought to their classrooms.

Influence of the teachers on the program

Teachers were overwhelmingly engaged with the program and pleased to have been involved. The teachers' enthusiasm was reflected in how they modified and changed the curriculum. In some cases modules were adapted to suit a particular cohort, in other cases new materials were found to complement the existing resources. This is consistent with the findings of Miranda and Russell (2011), whose research established that innovative teachers are likely to seek out external resources. For Digital Divas the teachers taught with both the materials we provided and new material introduced by them.

> I found some really good tutorials on Photoshop and some problems that we found in just setting up their magazine cover and things like that. We found solutions and so I posted those links. (Moffatt).

Another teacher described how she modified and extended one module by having the girls 'go out and take photographs, and play with their own photographs as well as creating the magazine cover as well. They really enjoyed that aspect of it'. She went on to explain how the modules gave her ideas of what else could be done 'and then I was able to adapt them a little bit to suit our student's needs, and likes.' (Holberton).

To be able to extend and modify the materials was important at some schools, such as the selective-entry all-girls' school. Many of the teachers used our curriculum but modified it for their students. This was particularly evident when teachers taught Digital Divas for a second time. They appeared to have had more confidence in what they were doing and this was reflected in the changes.

7 Pseudonyms have been used for all schools and the teachers

It is not a surprise that dedicated teachers are always looking to improve and it is encouraging that this extended to teaching girls about IT.

> I feel there is always more we can do – not always sure how or what. It is something that needs to grow and we need to continually improve and challenge our thinking on how to get the girls motivated and interested in this subject area. (Bartik)

However, it should be noted that in two schools the teacher reverted to their own curriculum. Our observations were that these teachers were not as confident. In one case, however, the teacher's confidence improved and he did teach more of the modules in the second iteration of Digital Divas in the school.

Overall it is evident that teachers influenced the program through their own adaptation and extensions to the materials we had provided.

Influence of the program on the teacher

Four of our schools were all-girls' schools, the other six were co-educational. For many of our teachers the experience of teaching an all-girl class was new to them. Overall the teachers found the experience to be very positive and valuable. A number of the teachers reflected on how much better and how much easier it was to teach an all-girl class and how this influenced their teaching style and approach. For example:

> The best aspect was being able to teach the girls without having to deal with any classroom management issues i.e. behaviour. You can really focus on extending the girls' knowledge and skills because you have more time to see the girls individually. (Bartik)

The all-girl environment certainly influenced teachers' perceptions of the value of all-girl classes. For example:

> I still think there's some other subjects where – not for the whole cohort – but I think there a definitely times where you need to say 'These girls need to be on their own', or 'These boys need to be quarantined, on their own'. (Mayer)

> I found that a lot of the girls' attitudes change mainly because it was a girl-only course. I think that they found that they could try to achieve more things because there wasn't boys in the room. (Holberton)

> It's a very different environment or feel to the whole class. The girls appreciated that too. They were very productive and they were challenged by some things and yet they were really, they persevered and they really started to hone their skills so that was really good to see. (Moffatt)

Teachers commented that they had more time to spend with the girls because there were no boys in the class, and as a result they were able to do things differently. In some cases they would take more time, be more selective in what they covered and consider more carefully how the curriculum could be delivered.

One of the surprising things for us, as researchers, was the value of the program in terms of teachers and their own learning. In an informal conversation with one of the researchers, one teacher explained how much she appreciated the level of detail in the materials because she was learning about the applications as the class was progressing; our materials were teaching her, in effect. What teachers themselves had learnt through the program was a familiar theme in the post- interviews.

Many of the teachers invested significant time in learning the materials, particularly where the software for teaching the modules was completely new. None of the teachers expressed any concern or frustration with having to do this, suggesting that they were motivated to learn as they went. 'I found it really interesting just like the girls, so I was learning with the girls as well, so it was quite fun.' (McAllister).

One teacher who had never used Dreamweaver sought help from the Expert Diva. The teacher explained that the Expert Diva helped her set up her own webpage and also helped teach the girls. Commenting on this the teacher said 'I actually sat down with the kids in the class and was doing it with her [Expert Diva], and she was explaining it to them, so I was learning it as well.' (Goldstine)

It also became apparent that the teachers themselves grew in confidence as their proficiency with technology increased as this quote illustrates:

> I enjoyed the first four modules and I'm not an IT teacher. I just teach myself and actually I think became pretty good at using those programs in particular. I enjoyed it myself and I learned a lot myself because I had to – because I'm not IT trained. I spent a lot of time on learning the software and all that sort of thing. (Moffatt)

For other teachers the software they were using was something they were already familiar with and the Digital Divas modules provided them with

an opportunity to update their knowledge on that particular package. A number of teachers saw this as a positive, as reflected here:

> It was good to get back into IT and see what other people are doing in IT and some of the possibilities. It also gave me something to aim for. Like I need to learn something about that. I need to learn some more about the filming part and how to get it onto computers. (Goldstine)

Another teacher explained:

> I actually had to go and reteach myself how to use some of the [applications]… like Flash, for example, I haven't used Flash for years. So I actually found it really good as a refresher for me, to find out what I was doing. And then also, because I learnt it on a PC, and had to reteach myself on the Mac, being able to then teach the girls that with the Mac helped me get into it a lot more than I would have thought I would. (Holberton)

For some teachers, particularly those who were not IT teachers, the module on careers gave them insights into IT careers they were not necessarily familiar with as reflected in this quote:

> I've had to really work hard at when they [girls] come to me with questions about a particular career, I go 'Okay, well I've got … or I can ask that person'. Oh, Facebook's been invaluable. 'Is there anyone doing x, y and z. Reply now'. It's been great to make connections like that, and for me to be able to say 'Oh well I spoke to so and so, who happens to be a such and such, and they've suggested that we look up this'. So yeah, having to stay abreast of that information has been a bit of a challenge. But I look forward to building on that now that I've identified that, to keep that going. (Mayer)

There were other interesting outcomes for teachers. One of our teachers was invited to present at the annual Victorian IT Teachers Association conference with one of the Expert Divas. This was something unexpected for the teacher and from her account a great experience. Another teacher said:

> I've actually even thought my son's looking at doing programming for applications on Apple Macs and he and I are going to have a look at how we can get a hold of that and maybe that could be a module one day, which would be good. (Goldstine)

One teacher with a non-IT background found herself teaching an all-boys computing class and decided to modify the modules to suit the boys' class, which she thought had worked very well.

Expert Divas

Our Expert Divas we saw as role models in the classroom rather than mentors, although there are similarities in the roles. Using university students as classroom facilitators (near-peers) is not uncommon. One US intervention program designed for girls from lower socio-economic backgrounds to improve their skills in maths and science and provide some career awareness included the use of university students as mentors (Brown, 2010). Brown (2010) highlights the impact the program had on the mentors, including developing their confidence and competence as mentors. A paper by Staehr, Martin, and Byrne (2000/2001) described an intervention program designed to support first-year female tertiary computing students and noted strategies designed by more senior women (their mentors) to help the first-year students. The mentors learned about mentoring, although there are limited details on the response of the senior women reported in this paper. The experience of our Expert Divas was quite similar in terms of building confidence and learning how to relate to the girls; however, the impact went beyond this.

Our motivation for providing an Expert Diva in each class was so that they could be an informal role model to the girls; someone who was closer to their age and studying IT at university. The Expert Divas were encouraged to answer questions about studying IT at university, to help dispel the myths surrounding IT and women as well as to provide support to the classroom teacher. The Expert Divas' engagement with the schools and the students had an impact on them and influenced them in surprising ways. We drew on the Expert Divas' weekly reflections and post-program interviews to explore this further.

Building confidence and skills

One of the most important effects the program had on our Expert Divas was the level of confidence these young women developed as a result of the experience. In describing what the best part of being an Expert Diva was Eve said 'building my confidence in talking to a big group of people, that's what I liked best.' In another case two Expert Divas worked together and as a result of that, one of the women explained how this had helped build

confidence and how much more prepared she felt to take on the role for a second time.

The Expert Divas also learned about how to work in a classroom, for example understanding what was needed to be effective:

> It was a challenge to interact with the class as a whole, and it has made me realise that is so easy for quiet, shy students to go unnoticed and fall behind in work in a largely numbered classroom. (Sally)

> I think the initial challenge was to communicate in a subtle manner that I am only supposed to support the student in their time of need – thus I am not a teacher as such. (Amiti)

One Expert Diva was confident enough to suggest to the teacher how the program might be improved. She explained how she and the teacher were 'planning to get the girls to use the message board on the Digital Diva Club site to ask questions or start discussions'.

As our Expert Divas spent more time in the classroom, their skills improved. Skills such as communication and how to enhance the experience of the girls' developed. Most Expert Divas used their time in the classroom to speak individually to girls about what they were doing and encourage their learning further:

> This week some of the students were getting incredibly frustrated with the tools. It helped to have a chat with them about their planned design and then assist them learning how to use the tool. Jumping straight into teaching them how to use the tools generally created more frustration that the student was having trouble. (Delia)

> I observed the girls, asked them [guest speakers] questions about how they were 'programming' the robot, and what they expect the robot would do if they change this or that set of instructions. I felt I was encouraging them with the work they had done, as well as encouraging the girls to expand their thinking. (Olga)

A number of the Expert Divas described how they interacted with the girls. Sometimes this involved encouraging discussion, asking questions, providing examples and help and generally engaging with what the girls were doing:

> I encouraged the girls to be creative but still remember to think about all the ethics and morals in the way the media portrays women at the

> moment. I told them it is important to remember what we had discussed in the last lesson. (Kirsten)

It was also evident that as time went on the girls became more comfortable with our Expert Divas in the classroom and began to ask them for more help:

> A few of the girls were hesitant to ask for help when needed ... But when I approached them and asked them if they had any questions, a lot of them found that there were areas that I was able to help with. (Shanta)

> They were quite hesitant to sort of use the online blog, but talking in class they were really quick to reach out to us for help, and really quick to sort of build up a friendly relationship with myself. (Olga)

This comment highlights the impact working closely with the girls had and what the Digital Divas were learning.

> However I'm confident and pleased I got to know all the girls on an equal level in the end. In relation to the quiet students, it's a bit of a challenge to interact with them, think of things to say, etc. They seemed more comfortable asking the teacher for help than myself, which was fine. The more I made general passing comments, asking if they need help or 'that looks great', aided in communicating with these types of students. It was all one massive learning experience! (Sally)

As with the teachers, the Expert Divas also learned new IT skills. The teaching of the modules involved a range of software, not all of which the Expert Divas were familiar with. For example the programming language used was Alice, developed specifically at the University of Virginia and Carnegie Mellon for teaching secondary-school students. There were also other programs such as Photoshop and multimedia applications the Expert Divas had to learn and this was of value.

Gaining Further Insights

Many of the Expert Divas have grown up in an environment where it was understood and accepted that women work in IT. It is also likely that they had access to, and knowledge of, technology before they went to university. For many of our Expert Divas, it was a surprise that the girls were unaware of the IT careers available and that women can and do work in IT.

> I would be interested to see how engaged they [the girls] could become if they were to speak to someone involved in the fashion industry who also works on ICT. Or even, I would love to give them a whole list of opportunities involved in this sort of area. (Kirsten)

> While I knew of the stereotype of a boys' only club in IT, I have never experienced anyone telling me that women are not meant to study IT before. A few students expressed that it's not that they don't want to have IT as a career it is that they have already picked another career path they would enjoy more. (Delia)

For some it was a shock when they discovered some girls did not have computers at home and there was a general lack of IT skills/knowledge among the girls that they were interacting with. They were also surprised that in some cases girls were not able to do activities the Expert Divas thought were straightforward such as transferring images from a mobile phone or a camera.

> I think, however, that the girls have not yet realised how the concepts of the module fit into IT – this includes the online research/news, the image editing, the presentation of information, and the communication skills. It's a shame to know that the greater message has not yet reached them, but I'm sure that in time it will. For now, it seems that the content is building their general confidence. (Olga)

> The girls seemed engaging enough when I was talking to them; however, I feel that they showed little interest in ICT in general as they didn't ask me much questions about my course or what ICT really involves. (Eve)

> When I spoke to a lot of them about what they planned to do after school, they were 'Oh yeah, I'll just work as the receptionist at mum and dad's business'. There was no 'I want to go to university and learn this'. (Delia)

Reflecting on her role, one Expert Diva explained how her perspective had also changed as a result of the program 'I'm just so grateful that I've had the opportunity to be a part of it again. It's even changed my own perspective on girls in the IT industry.' (Sally)

Level of Engagement and Sense of Achievement

All of our Expert Divas loved the experience; they enjoyed being in the classroom and seeing the girls grow in confidence and take on the challenges. They had a sense of achieving something with their work with the girls.

> A lot of the students made really good progress on their magazine covers. (Deb)

> This class I help the girls finalise their logos, and I just had general interaction with them about how they think the subject is going – I got all positive feedback, which is great! (Kirsten)

> One girl, however, was keen on making her own font in Photoshop, and was constantly seeking my help. This was great! She was really using her initiative, her imagination, and a variety of IT tools that were available to her. (Olga)

> It was great fun to help engage their brains into thinking in a problem-solving manner. (Sally)

> They wanted to know what the future is going to be for them or what changes there are going to be so when they asked me some questions it just makes me feel good. (Natalie)

> The modules are really fun to do; it's not just for little girls. (Eve)

The Expert Divas used their initiative to extend the girls themselves.

> One student enjoyed using Photoshop in class so much that she wanted to get it on her home computer, but found it cost too much (so I encouraged her to download a trial version to use for a month for free). (Deb)

> I made myself available to the students individually, to help them get their magazine covers from drawing to reality. In the process, I taught them a variety of tools which they can utilise as they continue to develop their covers. (Sabina)

One Expert Diva enjoyed the experience so much she is said she was thinking about becoming a teacher.

Extending Beyond the Role

An example of the impact of the program on our Expert Divas was how they took the initiative and extended their role beyond what we had asked them to do. Although it was not an expectation and we did not encourage our Expert Divas to take on the role of the teacher in the classroom (in fact we counselled against it in cases where we knew it was happening), many found themselves in that position and appear to have been happy to assume that responsibility. These were important experiences for the Expert Divas.

> I took this session by myself as Danielle was not there. It seemed like the girls had not progressed from where they were in the last session. So I had the groups make a final decision on what theme there movie was to be, along with an outline of the plot. (Sabina)

> The teacher went on long-service leave for a few weeks and so I thought I'd take the initiative to step in and show them, well introduce them to the task and then if I really got stuck, then that would be worst-case scenario and the teacher would come back but it turned out okay. (Kelly)

For Sally, given the confidence she had gained from her previous experience as a Digital Diva, she was able to take over when the teacher in charge of the class went on leave (the school did provide a replacement teacher for the class but they were not familiar with the curriculum). She went on to say that in future she would still feel quite comfortable taking on this role.

> My teacher went on leave a few weeks before the end of the semester, leaving me to control the work/classroom as substitute teachers either had no IT knowledge or had other work to do while the students worked. But because of learning from her previously, I was confident and quite happy to take the reins. (Sally)

In other cases, although the Expert Diva was not teaching the class for the whole lesson, it was frequently the case that they would teach the class one aspect of the program. This generally happened because the teacher was not confident with the software or the content and when the Expert Divas became aware of this, they stepped in and helped.

> … sometimes you would have five people turn up to a class so you'd have to improvise. So I taught them how to make a website at one point. (Sabina)

> I gave a presentation for the girls at the start of Photoshop and I think that was really good as well. It sort of got me more involved with them as well and yeah, I think it was really good. (Shanta)

The teacher at one school was very impressed with her Expert Diva, Kati, commenting that she stayed longer than she was paid for.

Schools and Their Curriculum

The attitude to technology within a school can influence the extent to which students, male or female, will elect to study IT. Schools are usually responsible for professional development, including technology training for teachers (Dawson & Rakes, 2003). School principals play a pivotal role in promoting technology use in schools (Anderson & Dexter, 2005; Schiller, 2003; Scrimshaw, 2004). We could not have implemented Digital Divas in any school without the support and encouragement of the principal. Research by Dawson and Rakes, (2003) concluded that the larger the amount of IT training and experience a principal has, particularly focusing on computers and the curriculum, the better IT will be integrated in the school. This is consistent with the findings of a study by Miranda and Russell, (2011), who found that how much a principal used technology influenced teachers' use and beliefs in the value of IT. Other studies such as that by Lai, Trewern, and Pratt (2002) argue that leadership is important for successful technology integration in schools. The ICT co-ordinator often provides this leadership by contributing to ICT school policy (Lai et al., 2002).

The ratio of computers to students ranged from 1 to 1.2 to 1 to 6. We were only able to obtain data from seven schools regarding the teaching of IT in students' final year (Year 12). Of the seven schools only four offered a Year 12 IT subject.

Given that some schools are not teaching IT widely, or as a separate subject, it is therefore important to reflect on the response of schools to the Digital Divas program. Four of the schools have now run the program more than once; one school ran the program four times and another three times. At the beginning of 2013 we contacted each of the schools and asked if they were planning to run Digital Divas in the future. Three other schools indicated they will be offering the program as an elective or it will be running as a non-elective subject. Two schools think it is likely to be offered again but decisions had not been made at the time of writing this book. Many of the schools do not provide details of the electives they offer on

their websites; however, two schools advertised on their website that they are offering Digital Divas.

The majority of the schools participating in Digital Divas did not have a strong focus on teaching IT, although they did recognise the importance of providing students access to technology. In one of the all-girl schools, because it is a selective-entry school, the girls are very academically driven. It was interesting to reflect on the impact of the program on that particular school. It was clear in our early interactions with the school that most of the girls were looking towards careers in medicine and law, not in technology; hence interest in technology was not strong. Reflecting on the program, the teacher saw its potential for these girls:

> I would like to try all modules and to see how the girls take to those modules and what can be done further in those modules but this time, time was not sufficient enough to do a lot, which is just our problem because we discovered Digital Divas a bit too late. I would like to spend a good year on it to really see what I can do for our cohort with regards to Digital Divas. (McAllister)

This school ran the program for three years and for two of those years it was delivered concurrently in Year 9 and Year 10 using different modules.

As researchers, we considered it important that Digital Divas be run as a single-sex class. A number of schools that requested to participate in the program were not included because they could not guarantee the class would be all girls. The participating schools were willing to provide an all-girl environment. Now that the research project is finished, schools that choose to start or continue teaching Digital Divas are able to run the program in any way they like. However, it is encouraging to see that the co-educational schools that are interested in continuing will still offer, or have offered, Digital Divas as single-sex classes. This suggests that one impact on the school is understanding the value of teaching IT to an all-girl class.

There was also a broader impact of the program on other aspects of schools, particularly with respect to the curriculum. As described earlier, teachers adapted the materials we provided for them and also supplemented the materials with the resources they had found themselves. Almost all of the teachers involved in Digital Divas have increased their IT skills and knowledge ultimately to the benefit of the school, particularly as a number of the teachers had very limited IT skills prior to becoming involved.

One teacher developed her own approach to teaching one part of the program. This involved the girls making fairy bread, which they then took outside to eat. As this quote illustrates, the involvement of the Expert Diva encouraged other girls in the school to ask questions about university.

> But when we went outside to eat it – you can't eat fairy bread in this classroom –some of the girls wandered over here to chat to other kids out in the yard, which meant at various times different girls came and just had some one-on-one, or some two-on-one time with Eve [Expert Diva]. I tried not to hover too much, but their conversations were really quite relaxed. Just talking about uni, and her upcoming exams, and how she'd coped with assessments and just things like that. Whether or not that was in an IT direction or just tertiary study in general, I think that was really valuable for them. Otherwise the only tertiary-educated people they meet are their teachers, and their doctors. I think that could be a bit limiting, especially in [Mayer].

Mayer Secondary College is a disadvantaged school where most of the students are not expected to go on to tertiary studies.

Discussion

Reflecting on the data we had gathered at the end of the Digital Divas project it became obvious that there had been unexpected effects and/or influences on those other than the participating girls themselves; Digital Divas had had a 'ripple effect'. Figure 7.1 summarises that impact.

Our target audience for the program were secondary school girls; however, as the ripple moved out further there was an impact on others. The next group on whom the Digital Divas program had the greatest impact, we believe, were the teachers. The extent to which the teachers would benefit from teaching Digital Divas was unexpected. Previous research highlights the effect on student learning when an enthusiastic teacher is teaching a class. As we discussed earlier, teachers are also critical to the uptake of technology in the classroom. Interviews with the teachers indicated that all our teachers expressed a high level of enthusiasm for teaching Digital Divas and many teachers taught the program more than once. Almost all the teachers learned new skills. In the case of some teachers the software used was new to them and this required them to become familiar with it; for others the program offered an opportunity to refresh their skills.

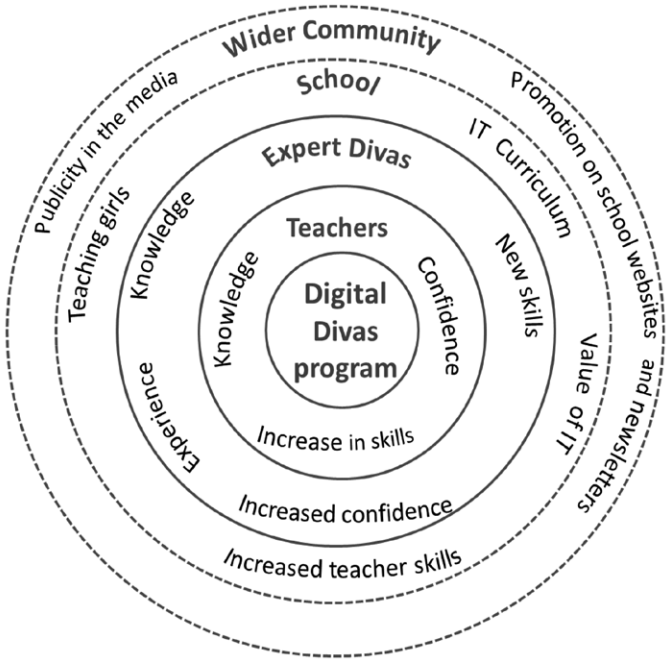


Figure 7.1: The ripple effect of the Digital Divas program

Many teachers grew in confidence in terms of their IT skills and teaching IT. For those who had not taught IT previously, they acquired a level of confidence both with the technology and with teaching IT. Along the way the teachers became more aware of a range of other things such as different careers in IT, different approaches to teaching and the value of teaching an all-girl class. There was enthusiasm among the teachers to find new resources to complement the material in the modules and clearly a number of teachers saw value in the fact that they were extending themselves as a result of being involved.

There was also an effect on the Expert Divas involved in the program. They too developed new skills learning software they were not familiar with; they learned how to interact and engage effectively with the girls and the teachers, as well as how to communicate more effectively. They were exposed to some of the issues relating to girls' knowledge about IT and IT careers which for some was a shock. Our Expert Divas also grew in confidence through the program; a number of them taught parts of the curriculum to the class and were not just involved in helping the girls with their work. One researcher noticed that even back at the university when there were calls for

volunteers for school talks, or to host school visits on open days, it was often the Expert Divas who volunteered.

As the use of computer technology in schools becomes all-pervasive, it is critical for the teaching staff to be adequately equipped and confident with the technology. Bauer and Kenton's (2005) research highlighted the importance of teachers being confident with IT in order to be able to effectively teach IT. Further, they found a direct link between IT skills and confidence. One clear effect on schools was on teacher confidence and equipping teachers who were not technologically savvy with new skills and knowledge, ultimately benefiting schools. The schools were exposed to a new way of teaching IT resulting in changing curriculum. The schools also gained insights into the value of teaching in all-girl classes.

Although the research did not measure the impact on the wider community extensively, chapter eight does provide details of the wider community of two of the schools – the circle represented by a dotted line – however information to the wider community was provided via the schools. The project attracted the attention of the media, with a short report on one ABC program and various items in newspapers both state-based and Australia-wide.

Conclusion

The designers of any intervention program, aiming for social change, generally expect their program to have an impact on an identified group. It is also likely, although rarely reported, that the intervention has had an influence or effect on others. This chapter has therefore provided insights on how an intervention program can and does have an impact on others. We set out with the aim of improving the awareness and skills of girls in computers and technology. We ended up improving the confidence and expertise of both the teachers and the Expert Divas and provided the schools with a different perspective on teaching IT. As researchers these have emerged as outcomes that we did not anticipate or plan, but we welcome the ripple effect. For those designing interventions in the future we would argue that looking at the wider impact of the project has value.

CHAPTER 8

THE WIDER COMMUNITY

Contributed by Amber McLeod

Overview

Girls' decisions not to participate in IT have been linked to both societal stereotypes about IT and the influence of parents, teachers, and peers. In this chapter the attitudes of the wider community towards girls and IT are explored and compared with the results of the Digital Divas program in order to investigate possible relationships. In this case it was found that when messages from the community about IT are divided, participants in the program are more likely to change their attitudes. The changes, however, were not always in the direction expected.

Introduction

One of the assumptions of the Digital Divas program was that the wider community (including parents, as well as other teachers and students not participating in the program) would be supportive.

The influence of society on girls' decisions to participate in IT is significant. While interventions such as the Digital Divas program try to convey the message to girls that it is acceptable and normal for them to have an interest in IT, they do not operate in isolation, and if girls are getting different messages from friends, family and society at large, then the impact of interventions may be less than hoped for. Indeed, in an evaluation of the CC4G intervention, Fuller, Connor, Johnston, and Turbin (2009) asked

how strongly interventions could influence attitudinal change when 'the girls (and boys) in our study were subject to an array of influences – educational, social, financial, emotional and cultural – on their attitudes to and abilities in IT' (p. viii). This issue helped shape a PhD study on which the current chapter is based. Specifically, the PhD examined the relationship between community attitudes and the outcomes of the Digital Divas program. The primary research question for this study was:

> Are the attitudes of the community towards IT important in terms of a successful intervention program?

In order to address this question, the attitudes of the community were gathered, the results from the program at two schools in 2011 were examined, and these findings were compared to explore a possible relationship. In line with the main Digital Divas program research, this study used a mixed-methods approach; both quantitative and qualitative data were gathered.

Three interesting findings became apparent from the PhD study. First, girls' attitudes were most likely to change when community attitudes about IT were divided. Second, the changes in girls' attitudes were not always in accordance with the goals of the Digital Divas program, suggesting that influences other than the program were at play. Third, the high standards of delivery presumed by the authors of the intervention were compromised by the practical implementation of the intervention, which may have unintentionally influenced the outcomes of the program.

IT Stereotypes

In some respects the research involved an investigation of the power of stereotypes, especially the way they can hinder achievement of intervention goals. So it was necessary to identify and examine key relevant stereotypes from the literature that include:

- IT is a male domain.
- IT professionals are geeks.
- IT jobs are socially isolating.
- IT jobs are bad for your health.
- IT jobs are difficult and boring.
- IT jobs are not compatible with a normal family life.
- IT professionals make a lot of money.

IT is a male domain. Here, two separate preconceptions have been combined: that IT professionals are men, and that men are naturally suited to IT. Currently the IT field in Australia is dominated by males (Department of Education Employment and Workplace Relations [DEEWR], 2013) and IT classrooms have been likened to a male locker room (Margolis & Fisher, 2002). When asked to draw IT professionals, male characters are drawn more frequently than females by both male and female students (Mercier, Barron, & O'Conner, 2006). Ideas circulating within the wider society that males have more technically-minded brains than girls, and an innate, obsessive fascination with technology, are seen as advantageous in the pursuit of an IT career (Leder & Forgasz, 2012; von Hellens, Clayton, Beekhuyzen, & Nielsen, 2009). In addition, males themselves believe they are naturally suited to IT (Zeldin, Britner, & Pajares, 2008).

IT professionals are geeks. The geek or nerd stereotype is widely cited by girls as a reason why they are not interested in joining the IT profession (Anderson, Lankshear, Timms, & Courtney, 2007; Lang, 2003; Margolis & Fisher, 2002). Those working in IT have been described as looking unhealthy – pale and grossly over- or underweight; wearing glasses with unfashionable hairstyles and clothing; exhibiting antisocial behaviour and having a strong interest in science fiction (Cheryan, Plaut, Steele, & Davies, 2009; Mercier, Barron, & O'Conner, 2006; Sheehan, 2003; Steele, 2010).

IT jobs are socially isolating. A stereotype of an IT job is that it involves working in isolation rather than being part of a team (Lang, 2003, Lang, 2007, Multimedia Victoria [MMV], 2001). Margolis and Fisher (2002) suggested that females are particularly sensitive to this stereotype. Female university students, in one study, reported the lack of friendships in an overwhelmingly male environment as a major reason for their withdrawal (Miliszewska, Barker, Henderson, & Sztendur, 2006).

IT jobs are bad for your health. It has been reported that students imagine that IT professionals work indoors in dark offices, often surrounded by junk food and science fiction paraphernalia (Cheryan et al., 2009; Steele, 2010; von Hellens, Clayton, Beekhuyzen, & Nielsen, 2009).

IT jobs are difficult and boring. Findings have suggested that IT work is thought to be technical, difficult, boring and repetitive, involving long hours and late nights (Fisher, Lang, Craig, Forgasz, & Lazarenko, 2009; Johnson & Miller, 2002; MMV, 2001; Miliszewska, Barker, Henderson, & Sztendur, 2006; van Oost, 2000; von Hellens, Clayton, Beekhuyzen, & Nielsen, 2009).

IT jobs are not compatible with a normal family life. Concerns about family have been reported as reasons for leaving IT university courses (Miliszewska, Barker, Henderson, & Sztendur, 2006), and women working in IT have reported their concerns about needing to place work ahead of family commitments in order to succeed in their jobs (von Hellens & Nielsen, 2001). More recently, criticism of the way the CEO of Yahoo, Marissa Mayer, chose to balance motherhood with her job reinforced the stereotype that IT is not a suitable job for women who have or want families (Miller, 2012).

IT professionals make a lot of money. It is widely recognized that IT professionals can earn a great deal (von Hellens, Clayton, Beekhuyzen, & Nielsen, 2009) although, unexpectedly, this has not always been seen as a positive, with some students describing those in the profession as 'money-grubbing' (Jewel & Maltby, 2001). Students reported that although they were aware of how well-paid IT jobs were, and the opportunities available, they were more interested in pursuing careers that related to their personal interests (MMV, 2001).

In summary, it appears that the prevalent stereotype is that IT is a male domain dominated by unhealthy, socially isolated geeks who spend all day inside doing difficult, boring jobs; this stereotype helps socialise girls to believe they are less suited to IT than boys.

Transmitting IT Stereotypes through Socialisation

Socialisers play a role in transmitting stereotypes and thereby influencing girls' academic and career choices. Socialisers can be parents, teachers and peers.

Parents

Parents play a significant role in influencing children's expectations and assumptions about interests and career pathways (Bovee Voogt, & Meelissen, 2007; Clayton & Beekhuyzen, 2004; Gal-Ezer Shahak, & Zur, 2009; Lang, 2007; Margolis & Fisher, 2002). Indeed, secondary school students have reported that their decisions about career choice are strongly influenced by parents (Clayton & Beekhuyzen, 2004; Rogers & Duffield, 2000; von Hellens, Clayton, Beekhuyzen, & Nielsen, 2009). It has been claimed that messages from parents about where a child fits in society are more powerful in terms of decisions, achievement and motivation than

demographic characteristics, positive computer experiences, or actual ability (Eccles, 2006, Vekiri & Chronaki, 2008).

Parental belief in the stereotype that IT is a male domain has been found to have been picked up by children and possibly contributed to higher self-efficacy and more positive beliefs about the value of computers among boys than among girls (Vekiri & Chronaki, 2008; Gal-Ezer et al., 2009; Miliszewska, Barker, Henderson, & Sztendur, 2006). IT can be modelled as unsuitable for females through a mother's fear of, or lack of interest in, computing (Gürer & Camp, 2002).

Teachers

Teachers, Margolis and Fisher (2002) claimed, affect the way students see themselves. Researchers claim that females, in particular, have been found to develop self-efficacy through vicarious modelling in their relationships with teachers (Zeldin, Britner, & Pajares, 2008). Encouraging, passionate teachers, and good student-teacher relationships have been reported to make students' sense of belonging to an IT environment stronger (Furrer & Skinner, 2003, Zeldin & Pajares, 2000).

Similarly, it has been suggested that student performance can be predicted by examining teachers' expectations and beliefs about student ability (Eccles, 2006; Jussim, Eccles, & Madon, 1996; Lee & Smith, 2001). Teachers' stereotypical beliefs and attitudes about appropriate behaviour and roles for boys and girls, and technology, have been found to distort their perception of actual student abilities (Eccles, 1994) and subtly steer girls away from IT (Barker & Aspray, 2006). Butler (2000) argued that teachers can give messages to girls, sometimes unconsciously, that they do not need to participate in computer technology; while male IT professionals have reported witnessing teachers actively discouraging women from studying mathematics and science (Zeldin & Pajares, 2000).

Female university students studying IT have reported that assumptions about the level of experience and knowledge of IT prior to joining the class, aggressive or patronizing lecture styles, unwanted positive discrimination, and stereotypical attitudes held by fellow students created negative classroom experiences which put females off IT (Crump, 2001; Nielsen, von Hellens, & Wong, 2001).

Peers

There is mixed evidence that peers influence females in their decisions regarding interest in computers and IT careers. When asked, secondary school students have sometimes suggested that their decisions about career choice or involvement in IT were strongly influenced by peers (Clayton & Beekhuyzen, 2004; Roger & Duffield, 2000; Thomas & Allen, 2006). At other times they have reported that they were not influenced by their friends' opinions (Adya & Kaiser, 2005; Gal-Ezer et al., 2009). In Australia, it has also been reported that friends discouraged students from involvement with computing (Clayton & Beekhuyzen, 2004; von Hellens, Clayton, Beekhuyzen, & Nielsen, 2009).

In short, through socialisation, parents, teachers, and peers appear to have a significant influence on students' decisions about study and career pathways.

The Wider Community Study

Only two of the schools, Goldstine SC and Bartik SC, were chosen for detailed investigation in 2011; however, they were representative of the higher and lower echelons of socio-educational advantage in Melbourne. Goldstine SC had an Index of Community Socio-Educational Advantage (ICSEA) score of 969, below the average of 1000, indicating it had students from lower socio-educational advantage than Bartik SC, which had an ICSEA score of 1074, indicating that their students were from higher socio-educationally advantaged backgrounds (see Table 4.1 in Chapter 4).

The Community

The term 'community' used in this research referred to four groups:

1. The Digital Divas teachers: These were 'Jay' at Goldstine SC, and 'Alice' at Bartik SC.
2. The Goldstine community (recruited through the school):
    - Goldstine parents of Year 9 students.
    - Goldstine teachers at the school (excluding the Digital Divas teacher).
    - Goldstine peers – Year 9 students not participating in the program.
3. The Bartik community (recruited through the school):
    - Bartik parents of Year 8 students.

- Bartik teachers at the school (excluding the Digital Divas teacher).
- Bartik peers – Year 8 students not participating in the program.

4. The wider Victorian community: Parents of students in Years 8 and 9 at Victorian schools, recruited through the social networking website Facebook.

Data Sources

Data from the main Digital Divas study

Digital Divas teacher data were gathered during the main study as described in Chapter 3. Data from 2010 and 2011 pre- and post-program teacher surveys and interviews, as well as classroom observations, were consulted.

Digital Divas student data from 2011 pre- and post-surveys from Goldstine SC and Bartik SC were also accessed from the main study. Thirteen students from Goldstine SC and 22 students from Bartik SC completed both the pre- and post-program surveys in 2011.

Data from the PhD study

In addition, data from the Goldstine, Bartik, and wider Victorian communities were collected specifically for the PhD study, drawn from separate surveys for parents, teachers, and peers. Participants were also invited to a group or email interview. The data-collection instruments are now described in more detail and copies of the instruments can be found in Appendix E.

The Instruments

The Goldstine, Bartik, and wider Victorian communities' surveys

Three community surveys, for parents, teachers (other than Digital Divas teachers) and peers, were developed to broadly identify the attitudes towards IT held in the community. Adaptations of the existing Digital Divas pre-program student and teacher instruments (described in Chapter 3) were used so that comparisons between community data collected in this study and data collected in the main program could be made.

Like the Digital Divas program instruments, the community surveys included:

- Multiple-choice answers (e.g., Boys/Girls/No difference).
- Items with five-point Likert-type response formats (1 = Strongly Disagree, 2 = Disagree, 3 = Not Sure, 4 = Agree, 5 = Strongly Agree).
- Open-ended questions (e.g., What do you think you would like about a job in computing?), including one question requiring students to produce a drawing.

In addition to demographic questions specific to each community group (parents, teachers, and peers), each community survey included items about:

- IT and gender (e.g., Boys are better than girls at fixing a computer);
- IT people and jobs (e.g., People who work in computing work alone);
- Future participation in IT (e.g., I would like my daughter to have a job in the computing industry);
- Enjoyment of computing (e.g., I think computing is very interesting); and
- Support for student computer use (e.g., My school is enthusiastic about students using computers).

Through the schools, all teachers at the school (excluding the Digital Divas teacher), and all parents and peers in the appropriate year level were sent explanatory statements, consent forms and surveys.

An online version of the parent survey, targeted at parents in Victoria, Australia, who had a child attending Years 8 or 9, was advertised on the social media network Facebook. These parents were not directly associated with the Digital Divas program. As these recruits lived in Victoria, however, and had children in the same year levels as those in which the program was run, Years 8 and 9, they were considered to be part of the wider community.

Surveys were filled out by 14 parents, 17 teachers and 14 peers from the Goldstine community; 31 parents, 15 teachers and 27 peers from the Bartik community; and 119 parents from the wider Victorian community.

The Goldstine, Bartik, and Wider Victorian Communities' Group and Email Interviews

The purpose of the interviews was to gain a greater depth of understanding of the attitudes identified through the surveys. It was anticipated that first-

hand opinions and clarification and exploration of the responses collected from the surveys would assist in answering the research question.

At the end of the survey participants were invited to take part in group interviews. Five parents from the wider Victorian community agreed to participate in group interviews.

The group interviews were semi-structured to allow free-flowing discussion but were based around the following areas (A copy of the group interview questions is found in Appendix E):

- Perceptions of an IT professional (e.g., the appearance and character of IT professionals);
- Perceptions of an IT job (e.g., knowledge of the type of IT jobs available); and
- Socialisation (e.g., parental support for student computer use).

In addition, nine email interviews were conducted along similar lines with parents and peers from the Goldstine, Bartik and wider Victorian communities.

Community Groups Data Analyses

As with data from the main study (described in Chapter 3), quantifiable data from the community surveys were analysed using SPSS. One sample t-tests were used to indicate whether mean scores were significantly different from 3, the middle value in the score range of relevant items, indicating 'not sure'. In order to determine whether there were any differences in attitude among the community groups, interval data were analysed using independent groups t-tests and ANOVAs. Chi-squared tests were used when data were categorical. The level of statistical significance was set at $p<.05$. Statistical comparisons were made between:

- The wider Victorian community, the Goldstine community, and the Bartik community.
- Goldstine community sub-groups (parents, teachers, and peers; and male peers and female peers).
- Bartik community sub-groups (parents, teachers, and peers; and male peers and female peers).

Paired t-tests were used to compare the mean scores on identical items on the pre- and post- surveys to determine if there had been a change in students' measured response to these items (e.g., attitudes or beliefs) as a consequence of the Digital Divas intervention. It should be noted that paired t-tests

can only be conducted on the responses of those participants who complete both the pre- and the post- surveys. Thus the number of responses analysed using paired t-tests was less than the number of participants completing the pre-survey, and also less than the number completing the post-surveys as some students completing one or other of the surveys did not complete the other.

Qualitative data were examined and organized into categories based on the literature. Qualitative analyses were used to compare:

- The Digital Divas teacher data.
- The group and email interview data.
- Open-ended questions in the community surveys.

Findings

Attitudes toward IT Identified from the Community

Digital Divas teacher attitudes

As there was only one Digital Divas teacher at each school, their attitudes will be discussed individually.

As stated in Chapter 2, to implement a successful program, one of the five key inputs required was a committed, creative, passionate teacher skilled in IT.

At Goldstine SC, Jay was enthusiastic about the program and believed it was on target to encourage girls' involvement and interest in IT. She envisaged girls being enthusiastic in the classroom and choosing IT in the future as a result of a successful program. Jay, who had ten years of experience as a teacher including four as an IT teacher, had studied an IT degree and had worked in the IT industry as an analyst programmer for six years before becoming a teacher. She was concerned that her IT knowledge level was only just above that of the students. She thought that the range of skills required for the program was unrealistic 'for any ordinary IT teacher to have' and that she would have liked training or step-by-step instructions for the program 'which would save me having to fossick around and try and figure it out myself.' In 2010, Jay commented that she had 'expected that the [Expert] Diva would know how to use all the modules and know exactly what to do and would do all that'. This indicated that she thought she could take a passive role in the classroom, evidence of her incorrect interpretation of program expectations of the teacher and the

Expert Diva. In 2011, however, Jay believed her IT skills had improved and, although still concerned about her level of knowledge, she was 'much more confident'.

Classroom observations of Jay by the Digital Divas research team led to impressions that she was time-poor. She seemed disorganised, there appeared to be a lack of preparation of the materials that the program provided to teachers, and she had class-control issues, with students watching movies and writing blogs during class time.

At Bartik SC, Alice, who was involved with the Digital Divas pilot program, was pleased and excited to continue her involvement with the program. She saw a successful program as one that would result in more girls taking IT units at VCE level. Alice was a curriculum coordinator and IT teacher at the school who had taught IT for eight years. She had studied IT at tertiary level, undertaken professional development in IT and IT education since becoming a teacher, and was interested in doing more. Alice was employed by the Digital Divas research team to write the modules for the program and was enthusiastic, with ideas for expansion of the program including involving other classes and arranging excursions to IT companies. In the interviews Alice said she enjoyed the flexibility of the curriculum, experimenting with ideas and finding out what worked with her students. She rated her computer skills as high and her enjoyment of teaching IT as high. Classroom observations by the Digital Divas research team in 2010 revealed Alice's enthusiasm, confidence and ability to run the class.

Alice was, however, on maternity leave a few weeks before the end of the 2010 class and for the first term of the 2011 class. While no data were gathered from the replacement teachers, student comments in the 2011 post-program interview indicated very different teaching styles. Students explained that while Alice 'gives us more time if we don't get something done or she's very flexible', one replacement teacher (a male) was described as rigid, demanding, and strict.

In addition to finding teachers who were experienced, confident, and enjoyed teaching IT, a goal of the program was to increase girls' confidence in, and attitudes towards, IT and anticipated results were that girls might consider studying IT and envisage themselves in IT careers. It was hoped that the Digital Divas program teachers' beliefs about gender differences with regard to IT would align with the aims of the program. On the pre- and post-intervention survey surveys, teachers were asked several questions related to this issue.

Jay, the Goldstine Digital Divas program teacher, indicated that she believed boys were more confident, competent, and interested or enthusiastic about IT than girls. She thought that this was because boys were more proficient with IT, more likely to use computers at home, and because boys picked IT subjects and girls did not. She noted that girls were more passive with IT; they followed instructions and asked for help, whereas boys had a go, took risks and 'fiddled', which made them more suited to IT.

Comments by Jay in the pre-and post-intervention interviews appeared to indicate that she was not, perhaps, the role model the program had envisaged, as she seemed to have some stereotypically 'nerdy' qualities; for example, she used her personal IT experience selling concrete pipes to inspire the students. She was also surprised that the students were so engaged in manipulating pictures and discussing models in the 'Fab & Famous' module. Her surprise provided further evidence that Jay may have been out of touch with what the students found interesting. Jay assumed that the students would find programming boring and stated that IT is a 'nerd class'. In addition, her personal beliefs about gender and IT were not a good fit for the goals of the program and she did not seem to embody the motivated, creative, skilled IT teacher assumed as a prerequisite for the program to be successful.

Alice, the Bartik Digital Divas program teacher, was enthusiastic, confident and well versed in the requirements of the program, not least because she wrote the teaching modules. While she believed boys were more enthusiastic than girls about computers, she thought that confidence and competence and the appeal of IT tasks depended upon individual circumstances rather than the gender of a student. Alice was much closer to the teacher envisaged for the program.

School Community Attitudes about IT

The attitudes of the Goldstine, Bartik and wider Victorian communities were compared and statistically significant differences in mean scores were found for only one item: 'People have to be very hard-working if they want to work in the computer industry'. Post-hoc comparisons indicated that the mean score for the wider Victorian community (mean = 2.91) was significantly different from the mean scores for the Goldstine community (3.53), and the Bartik community (3.26), indicating that while the members of the Goldstine and Bartik communities agreed that people have to be very hard working if they want to work in the computer industry, members of the wider Victorian community were unsure.

As only one statistically significant difference was found between the three community groups, the results are discussed together as one

'combined' community, with any differences within individual communities highlighted.

The majority of the combined community believed there was no gender difference with regard to IT. When community members did perceive a gender difference, however, it was strongly in favour of boys. The combined community recognised that IT jobs were enjoyable, although difficult, paid well, and required team work – all positive views about IT jobs. They also believed, however, that long hours at a computer were involved, which may lead to health problems. They imagined IT people to be unpopular males with few interests outside computing.

Within the Bartik community, however, not all sub-groups (parents, teachers, and peers – male and female) were in agreement, with the following statistically significantly differences in mean scores:

- Bartik male peers (mean = 3.36) agreed but Bartik female peers disagreed (2.44) that boys are better than girls at working with computers, and, although not statistically significantly different, Bartik male peers (3.18) agreed that boys are more suited than girls to work in the computer industry, while Bartik female peers (2.63) disagreed. The data suggest that Bartik male peers were more stereotyped in their attitudes toward IT than the female peers.
- Bartik teachers (3.57) and peers (3.58) agreed that computing professionals have a lot of outside interests while Bartik parents (2.87) disagreed.
- Bartik teachers (3.47) and peers (3.67) agreed that people have to be very hard-working if they want to work in the computer industry while Bartik parents (2.81) disagreed.
- Bartik peers (3.52) agreed that a person who works in computing makes a lot of money while Bartik parents (2.84) and teachers (2.93) disagreed slightly.

These results indicate quite different ideas about IT people and careers within the Bartik community.

Employment in the computer industry was a contentious issue across the community. The Goldstine and Bartik parents were all unsure whether they would like their sons or daughters to have jobs in the computer industry. Parents from the wider Victorian community, however, were statistically significantly more likely to agree that they would like their sons to have jobs in the computer industry than their daughters.

Among the peers, Goldstine community male and female peers, and Bartik male peers, were unsure whether they would like to have a job in the computer industry. Bartik female peers, however, disagreed that they would like a computer job. These attitudes present in the community were not supportive of one of the main goals of the program: to encourage future involvement in IT among the participants.

From the community surveys and interviews, positive attitudes about the importance of computing at school were found across all the community groups. All groups and sub-groups in the combined community believed that computers make learning more enjoyable. All communities also agreed that computing is interesting. There was also positive recognition that parents and teachers were supportive of student computer use. In particular, the communities agreed that schools were enthusiastic about students using computers. These attitudes were pleasing to see and consistent with the program goals.

Within the Goldstine community, parents (4.07) and teachers (4.11) agreed statistically significantly more strongly than peers (3.50) that the school is enthusiastic about students using computers. A possible explanation could be that because the computer activities the peers would like to engage in at school are not the same as those that the schools or their parents would like or expect them to be engaged in. In addition, although not statistically significant, Goldstine male peers (4.13) agreed much more strongly than female peers (3.33) that computing is very interesting, revealing attitudes in accordance with the stereotype that IT is a male domain.

Among the Bartik community sub-groups, teachers (4.40) agreed significantly more strongly that the school was enthusiastic about students using computers than were parents (3.65) or peers (3.52); and peers (3.96) indicated statistically significantly stronger agreement than Bartik teachers (3.20) that computing was interesting.

On the whole, community attitudes toward IT were fairly positive and there was shown to be strong support for student computer use, these views were consistent with program goals. However, beliefs in negative IT stereotypes were held by some members of the community, particularly with regard to the gender, isolation, unpopularity, and health of IT people, as well as the long hours involved in a difficult career. This perhaps provides a reason for the uncertainty about future student involvement in IT careers found across the community groups. The Goldstine community showed the most consistent views across sub-groups, while in the Bartik community there were quite varied attitudes across the sub-groups.

Digital Divas Student Data Analyses

Paired t-tests were used to compare the pre- and post-intervention survey surveys for 13 Goldstine and 22 Bartik Digital Divas students in 2011 to determine whether any changes in attitude, either a statistically significant change ($p<.05$) or a trend ($.1>p>.05$), occurred.

Changes in participant attitudes occurred at both Goldstine SC and Bartik SC. Among Goldstine Digital Divas students, four changes in attitude were found; all were opposite to the program goals. The changes in attitude were that after participation in the program, students agreed less strongly that computing was interesting, and were no longer considering a job in computing after school or when they finished studying (two statements) or including IT as a VCE subject.

Among Bartik Digital Divas students there were seven changes in attitude. Of these, four were consistent with the relevant program goals. These four changes were that after participation in the program, Bartik Digital Divas students disagreed more strongly that boys were more suited to, or better at, various aspects of computing than girls (two statements), had a greater understanding that those working in IT can make a lot of money, and that IT professionals do not work alone. The remaining three changes in attitude, divergent from the relevant program goals, were that students no longer considered including IT as a VCE subject, were no longer sure whether computing was interesting, and disagreed more strongly that they would like to be thought of as geeks.

It is noteworthy that both Goldstine and Bartik Digital Divas students changed their attitudes (in a negative direction) about future participation in IT and how interesting computing is. In light of the mixed community attitudes toward future participation in IT, this suggests that perhaps community attitudes had an influence on the outcomes of the program.

Comparisons between Digital Divas Students' Views and Community Views

A pattern emerged from the data indicating that changes in attitude among the program participants were related to a diversity of attitudes across community sub-groups (parents, teachers, and peers). When community sub-group attitudes were uniform, changes in attitude among program participants were less evident.

In the Goldstine community, sub-group attitudes about gender and IT, and IT people and jobs, showed uniformity with no statistically different mean scores. Correspondingly, Goldstine Digital Divas student attitudes about

gender and IT, and IT people and jobs, did not change after participation in the program.

While there were no statistically significantly differences between the Goldstine community sub-groups' attitudes about IT people and jobs with respect to future participation in IT, there was a large difference between Goldstine parents' views about their daughters and Goldstine peers' views. For example, parents were more enthusiastic about their daughters working in IT jobs than the female peers themselves. After participating in the program, there were three changes in Goldstine Digital Divas students' attitudes about future participation in IT: students no longer considered including IT as a VCE subject or a job in computing when they leave school or finish studying. This was not in line with the program goals.

The Goldstine community's perceptions of computing were uniform across sub-groups for all but two items: that the school was enthusiastic about students using computers; and that computing was very interesting. There was one change in Goldstine Digital Divas students' perceptions of computing: after participating in the program, Goldstine Digital Divas students were unsure whether computing was very interesting, after initially agreeing that it was. This was not in line with the program goals.

There appeared to be a pattern apparent in the results. Changes in Digital Divas student attitudes occurred when Goldstine community sub-group attitudes were varied. When Goldstine community sub-group attitudes were uniform, there was no change in Digital Divas student attitudes. This suggests that community attitudes towards IT were important to the outcomes of the program.

Bartik community sub-group attitudes about gender and IT were diverse for two statements: that boys are more suited than girls to work in the computer industry and are better than girls at working with computers. There was a change in Bartik Digital Divas students' attitudes, consistent with program goals, for these two statements. The Bartik community sub-group attitudes were diverse on three items related to IT people and jobs: that people who work in computing work alone; that a person who works in computing often makes a lot of money; and that they would like a job in IT. All changes in attitude among Bartik Digital Divas students (both those consistent with and those opposite to the program goals) were found for these three items. Among the Bartik community sub-groups, attitudes about whether computing is interesting were diverse. After participation in the program, there was a change in attitude among Bartik Digital Divas students that was, however, opposite to the program goals. Once more,

these results appear to suggest a pattern. When Bartik community sub-group attitudes were uniform, there was no change in Digital Divas student attitudes; when Bartik community sub-group attitudes were varied, Digital Divas student attitudes did change.

In the Bartik community and among Bartik Digital Divas students, there were three instances for which this pattern was not followed. There were two statements for which community sub-group attitudes were diverse (that people need to be hard-working to work in the computer industry, and that the school was enthusiastic about students using computers) and there was no change in attitude among Bartik Digital Divas students. There was one statement for which Bartik community attitudes were uniform (they would not like to be thought of as a geek), but a change in attitude occurred among Bartik Digital Divas students.

The results from Bartik SC also support the pattern described above, with changes in attitude among Digital Divas students occurring mainly when community sub-group attitudes were diverse.

The Direction of Change

While there is some indication that Digital Divas student attitudes were more likely to change when community attitudes were divided over a particular item, the direction of change found among the Goldstine and Bartik Digital Divas student attitudes has not been accounted for. All changes in attitude among Goldstine Digital Divas students were inconsistent with the Digital Divas program goals. Of the seven changes in attitude among Bartik Digital Divas students, only four were consistent with program goals. It should be noted that the directions of some changes were not only inconsistent with program goals, but also with attitudes identified from the Goldstine, Bartik, and wider Victorian communities.

At both schools, attitude changes about whether computing is very interesting were away from both program goals and community attitudes. In addition, at Bartik SC, Digital Divas students agreed less strongly that they would like to be known as computer geeks which was not only inconsistent with program goals (that being a geek was positive), but also community attitudes. This raises the question: what else influenced the students? The available data do not allow any definitive conclusions here; however, it may be speculated that perhaps the modules that were designed to excite the girls were not as engaging as presumed. Possibly, the Digital Divas students simply lacked the maturity to appreciate the messages of the program. Perhaps jobs and career decisions did not seem relevant to them. It is also

possible that the role models presented in the form of the guest speakers from industry, Expert Divas, or the Digital Divas teachers themselves did not present the positive female ICT models envisaged.

This last issue appears to reinforces a point raised by Weisgram and Bigler (2007), who suggested that a decrease in egalitarian views among a group of STEM intervention program participants may have been due to 'the physical appearance or mannerism of the female presenters [which] led some girls to endorse gender stereotypes about women in science' (p. 267). It was possible that some of the role models may have unconsciously reinforced stereotypes about 'nerdy' IT people.

Conclusion

As sign-posted in the introduction to this chapter, there were three key findings from this research. First, it appears that the attitudes of the community towards ICT were important to the outcomes of the Digital Divas intervention program at these two schools. Changes in attitude among the Digital Divas students, after participation in the program, generally occurred when there was a diversity of attitudes across community sub-groups; however, when community sub-group attitudes were uniform such changes generally did not occur.

The second key finding was that when changes in attitude did occur they were not all in accordance with the program goals, suggesting there were other unanticipated influences on the Digital Divas students.

This leads to the third key finding, which was that the implementation of the program in these two schools in 2011 did not meet the assumptions and high standards expected for the program to succeed; for example, with respect to the recruitment of motivated, creative, passionate teachers skilled in IT. Although a diversity of attitudes among community sub-groups appeared to be consistent with, and arguably contributed to, positive changes in attitude among program participants, other factors such as the role models (Expert Divas or speakers), the modules selected and taught in these schools, or the age level of the Digital Divas students, may have had other, unanticipated, effects on the success of the program.

CHAPTER 9

CONCLUDING REMARKS

> Interest in STEM fields doesn't necessarily translate into choosing one of these fields for a career. Although interest in STEM is high, few girls consider it their number one career choice, given competing opportunities and interests. (Modi, Schoenberg, & Salmond, 2012, p. 16)

Our starting point and motivation for this project was the observation and acknowledgement of a problem, and concern for the declining interest girls were showing in IT generally and more specifically as a career. We did not seek to explore why this phenomena has occurred as significant research on this has already been conducted. We were very aware that this is an international problem, present in most westernised democracies. The opening quote of this chapter is from a study in the USA published in 2012. We include it now at the conclusion of our program because, although it did not inform our research during its course, it does verify some of the findings from the Digital Divas project and will be discussed further in this concluding chapter.

The primary question our research set out to explore was:

> *Can a program such as Digital Divas, which includes specifically designed, educationally based materials, change girls' attitudes and perceptions towards IT and IT careers in the longer term?*

We believe we have demonstrated that it can be done. Our results show that, in this cohort of students, attitudes and perceptions towards IT and IT careers changed significantly (see Chapter 6). In this, our concluding chapter, we consider which aspects relating to the design of the program and the research contributed to its success. We hope that this documentation of our program design and reflection on our journey will be of value to those

wishing to implement any intervention program in the future, for we know that specifically in Australia the lack of gender diversity in IT continues in 2014 and is still reported in the news media (Butt, 2014).

In addition, we reflect on the value of the evaluation framework we used and critically apprise a number of aspects of the program, in particular what did and what did not work. There were elements of our findings that surprised us initially, and we discuss these in more detail. Finally we will comment on the sustainability of the Digital Divas program and propose future research specifically relating to girls and IT.

Designing a Successful Intervention Program

Given the numerous intervention programs designed and implemented to affect change, it is important to consider the key elements in our program and our research that we believe contributed to its success. These are presented to inform future researchers and intervention program designers.

- We employed a participatory research approach, that is, one in which research is conducted as a 'collaborative, co-creative journey between members of the academy and the community.' (McKemmish et al., 2012 p. 986). We worked alongside our participating schools, principals, and teachers. More specifically, we did not see it as our role to impose our knowledge or views (however well-informed by research) on those we worked with. We let each school inform us on how they could best run our program should they choose to do so, with the proviso that the single-sex aspect was not compromised. We invited teachers to contribute to our curriculum and employed one as our educational developer. The school community was integral in informing the design of the Digital Divas program, particularly the community in our first school, Bartik.
- A solid research and implementation plan, in the form of an evaluation framework, was developed. This was essential given that it was a four-year program. The evaluation framework provided the necessary detail and guidance we needed. This is discussed in more detail in the next section.
- The embedding of the program into each school's curriculum was core to the ethos of our program and ensured that Digital Divas was treated as an authentic subject, not as an add-on or extra to

the curriculum. This aspect was introduced based on our own experiences from our CC4G trial and other larger international projects, particularly CC4G. We believe this aspect contributed to normalising the notion that girls can and do 'do IT'. The girls' work and learning was assessed. This ensured, as far as possible, that girls took the class seriously and therefore contributed to a greater engagement with the materials.

- We kept the main focus of the program in mind at all times and designed the program around that. Expert Divas (role models) and speakers were a critical component. They provided a direct, tangible connection between women and IT careers. The Expert Divas were another constant reminder to the girls that women can and do 'do IT' because they came weekly to the classes.
- The quality of the curriculum was important. It was focused on students' interests first, and technology second. The curriculum was designed to be fun, flexible, and to promote collaboration within the classroom. The girls were excited by the curriculum and hence enjoyed the classes, while still learning quite sophisticated IT concepts and applications. Employing a current teacher to design the modules meant that the modules were developed with both students and teachers in mind.
- We made regular visits to the schools so we were able to observe operations and help reinforce our involvement and commitment to the program in the schools. The visits also supported the participatory research approach, giving the teachers the opportunity to share with us what they were doing, changing and learning. This was also an important outreach for each of our universities and helped build links between the two sectors. It was fortunate that all the researchers had backgrounds as teachers, therefore allowing us to appreciate the complexities of the environment in which our program was being delivered.
- Implementing the program for a longer period of time was critical in our planning and structure. In most of the cases Digital Divas ran for 20 weeks (a semester), with most schools timetabling between two to four classes each week. In one school it ran for one term only (10 weeks). However, after this trial it then became a regular addition to the timetable and ran in both semesters for several years following. This longer period of delivery time

increased the chances of the program having a sustained impact on girls' attitudes to IT. Regular timetabled classes enabled teachers to reinforce positive messages about IT through a variety of activities and exercises.

- The diversity of skills and backgrounds of the team helped ensure that we explored a wide range of approaches and were not closed in our thinking. The team members all worked as academics; one in an education faculty, two in faculties of IT in different universities and one in an Information Systems school within a faculty of Business. All four team members also had backgrounds in both IT and education, all having started their careers as secondary school teachers. In addition, and this was very important, the research fellow employed had excellent skills in interviewing and conducting focus groups and had an education background. Having the same person conduct the interviews ensured consistency. The project also funded a PhD in education (see chapter 8).

The Evaluation Framework

In Chapter 2 we discussed our rationale for using an evaluation framework and provided details of its design. In any four-year project, there is the potential for the research team to lose their way, or drift from the original plan. The detailed evaluation framework that we developed at the start of the project became an important anchor and reference point throughout the project. The design of the research instruments and the analysis of the data were guided by the assumptions we developed.

As we reflect now, at the end of the project, the importance of the evaluation framework is evident. At the beginning the four researchers on the project team spent time agreeing on what the project was investigating and framing the assumptions that we made. Before resources could be allocated, money and people, we needed to agree on what our goals were in line with our assumptions. The framework provided not just a starting point but helped in identifying what decisions had to be made and when, then the activities could follow.

What Worked, What We Could Have Improved and What was Surprising

In any longer-term research project there are elements that are successful, things that we do that work exactly as anticipated, and things that surprise. However, we must also be realistic and acknowledge what did not work or what we would do differently next time. It is only through these reflections that others can learn.

What Worked:

- Given that teachers are time-poor, providing them with module guidelines, teacher instructions, student handouts, assessment options and other guidelines worked to ensure teachers were generally able to teach the modules as planned without having to invest much more of their precious time.
- Employing a teacher to design the modules was the right decision. All the modules except one were considered a success. The Alice programming module, however, was one that many girls and some teachers struggled with, and was not widely adopted by schools.
- The additional materials we provided on the portal were used by teachers.
- The all-girl classes were appreciated both by the girls and the teachers as highlighted in their qualitative comments. Although we anticipated difficulties with co-educational schools being able to run an all-girl elective, in practice this was not a problem. Only one school that initially wanted to participate in the program pulled out because an all-girl class could not be guaranteed.
- The training we provided for the teachers worked. Teachers valued the opportunity to talk with us further, giving us the opportunity to ensure that the program's aims and objectives were understood. The first roll-out of the program involved teachers being released from school for a half-day. This release was supported by the principals. After this, teachers attended training in their own time, often during school holidays, in preparation for delivering the class in the next semester. The one issue we had was when one school changed the teacher taking Digital Divas; the new teacher was unable to do the training.

- Allocating an Expert Diva to each new school was a success. These undergraduate women studying an IT degree were a constant support to the teacher and the research team in the schools. The girls related to our Expert Divas because they were closer to their ages compared to their teachers. As the program progressed we learned to use the Expert Divas as our conduits of communication, delivering and collecting surveys and providing additional support to the teacher alongside their informal role-modelling.
- As the program grew it became increasingly necessary to provide follow-up visits to each school by the web administrator. The portal was designed to allow teachers to add and remove the names of students in their classes. When teachers in the schools were not confident in doing this, our web administrator visited them on-site and spent time with them. Often the Expert Divas also assisted the teachers in this aspect of the program.

What We Could Have Improved:

- We needed to be more realistic. We had an expectation that the portal would be used for more than storing the teaching materials for downloading. It was expected that teachers would communicate with each other and share materials and experiences through the portal; this did not happen. On reflection, these were unrealistic expectations as teachers are busy and time-poor and were unlikely to have the spare time to do this.
- The surveys we devised for the girls were too long. In hindsight, more than 50 questions, both quantitative and qualitative, was too many.
- We gathered a significant amount of data from the long survey tools, focus groups, and interviews, and we have not been able to use all the information. Some of the data, on reflection, did not inform the core of our research project. Despite this, collecting both qualitative and quantitative data throughout the project was important and helped us refine what we were doing.
- While we asked the Expert Divas to keep a blog as part of their role, these blogs were not completed as frequently as we would have liked. We should have put more time into following up with students to provide the expected data. There was a misunderstanding by some Expert Divas of what was required.

Some provided short reports on classroom activities rather than reflecting and commenting on their observations of student engagement and the mentoring they had provided.

What Surprised Us:

There were some elements of the program that surprised us. Some related to our assumptions and some were incidental. For example:

- Not all teachers allocated by their principal to deliver the Digital Divas program had IT backgrounds. When planning the program we had not considered this possibility. In our trial school, the teacher not only had an IT teaching background but had been an IT professional before re-training as a schoolteacher. Most schools need their IT-qualified teachers to take their senior classes. Thus, junior and middle-school classes are likely to be staffed by teachers who volunteer or have had some marginal experience with IT in the past. Since Digital Divas was delivered primarily to Year 8 and 9 students, many teachers in our program did not have any formal IT teaching qualifications. This proved to be a great test of our materials and served as affirmation of their quality, as these non-IT trained teachers were able to teach with our materials and learn alongside their students as discussed in Chapter 7. There was one exception. In one school the art teacher was allocated to teach the Digital Divas program. He adapted the materials to teach what he had previously taught as part of his art class; this negated the aims and objectives of our program.
- Our female speakers from industry were very enthusiastic to come to the classes and speak to the girls. They brought this passion to the classroom. Many were willing to talk to more than one group and would ring us in consecutive years to volunteer for activities. We were made aware of major IT corporations where community work (such as speaking to school students) was encouraged; in some cases this was included in key performance indicators. Industry supported our program indirectly by allowing these women to work with us.
- As reported in Chapter 7, we had an impact on the teachers themselves, particularly the non-IT teachers. Our program contributed to building teacher IT self-efficacy through the provision of detailed and accessible teacher instructions in the

modules, which was complemented by the presence of a current undergraduate IT student in the class each week to further help and explain issues or problems with software and programs. Experienced and confident IT teachers used our materials as a springboard and developed further materials to suit their own students. The removal of the dichotomy of gender in these usually male-dominated environments – IT classrooms – was regarded as a positive experience by all.

- We were somewhat surprised to find that the majority of girls in the high-SES schools reported that they would never consider an IT career, despite often being the most IT-savvy of our cohort. They reported that they were interested in IT and enjoyed the class. The highest SES school in the study ran the program twice a year for several years. However, many of the students at the school aspired to what are considered to be high-prestige careers, such as medicine and law; IT careers were not in their sights. This finding is not dissimilar to that reported by Modi et al (2014). In their survey of 852 students, 74% reported that they were interested in STEM (Science, Technology, Engineering and Mathematics). Of this percentage 'only 13% say that it [STEM] is their first choice. Two-thirds of STEM girls are interested in medicine/healthcare (careers such as a doctor, veterinarian, nurse, pharmacist, dentist) as a career choice and STEM girls choose this field as their number one choice over any other career.' (Modi et al, 2014, p.16).

Implications of Our Findings and Recommendations for Future Girls in IT Intervention Programs

Based on our experiences with the Digital Divas program and this research study, we feel well-placed to provide informed recommendations for those contemplating future intervention programs to change girls' attitudes towards IT; increase girls' confidence using technology; encourage further study in the field of IT; and aspirations to enter related career paths.

Recommendation 1:

Work with school principals and senior administrators who fully appreciate the aims and goals of the program. Ensure that the school community (teachers, students, and parents) are aware of the program and fully support it.

Recommendation 2:
Secure enthusiastic and committed teachers who are aware of the issues associated with girls' under-representation in the field of IT. Teachers should preferably have an IT background or, at least, functional IT skills. Teachers should not be forced to move outside of their discipline area and their comfort zone to implement such a program. If they are, then further support needs to be provided.

Recommendation 3:
Develop and implement extended programs that run as part of a school's curriculum (e.g., as an elective) and not as co-curricular or short-term one- or two-day activities.

Recommendation 4:
If possible, run the program in single-sex classes. Our research shows this to be the most effective context in which to run these types of program.

Recommendation 5:
Use existing materials, such as those developed for the Digital Divas program, and/or develop materials that are relevant to girls' interests and that simultaneously develop IT skills and computer software familiarity. Include role models such as female guest speakers from the IT industry and/or organise visits to IT workplaces in which woman are prominent.

Recommendation 6:
Produce a comprehensive implementation plan and evaluation framework, which will guide the development of valid and reliable instruments to evaluate the program and gauge its success.

Future Research

Two years on from the formal end of the Digital Divas research program the activities continue. The website is still active for teachers to download the modules and implement in their own schools. In Chapter 4 we commented on which of our schools continued with the program after the completion of our data-gathering for this research study. In the years since concluding our data-gathering there have been many approaches by a variety of schools to use our resources. We have also been asked to provide input on an appropriate classroom design to support and encourage collaboration in the classroom.

There have also been suggestions for the portal coming from interested people internationally.

In 2014 we added a Creative Commons licence to the materials and extended our web presence for the next five years. We have had interest from teachers around Australia and overseas. Specific modules have also been added to an online repository for all Australian teachers, funded by the Education Ministers across the Australian states and territories to complement the roll-out of the new Australian (national) curriculum (Scootle, 2014). It is important to note that this new curriculum has Information and Communication Technology (ICT) as the third (of seven) listed general capabilities after Literacy and Numeracy (http://www.australiancurriculum.edu.au/).

Our research team continues to work in the area of promoting IT to girls although there has been a subtle shift in our focus, learnt from the Digital Divas project, to focus more on developing the digital technology self-efficacy of all teachers, not just IT teachers. The influence of an enthusiastic teacher who is competent and skilled in IT will support the education of all students and, as has been noted by (Ashcraft, Eger, & Friend, 2012), can be a powerful influence to encourage and maintain girls' interest with IT into the future.

We were determined to 'do it right' and believe we have avoided the following salient warning by an expert in the field:

> Too often well-intentioned individuals embark upon intervention programs without a clear understanding of what 'the problem' is for which the intervention is the solution. At best, such endeavours could be ineffective; at worst such 'interventions' could end up doing more harm than good if they are reinforcing damaging gender assumptions. (Trauth, 2012, p. 53)

The 'Digital Divas Club' was included in the regular school curriculum with a set of materials designed specifically to focus on female student interests as well as current issues, not as an extra-curricular club. The curriculum modules were created with the direct input of a practicing schoolteacher with many years of experience in this field. The resulting modules were strongly visual, focused on health, diet, and body image; at no time was a computer application taught in isolation. The introductory modules led to a gentle programming introduction using Alice, an object-oriented programming tool. An active informal mentoring aspect was added to the program. This linked university students currently undertaking a computing degree (called

Expert Divas) with each school. The Expert Divas visited the class weekly to maximise the mentoring opportunities.

We have confidence that through our research study we have delivered more good than harm, and that our findings provide a roadmap for those looking to implement a similar intervention program in future.

APPENDICES

Appendix A

Introduction

This appendix contains details of the schools, teachers and Expert Divas. Where a school taught Digital Divas more than once and if a second or third teacher taught it, the order of the listed teachers is the order they taught in.

School	Teacher/s	ED
Bartik Secondary College	Alice John	Allison, Olga Marg, Sally
Clarke Secondary College	Jane	Li
Forsythe Girls' High School	Stephen	Delia
Goldstine Secondary College	Jay	Eve Bala
Holberton Secondary College	Di Deanne	Natalie, Shanta Deanne
Koss College	Alysa	(small class no ED appointed)
Mayer Secondary College	Melanie	Eve
McAllister Secondary College	Ellie Lee	Amiti, Kirsten Olive, Sabina
Moffatt Secondary College	Jen	Kelly
Spertus College	Rosa	Kim

In this section we provide a brief biography for each of the women whose names we adopted for the schools' pseudonyms.

Bartik Secondary College

In 1946 six women were chosen from a group of 100 to become 'computers' and it was their job to write the machine code for the ENIAC (Gürer 2002). Elizabeth Jean Jennings (later Bartik) was one of these women. Bartik (Dec 27, 1924–Mar 23, 2011) had graduated in 1945 from Northwest Missouri State Teachers College, with a major in mathematics, where she had often been the only girl in the class (Fritz 1996). Instead of starting work as a teacher Jean joined the University of Pennsylvania in Philadelphia. It was from there that she was recruited as one of six women to become computers (now known as programmers) for the new machine being completed at the Moore School for the Army's Ballistics Research Laboratories. Fritz (1996, p13) explains that 'the job of computers was critical to the war effort, and women were regarded as capable of doing the work more rapidly and accurately than men. By 1943, and for the balance of World War II, essentially all computers were women as were their direct supervisors.' The women were given the diagrams of the machine and then asked to make it perform numerical calculations, even though there were no user manuals or instruction on how to program such a machine. After the war Jean remained active in the computing field, combining work with raising a family.

Sources: Gürer 2002; Fritz 1996

Clarke Secondary College

Edith Clarke (10 Feb, 1833–29 Oct, 1959) was a pioneer for women in both engineering and computing. She graduated with an honours degree in Mathematics in 1908 from Vassar College. In 1911 she worked as a 'computor assistant' (skilled mathematician) at AT&T where she stayed to train and directed other 'computors'. In 1919 Edith was the first woman graduate from the Electrical Engineering program at MIT earning her MSc. Degree. She then worked as a computor for General Electric in New York. In 1921 she filed a patent for a 'graphical calculator' that was used in solving electric power transmission line problems. Later she became an Electrical Engineering professor at the University of Texas, Austin and its first female teacher of engineering

Sources: Edison Tech Centre n.d; The Ada project, n.d.

Forsythe Secondary College

Alexandra Illmer Forsythe (May 20, 1918–Jan 2, 1980) is best known for a series of several books on computing and computer science. She was also a good mathematician and computer programmer in her own right. She wrote

the first textbook on Computer Science and was co-author of many more which were published by Wiley and Sons or Academic Press. Her final book was published in 1978 on Programming Language Structures.

Sources: The Ada project

Goldstine Secondary College

Dr Adele Goldstine (21 Dec, 1920–Nov 1964) was a mathematician who created an improved programming system for the ENIAC, one of the world's first electronic digital computers, at the University of Pennsylvania in the 1940s. Adele was the author of the two-volume 'Technical Report on ENIAC' which was the original technical description of the ENIAC (Gürer 2002). This manual detailed everything about the logical operation of the machine. In 1946, Adele implemented a stored program modification to the ENIAC. Consequently the programmers no longer 'had to manually plug and unplug cables for reprogramming every time but the computer was able to perform a set of fifty stored instructions' (IEEE, 2013). Goldstine combined her career with marriage and two children. She died, from cancer, in 1964 at the age of forty-three.

Sources: Fritz 1996; Gürer 2002; IEEE 2013

Holberton Secondary College

Betty Holberton (7 Mar, 1917–8 Dec, 2001) was also one of six 'computers' hired to be the first programmers for the ENIAC project in 1945 (Fritz, 1996). Betty was involved later in programming the UNIVAC I. During her time working on the UNIVAC I, Holberton developed strategies to enable sorting – so that records could be put in order dependent upon a certain key (Gürer, 2002). In 1951 Holberton devised the first sort-merge generator, which was a large step forward as it was the beginning of using a computer to write programs and a step towards the invention of the world's first business programming language, FlowMatic, by Grace Hopper (Spertus and Gürer 2003). Betty also played a major role in the development of the language Fortran, helping to monitor and control its standardisation. Betty retired in 1983 after her professional career had spanned four decades (Fritz, 1996).

Sources: Fritz 1996; Gürer 2002; Spertus and Gürer 2003

Koss Community College

Adele Mildred (Milly) Koss became a programmer/analyst after graduating with a mathematics degree from the University of Pennsylvania. She worked with Grace Hopper on the UNIVAC I, the Editing Generator in

1952 and contributed to the development of the first compilers, the A0 and A2. In a career spanning 47 years she covered all phases of computer technology, implementation and management, including applications design and development, software/hardware selection, database technologies and computer security. Milly was one of seven women honoured with a Pioneer Award at the Grace Hopper Celebration for Women in Computing, San Jose, California in September 1997.

Sources: Goyal 1996; Koss, 2003

McAllister Secondary College

Another of the women who worked as a programmer for the ENIAC was Homé McAllister. Homé McAllister (3 Jan 1925–) was a mathematician who worked as a programmer on the ENIAC, EDVAC and ORDVAC. She married George Reitwiesner, another Ballistics Research Laboratory employee. Together, in 1951, they used the ENIAC to solve the diagonalisation of a set of symmetrical matrices. Homé McAllister retired from government service in 1955.

Sources: Fritz, 1994

Meltzer Secondary College

Marlyn Meltzer (1922–2008) was selected in 1945 by the US Army to program the ENIAC computer. She was therefore one of the first six programmers ('computers') in the world. Marlyn was inducted into the WITI Hall of Fame on June 5, 1997.

Sources: Eniac programmers project

Moffatt Secondary College

Ann Moffatt commenced working in the computing industry in 1959 (FITT, nd). While working with the FI Group in the UK on projects such as the 'black-box' for the Concorde airplane, she was instrumental in introducing teleworking which enabled women to work from home while raising their children (Pearcey Foundation, 2011). Ann was a member of the British Standard Institution's Committee for Programming Languages (1965–74), was chair of the British Computer Society's CODASYL working group on database design and advisor to the British Science Museum on their Computing Gallery (Bennett, 1994). After immigrating to Australia in 1974, she has been a member of the Australian Law Reform Commission's Privacy Inquiry and the Australian Standards Association's Committee for Open Systems Interpretivist-connection. She was organising chair of the

ACS/IFIP Joint International Symposium on Information Systems (JISIS) in 1984, representative for Australian business on the NSW Department of Education's Computer Advisory Committee (1984-6), chair, NSW Software Industry Association (1985–7) and chair ACS New South Wales (Bennett,1994). Ann is a Fellow of the British Computer Society as well as a member of the Australian Computer Society. Ann established the not-for-profit network Females in Information Technology and Telecommunications (FITT, nd).

Sources: FITT n.d.; Bennett 1994; Pearcey Foundation, 2011

Spertus Secondary College

Ellen Spertus graduated from Massachutts Institute of technology with a degree in Computer Science and Engineering. She also has a Masters degree and a PhD in Electrical Engineering and Computer Science. Her PhD explored the issues of women in computer science and she found persistent discrimination against women in the field. She found that it wasn't the women being stupid, but all the barriers against them. Spertus has recently been working at Google on App Inventor for Android, a block-based development platform with a graphical user interface that lets developers and amateurs alike create applications for Android. In May 2011, the book *App Inventor* was published by O'Reilly Media, co-authored by Spertus and David Wolber, Hal Abelson, and Liz Looney.

Appendix B
Student Survey Instruments

Pre- Survey for Students

COMPUTERS AND YOU
Digital Divas Student Commencement Survey

This survey is part of a large research study aiming to find out students' beliefs about using computers. We also want to know how computers are being used by students.
The survey is divided into FOUR parts. There are no correct or incorrect answers to the questions. We are only interested in your personal opinion. Your answers will be kept confidential.

You can complain about the study if you don't like something about it. To complain about the study, you need to phone 9905 5490. You can then ask to speak to the secretary of the Human Ethics Committee and tell him or her that the number of the project is **CF09/2617 - 2009001507**. You could also write to the secretary. That person's email address is: muhrec@adm.monash.edu.au

Postal address: The Secretary, Human Ethics, Monash Research Office, Building 3E, Room 111, Monash University, Clayton 3800, Victoria.

Part 1: About You

For each of the following questions, please indicate your response by filling in the spaces or by marking the appropriate boxes with a cross. e.g. ☒

1.1 Your name:

1.2 Your year level: ☐ 7 ☐ 8 ☐ 9 ☐ 10

1.3 Your home postcode:

1.4 The name of your school:

1.5 Do you regularly speak a language other than English at home? ☐ Yes ☐ No

1.6 Are you an Aboriginal or Torres Strait Islander? ☐ Yes ☐ No

For each of these questions, please cross a number from 1 to 5, where 5 = excellent, 4 = good, 3 = average, 2 = below average, 1 = weak

1.7 How good are you at computing? ☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1

1.8 How good would you like to be at computing? ☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1

1.9 How good do your parents think you are at computing? ☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1

1.10 Where would your computing teacher put you on this scale? ☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1

1.11 Where would your mother put you on this scale? ☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1

1.12 Where would your father put you on this scale? ☐ 5 ☐ 4 ☐ 3 ☐ 2 ☐ 1

Part 2: About You and Computers at home and at school

2.1 How many computers are there in your home? ☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ More than 4

IF YOU HAVE A COMPUTER AT HOME, answer **all questions** below.

IF YOU DO NOT HAVE A COMPUTER AT HOME, go to Q2.17

2.2 Do you use the computer(s) at home? ☐ Yes ☐ No

2.3a Do you have your **own** computer at home? ☐ Yes ☐ No

2.3b If you have to share a computer at home, do you get as much time to use the computer as you would like? ☐ Yes ☐ No

2.4 Are you connected to the Internet from ANY of the computer(s) at home? ☐ Yes ☐ No

1.

Listed below are examples of computer activities you might use ***at home*** for **school work** or **just for fun**. For each, indicate **Yes** or **No** if you use *at home* for **School work** and if you use it at home **Just for fun**.

	Activity at HOME for:	School work		Just for fun	
2.5	Games	☐ Yes	☐ No	☐ Yes	☐ No
2.6	Web browser (*e.g. Netscape, Groove, Firefox, Safari*)	☐ Yes	☐ No	☐ Yes	☐ No
2.7	Social networking (*e.g. Facebook, YouTube, online games*)	☐ Yes	☐ No	☐ Yes	☐ No
2.8	E-mail (*e.g. gmail, hotmail, yahoo*)	☐ Yes	☐ No	☐ Yes	☐ No
2.9	Word processor (*e.g. Word*)	☐ Yes	☐ No	☐ Yes	☐ No
2.10	Spreadsheet (*e.g. Excel*)	☐ Yes	☐ No	☐ Yes	☐ No
2.11	Presentation software(*e.g. Powerpoint*)	☐ Yes	☐ No	☐ Yes	☐ No
2.12	Photo/Video Editing (*e.g. Photoshop, Movie Maker*)	☐ Yes	☐ No	☐ Yes	☐ No
2.13	Web design (*e.g. HTML Coding*)	☐ Yes	☐ No	☐ Yes	☐ No
2.14	Entertainment Downloading (*e.g. Music, Movies*)	☐ Yes	☐ No	☐ Yes	☐ No
2.15	Blogging	☐ Yes	☐ No	☐ Yes	☐ No
2.16	Other computer software you use:	☐ Yes	☐ No	☐ Yes	☐ No
	Software name(s):				

2.17 How many hours per week do you use a computer at home?

☐ None ☐ 1-5 hours ☐ 6-10 hours ☐ 11-15 hours ☐ 16 or more

2.18 How many hours per week do you use a computer at school?

☐ None ☐ 1-5 hours ☐ 6-10 hours ☐ 11-15 hours ☐ 16 or more

2.19 What do you think you will be doing in the Digital Divas class?

2.20 Is there anything in particular you would really like to learn about in the Digital Divas class?

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Part 3: Computers and YOU

Listed below are a number of statements. Your opinion about each is important to us.
For each statement please indicate one of the following responses:
Strongly Agree, Agree, Not Sure, Disagree, Strongly Disagree

		Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
3.1	Teachers think it is important to use computers for learning	☐	☐	☐	☐	☐
3.2	If something goes wrong on the computer I panic	☐	☐	☐	☐	☐
3.3	People who work in computing work alone	☐	☐	☐	☐	☐
3.4	I am confident using the computer for communicating with people	☐	☐	☐	☐	☐
3.5	Boys are better than girls at fixing a computer	☐	☐	☐	☐	☐
3.6	I want to study computing as part of my VCE	☐	☐	☐	☐	☐
3.7	I think computing subjects are very interesting	☐	☐	☐	☐	☐
3.8	My parents encourage me to use computers	☐	☐	☐	☐	☐
3.9	I am confident that I can master anything on a computer that is needed for school work	☐	☐	☐	☐	☐
3.10	Girls are more likely than boys to ask for help when they are not sure what to do next when working on the computer	☐	☐	☐	☐	☐
3.11	Girls find it easier to work with a new program than boys	☐	☐	☐	☐	☐
3.12	I find it easy to teach myself how to use a new program	☐	☐	☐	☐	☐
3.13	Boys are more suited than girls to work in the computer industry	☐	☐	☐	☐	☐
3.14	I would like a job working with computers when I finish studying	☐	☐	☐	☐	☐
3.15	My school is enthusiastic about students using computers	☐	☐	☐	☐	☐
3.16	I feel nervous when I have to learn something new on the computer	☐	☐	☐	☐	☐
3.17	I would like it if people thought of me as a computer geek	☐	☐	☐	☐	☐
3.18	I don't understand how some people can get so involved with computers	☐	☐	☐	☐	☐
3.19	I enjoy thinking up new ideas and examples to try out on a computer	☐	☐	☐	☐	☐
3.20	I would like a job specifically in the computing industry after I finish studying	☐	☐	☐	☐	☐
3.21	If I can avoid using a computer I will	☐	☐	☐	☐	☐
3.22	Boys are better than girls at working with computers	☐	☐	☐	☐	☐
3.23	Girls are better than boys at setting up a new computer	☐	☐	☐	☐	☐
3.24	A person who works in computing often makes a lot of money	☐	☐	☐	☐	☐
3.25	I have to work hard to do well in computing	☐	☐	☐	☐	☐
3.26	I am good at fixing computer problems	☐	☐	☐	☐	☐
3.27	I feel confident using computers at home	☐	☐	☐	☐	☐
3.28	I would like a job working with computers when I leave school	☐	☐	☐	☐	☐
3.29	People who are really good at computing are popular	☐	☐	☐	☐	☐
3.30	I will work at a computer for long periods of time to successfully complete a task	☐	☐	☐	☐	☐
3.31	I like to play around with the computer	☐	☐	☐	☐	☐
3.32	Kids who are good with computers are admired	☐	☐	☐	☐	☐
3.33	Using a computer makes learning more enjoyable	☐	☐	☐	☐	☐

Part 4: Computing Careers and Jobs

4.1 Please draw a picture of someone who works in the computing industry and what they are doing:

4.2 Please describe the person and explain what is happening in the picture:

4.3 What do you think you would like about a job in computing?

4.4 What do you think you would NOT like about a job in computing?

Thank you for your participation

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4.

Post- Survey for Students

Post Digital Divas Student Survey

This survey is part of a large research study aiming to find out students' beliefs about using computers. We also want to know how you have found the Digital Divas program.

There are no correct or incorrect answers to the questions. We are only interested in your personal opinion. Your answers will be kept confidential.

You can complain about the study if you don't like something about it. To complain about the study, you need to phone 9905 5490. You can then ask to speak to the secretary of the Human Ethics Committee and tell him or her that the number of the project is **CF09/2617 - 2009001507**. You could also write to the secretary. That person's email address is: muhrec@adm.monash.edu.au
Postal address: The Secretary, Human Ethics, Monash Research Office, Building 3E, Room 111, Monash University, Clayton 3800, Victoria.

For each of the following questions, please indicate your response by filling in the spaces or by marking the appropriate boxes with a cross. e.g. ☒

Part 5: Thinking about Digital Divas

Your name:

5.1 Overall, did you enjoy being in Digital Divas? ☐ Yes ☐ No

5.2 What did you like most about Digital Divas?

Why?

5.3 What did you like least about Digital Divas?

Why?

5.4 What was the most interesting thing you learnt during Digital Divas?

Why was it interesting?

5.5 What was the most difficult activity?

What made it difficult?

5.6 What did you learn from the guest speakers?

1.

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5.7 What did you learn from the University student?

5.8 Did you learn about jobs/careers in IT? ☐ Yes ☐ No
Please explain:

5.9 Have you spoken to others about careers in IT? ☐ Yes ☐ No
If yes, provide details:

5.10 Have your ideas about girls and computers changed? ☐ Yes ☐ No
Why?

5.11 Has your confidence with computers changed? ☐ Yes ☐ No
Please explain:

5.12 Would you choose IT as a subject to study in VCE? ☐ Yes ☐ No
Why?

5.13 What have you told your friends/parents about Digital Divas?

5.14 Would you recommend Digital Divas to your friends? ☐ Yes ☐ No
Why?

5.15 What have you learnt that you are likely to use again?

[redacted]

Part 6: Computers and YOU

Listed below are a number of statements. Your opinion about each is important to us.
For each statement please indicate one of the following responses:
Strongly Agree, Agree, Not Sure, Disagree, Strongly Disagree

		Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
6.1	Teachers think it is important to use computers for learning	☐	☐	☐	☐	☐
6.2	If something goes wrong on the computer I panic	☐	☐	☐	☐	☐
6.3	People who work in computing work alone	☐	☐	☐	☐	☐
6.4	I am confident using the computer for communicating with people	☐	☐	☐	☐	☐
6.5	Boys are better than girls at fixing a computer	☐	☐	☐	☐	☐
6.6	I want to study computing as part of my VCE	☐	☐	☐	☐	☐
6.7	I think computing subjects are very interesting	☐	☐	☐	☐	☐
6.8	My parents encourage me to use computers	☐	☐	☐	☐	☐
6.9	I am confident that I can master anything on a computer that is needed for school work	☐	☐	☐	☐	☐
6.10	Girls are more likely than boys to ask for help when they are not sure what to do next when working on the computer	☐	☐	☐	☐	☐
6.11	Girls find it easier to work with a new program than boys	☐	☐	☐	☐	☐
6.12	I find it easy to teach myself how to use a new program	☐	☐	☐	☐	☐
6.13	Boys are more suited than girls to work in the computer industry	☐	☐	☐	☐	☐
6.14	I would like a job working with computers when I finish studying	☐	☐	☐	☐	☐
6.15	My school is enthusiastic about students using computers	☐	☐	☐	☐	☐
6.16	I feel nervous when I have to learn something new on the computer	☐	☐	☐	☐	☐
6.17	I would like it if people thought of me as a computer geek	☐	☐	☐	☐	☐
6.18	I don't understand how some people can get so involved with computers	☐	☐	☐	☐	☐
6.19	I enjoy thinking up new ideas and examples to try out on a computer	☐	☐	☐	☐	☐
6.20	I would like a job specifically in the computing industry after I finish studying	☐	☐	☐	☐	☐
6.21	If I can avoid using a computer I will	☐	☐	☐	☐	☐
6.22	Boys are better than girls at working with computers	☐	☐	☐	☐	☐
6.23	Girls are better than boys at setting up a new computer	☐	☐	☐	☐	☐
6.24	A person who works in computing often makes a lot of money	☐	☐	☐	☐	☐
6.25	I have to work hard to do well in computing	☐	☐	☐	☐	☐
6.26	I am good at fixing computer problems	☐	☐	☐	☐	☐
6.27	I feel confident using computers at home	☐	☐	☐	☐	☐
6.28	I would like a job working with computers when I leave school	☐	☐	☐	☐	☐
6.29	People who are really good at computing are popular	☐	☐	☐	☐	☐
6.30	I will work at a computer for long periods of time to successfully complete a task	☐	☐	☐	☐	☐
6.31	I like to play around with the computer	☐	☐	☐	☐	☐
6.32	Kids who are good with computers are admired	☐	☐	☐	☐	☐
6.33	Using a computer makes learning more enjoyable	☐	☐	☐	☐	☐

[redacted]

Part 7: Computing Careers and Jobs

7.1 What do you think you would like about a job in computing?

7.2 What do you think you would NOT like about a job in computing?

Thank you for your participation

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4.

Appendix C
Teacher Survey Instruments

Pre- Survey for Teachers

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Pre Digital Divas: Teacher Survey

This survey is part of a large research study aiming to find out the effect of the implementation of the Digital Divas Program.
The survey is divided into FOUR parts. There are no correct or incorrect answers to the questions. We are only interested in your personal opinion. Your answers will be kept confidential.

You can complain about the study if you don't like something about it. To complain about the study, you need to phone 9905 5490. You can then ask to speak to the secretary of the Human Ethics Committee and tell him or her that the number of the project is **CF09/2617 - 2009001507**. You could also write to the secretary. That person's email address is: muhrec@adm.monash.edu.au
Postal address: The Secretary, Human Ethics, Monash Research Office, Building 3E, Room 111, Monash University, Clayton 3800

Part 1: About You

For each of the following questions, please indicate your response by filling in the spaces or by marking the appropriate boxes with a cross. e.g. ☒

1.1 Name of your school:

1.2 Your gender: ☐ Female ☐ Male

1.3 Please cross which year level your Digital Divas program is aimed at: ☐ 8 ☐ 9 ☐ 10

1.4 Please list the positions of responsibilities you currently hold at your school (e.g., curriculum coordinator, year 8 coordinator, ICT coordinator, class teacher):

1.5 Including this year, how many years have you been teaching?

1.6 Including this year, how many years have you been teaching in your present school?

1.7 Including this year, how many years have you been teaching ICT?

1.8 What subjects other than ICT do you teach this year?

1.9 Please indicate all the year levels in which you have ever taught ICT: ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12

1.10 Have you ever worked in the ICT industry? ☐ Yes ☐ No
If Yes, please describe:

1.11 Before you started teaching, how many semester length units of ICT did you study at the tertiary level? _____

1.12 Was ICT education (e.g. computing method) a component of your teacher education program? ☐ Yes ☐ No

1.13 Since completing your initial education program, have you taken any subsequent tertiary study in ICT? ☐ Yes ☐ No

1.14 Since completing your initial education program, have you taken any subsequent tertiary study in ICT education? ☐ Yes ☐ No

1.15 Since completing your initial education program, have you taken any short courses or professional development (in-house or external) in teaching ICT? ☐ Yes ☐ No
If Yes, please describe:

Even though you have had some professional development in teaching ICT, would you like further professional development? ☐ Yes ☐ No
Please elaborate:

		High		Moderate		Low
1.16	How would you rate your computer skills?	☐	☐	☐	☐	☐
1.17	How would you rate your enjoyment of teaching ICT?	☐	☐	☐	☐	☐

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Part 2: Computers in Your School

2.1 Please indicate what you think is the priority given to computer education within your school? ☐ High priority ☐ ☐ Moderate priority ☐ ☐ Low priority

2.2 How are computers organised in your school? Please indicate one or more responses

- ☐ Laboratories
- ☐ Cluster/pods of machines in classrooms
- ☐ Students own or lease computers/lap-top programme
- ☐ No school computing resources
- ☐ Some other way. Please state:

_____

2.3 Please select at which levels ICT is offered as a separate subject/elective in your school: ☐ 7 ☐ 8 ☐ 9 ☐ 10

2.4 Please indicate which senior ICT subjects are offered this year at your school:

VCE Subject	Yes	No	Don't know	VET/VCAL Please list
Unit 1: IT in action	☐	☐	☐	_____
Unit 2: IT pathways	☐	☐	☐	_____
Unit 3 and 4: IT applications	☐	☐	☐	_____
Unit 3 and 4: Software Development	☐	☐	☐	_____

Part 3: Your views: Girls, boys and ICT

3.1 Who is more confident using ICT? ☐ Boys ☐ Girls ☐ No difference ☐ Depends

Please explain your response _____

3.2 Who is more competent using ICT? ☐ Boys ☐ Girls ☐ No difference ☐ Depends

Please explain your response _____

3.3 Who is more interested/enthusiastic about ICT? ☐ Boys ☐ Girls ☐ No difference ☐ Depends

Please explain your response _____

3.4 In ICT classes you have taught in the past, have you observed boys and girls behaving differently with respect to the hardware? ☐ Yes ☐ No ☐ Sometimes

Please explain your response _____

3.5 In ICT classes you have taught in the past, have you observed boys and girls behaving differently with respect to the ICT activities in which they engage? ☐ Yes ☐ No ☐ Sometimes

Please explain your response _____

3.6 To whom are the ICT tasks used in classes in your school more likely to appeal? ☐ Boys ☐ Girls ☐ No difference ☐ Depends

Please explain your response _____

3.7 It is generally believed that girls are less likely than boys to consider ICT as a career. What do you believe can be done to encourage girls' involvement and interest in ICT?

_____

Part 4: The Digital Divas Program

4.4 Please explain why you have agreed to implement the Digital Divas program?

_____

4.5 What would success in the Digital Divas program look like to you?

_____

Is there anything else?

_____

THANK YOU FOR YOUR HELP

Post- Survey for Teachers

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Post Digital Divas: Teacher Survey

This survey is part of a large research study aiming to find out the effect of the implementation of the Digital Divas Program.

There are no correct or incorrect answers to the questions. We are only interested in your personal opinion. Your answers will be kept confidential.

You can complain about the study if you don't like something about it. To complain about the study, you need to phone 9905 5490. You can then ask to speak to the secretary of the Human Ethics Committee and tell him or her that the number of the project is **CF09/2617 - 2009001507**. You could also write to the secretary. That person's email address is: muhrec@adm.monash.edu.au
Postal address: The Secretary, Human Ethics, Monash Research Office, Building 3E, Room 111, Monash University, Clayton 3800

For each of the following questions, please indicate your response by filling in the spaces or by marking the appropriate boxes with a cross. e.g. ☒

5.1 How many students were enrolled in your Digital Divas class? ☐☐

5.2 Which units/topics did the students enjoy the most/least?

Why?

5.3 Which units/topics did the students find most/least engaging?

Why?

5.4 With which units/topics were the students most/least confident?

Why?

5.5 What do you think was the most useful activity?

Why?

5.6 How useful was the University student?

5.7 Do you think the students understood the relationship between what they were doing in class and ICT jobs? ☐ Yes ☐ No

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5.8 Have any of the students asked for information about future ICT study? ☐ Yes ☐ No

Please give details:

5.9 In your opinion will more students go on to study ICT as a result of Digital Divas? ☐ Yes ☐ No

Why?

5.10 If you were to change the Digital Divas program what would you do differently?

Why?

5.11 Was the Digital Divas program a success? ☐ Yes ☐ No

Please elaborate:

5.12 How were the girls selected who took part in Digital Divas?

Please elaborate:

5.13 Please list all the modules you covered this semester:

Anything else?

Please write about any facet of your experience with Digital Divas that you would like to tell us about or to expand upon:

THANK YOU FOR YOUR HELP

Appendix D
Focus Group and Interview Instruments

Pre- Focus Group Questions for Girls

1. What sorts of activities do you enjoy most on the computer?
2. What do you predominately use the computer for? School assignments? Keeping in touch with friends? Etc. …
3. Do you think that more boys than girls study ICT subjects at school? If yes, why do you think this is the case?
4. Does working in an ICT job appeal to you? Why? Why not?
5. Do you know any women who work in ICT? If yes, what do you think they do? What do you think their day looks like?
6. How confident do you feel when asked to complete technology tasks?
7. How important are ICT skills in everyday life?
8. How important are ICT skills in society generally?

Post- Focus Group Questions for Girls

1. What was the best thing about Digital Divas?
2. What was the best thing or the worst thing?
3. What would be the improvement, so can you make a suggestion? How do you think?
4. What did you learn that you didn't learn before or you didn't know before?
5. Are you aware of any job opportunities in IT in the future? Did you get any perspectives on that?
6. Do you want to share whatever the highlights of that? What did you learn?
7. So they have introduced different types of IT jobs?
8. What about the study pathways?
9. Was it informative?
10. Are you aware of any job opportunities in IT?
11. Do you recommend Digital Divas classes to any other students?

12. How would you modify it (Digital Divas) if you wanted to suggest to another student?
13. How confident are you now? Has it grown on you?
14. Have your ideas changed about women's role in IT by any chance?
15. Anything else that you'd like to add to make this project a better project, do you want to just give your idea, everybody please? Anything you can suggest anything is fine.
16. Would you choose IT subjects next year?
17. How would you choose IT if you want to do IT, what would it be?

Focus Group Questions for Girls who Completed the Program One or Two Years Previously

1. What do you remember about the Digital Divas Club program you completed?
2. What was the best thing about Digital Divas?
3. What was the worst thing about Digital Divas?
4. Are you more confident now in using computers compared with before you did the Digital Divas class?
5. Do you recall who the university student was that came to the Digital Divas class? What was she doing at university and what sort of job do you think she may have ended up working in?
6. Do you believe IT is a career best suited to males or females? Can you explain your answer?
7. Are you considering a future course or career in ICT? If the answer is yes, please explain why. If not, why not?
8. What career has your careers teacher advised you to pursue? Why?
9. What career has your parents or family advised you to pursue? Why?

Pre- Interview Unstructured Questions for Teachers

1. How would you describe the ICT experience of a 'typical' secondary school student?
2. How is ICT promoted in your school?
3. What do you expect will be the benefits for the girls who participate in DD?

4. What do you see as the benefits for your school in participating in DD?
5. Do you anticipate any problems with implementing DD in your school?
6. Do you think there are any issues that you, as the teacher, may encounter as a result of conducting a single-sex class in your school? If so, what strategies can you use to deal with these issues?
7. Do you anticipate any issues that participating girls may encounter due to selecting a single-sex ICT class in your school? If so, what strategies could they use to deal with these issues?
8. Which types of ICT tasks are most appealing to secondary school girls? Why?
9. In your experience, are there any particular characteristics that students who engage with ICT possess?

Post- Unstructured Interview Questions for Teachers

1. How did Digital Divas go overall do you think?
2. What would you say they were the best aspects of DD, that it expanded their horizons, they learnt about different applications, so what was the very best thing do you think?
3. Was there any worst aspect, were there any negatives that you can think of?
4. Overall were the girls very engaged?
5. Can you identify specifically what the girls enjoyed the most?
6. So which modules did you cover? You did Fab and Famous and the first one the logo one is that right?
7. Did they really enjoy the second one the most?
8. Was there good progression from gaining skills from the first module and applying those skills to the second one?
9. How would you describe your own level of engagement and enjoyment of the program?
10. Was there a fairly high level of engagement and enjoyment?
11. Were there any impediments to this do you think?
12. Was the Expert Diva a help to you?
13. Did the Expert Diva have the IT expertise to assist the girls?

14. On another level do you think she (Expert Diva) had an effect say as a role model in turning around ideas, their attitudes
15. She was very effective then and really helpful in the classroom and related well to the girls?
16. Was time an impediment getting in the way of doing more?
17. Anything else that was constraining?
18. Do you think the program was successful in terms of changing girls' attitudes to IT?
19. Do you feel the girls are more confident?
20. Do you think more girls will select IT subjects next year or down the track?
21. Are the girls now more aware of careers in IT?
22. How affective was the strategy of incorporating Expert Divas into the program?
23. How effective was the use of guest speakers?
24. Did you feel adequately supported by the Digital Divas team?
25. Did you find the materials easy to access and clear?
26. Was it quite user friendly do you think?
27. Overall were your expectations realised and did you achieve what you hoped to achieve?
28. Good. Do you have any suggestions as to how DD could be improved at all?
29. Will your school continue with Digital Divas next year?
30. Is there anything else you'd like to say about the project?
31. Was it a steep learning curve for you or not? As you went along you grasped the ideas anyway?

Expert Diva Weekly Reflection Questions

1. Which module is the class working on this week?
2. Describe your contribution to the class you attended.
3. What went well? What didn't work well?
4. How engaged were the girls overall, on a scale of 1–10? (1 = unengaged, 10 = extremely engaged.)
5. Any other comments or reflections?

Post- Interview Questions for Expert Divas

1. How do you think it went overall? Did you enjoy the experience?
2. Was it what you expected?
3. What did you enjoy most about being an Expert Diva?
4. Was there anything that you didn't enjoy?
5. Was there anything else? Nothing negative?
6. So you just enjoyed the whole experience?
7. Where there any challenges at all?
8. Did you feel well prepared for your role?
9. Did the induction give you an idea of what to expect?
10. How effective, appropriate or engaging do you think the modules were for teaching girls?
11. Which module do you think they enjoyed the most?
12. Is there anything that we, the Digital Divas research team, could change or do better or differently to improve your experience as an Expert Diva?
13. How successful do you think the strategy of placing Expert Divas in schools is, in terms of you being a role model and influencing the girls' attitudes?
14. Is there anything else you'd like to say about the Digital Divas project?
15. Do you think you grew in confidence as you went along?

Appendix E
Wider Community Survey Instruments

Parent questionnaire

Community Survey: Parent

This survey is part of a large research study aiming to find out parents' beliefs about using computers. We also want to know how computers are being used by parents. There are no correct or incorrect answers to the questions. We are only interested in your personal opinion. Your answers will be kept confidential.

You can complain about the study if you don't like something about it. To complain about the study, you need to phone 9905 5490. You can then ask to speak to the secretary of the Human Ethics Committee and tell him or her that the number of the project is **CF09/2617 - 2009001507**. You could also write to the secretary. That person's email address is: muhrec@adm.monash.edu.au

Postal address: The Secretary, Human Ethics, Monash Research Office, Building 3E, Room 111, Monash University, Clayton 3800, Victoria.

For each of the following questions, please indicate your response by filing in the spaces or by marking the appropriate boxes with a cross. e.g. ☒

1. The name of your child's school: _____

2. About your family:

	Gender	Age	Year level	Computer skills					Enjoyment of computers				
				Very High	High	Moderate	Low	Very Low	Very High	High	Moderate	Low	Very Low
Child 1				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Child 2				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Child 3				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Child 4				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
Child 5				☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

3. About yourself:

3.1 Your gender: ☐ Male ☐ Female

3.2 Your age: ☐ Under 20 ☐20-29 ☐30-39 ☐40-49 ☐ 50-59 ☐60-69 ☐70-79 ☐80+

3.3 Do you regularly speak a language other than English at home? ☐ No ☐ Yes - which language? _____

3.4 Highest level of education: ☐ Primary School ☐ Year 10 ☐ VCE ☐ Certificate (incl trade certificates, apprenticeships, etc) ☐ Diploma ☐Degree ☐Post Graduate

3.5 Your occupation:

☐ Not currently in paid employment ☐Technician and trades worker ☐ Sales worker
☐ Manager ☐ Community & personal service worker ☐ Machine operator or driver
☐ Professional ☐ Clerical and administrative worker ☐ Labourer

3.6 Industry in which you are currently employed:

☐ Not currently in paid employment ☐ Retail trade ☐ Administrative and support services
☐ Agriculture, forestry and fishing ☐ Accommodation and food services ☐ Public administration and safety
☐ Mining ☐ Transport, postal and warehousing ☐ Education and training
☐ Manufacturing ☐ Information, media and telecommunications ☐ Health care and social assistance
☐ Electricity, gas, water and waste services ☐ Financial and insurance services ☐ Arts and recreation services
☐ Construction ☐ Rental, hiring and real estate services ☐ Other services
☐ Wholesale trade ☐ Professional, scientific and technical services

3.7 Your computer skills: ☐ Very High ☐ High ☐ Moderate ☐ Low ☐ Very Low

3.8 Have you ever studied computers? ☐ Yes Please describe (short course, professional development, etc) _____

☐ No Would you like to? ☐ Yes ☐ No

3.9 How many hours per week do you use a computer at home? ☐ None ☐1-5 ☐6-10 ☐11-15 ☐16 -20 ☐21-25 ☐26 -30 ☐31+

3.10 How many hours per week do you use a computer at work? ☐ None ☐1-5 ☐6-10 ☐11-15 ☐16 -20 ☐21-25 ☐26 -30 ☐31+

3.11 How many hours per week do you watch TV? ☐ None ☐1-5 ☐6-10 ☐11-15 ☐16 -20 ☐21-25 ☐26 -30 ☐31+

4. Your opinion about boys, girls and computers:

	Boys	Girls	No difference	Please explain your response
4.1 Who is more confident using computers?	☐	☐	☐	
4.2 Who is more competent using computers	☐	☐	☐	
4.3 Who is more interested/enthusiastic about computers?	☐	☐	☐	

4.4 Listed below are a number of statements. **Your opinion** about each is important to us.

For each statement please indicate one of the following responses:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Using a computer makes learning more enjoyable	☐	☐	☐	☐	☐
Computing professionals have a lot of outside interests	☐	☐	☐	☐	☐
Boys are better than girls at fixing a computer	☐	☐	☐	☐	☐
I think computing is very interesting	☐	☐	☐	☐	☐
Girls are more likely than boys to ask for help with computers	☐	☐	☐	☐	☐
Girls find it easier to work with a new program than boys	☐	☐	☐	☐	☐
Boys are more suited than girls to work in the computer industry	☐	☐	☐	☐	☐
My child's school is enthusiastic about students using computers	☐	☐	☐	☐	☐
People who work in computing work alone	☐	☐	☐	☐	☐
I would like it if people thought of me as a computer geek	☐	☐	☐	☐	☐
Boys are better than girls at working with computers	☐	☐	☐	☐	☐
Girls are better than boys at setting up a new computer	☐	☐	☐	☐	☐
A person who works in computing makes a lot of money	☐	☐	☐	☐	☐
People have to be very hard working if they want to work in the computer industry	☐	☐	☐	☐	☐
Computing jobs are good for people with families	☐	☐	☐	☐	☐
People who are really good at computing are popular	☐	☐	☐	☐	☐
Computing professionals work in teams	☐	☐	☐	☐	☐
I would like my daughter to have a job in the computer industry	☐	☐	☐	☐	☐
I would like my son to have a job in the computer industry	☐	☐	☐	☐	☐

4.5 Which TV shows do you watch that involve computer experts?

4.6 Can you name any females on TV who are computer experts or need computers for their jobs?

4.7 It is generally believed that girls are less likely than boys to consider computing as a career. What do you believe can be done to encourage girls' involvement and interest in computing?

4.8 If you are interested in participating in a 30 minute focus group about girls and computing careers with other parents from your child's school, please write your name and email address or phone number and you will be contacted shortly:

_____

Thank you for your participation

Teacher Questionnaire

Part 1

My name is Amber McLeod and I am conducting a research project with Associate Professor Helen Forgasz from Monash University and Dr Catherine Lang from Swinburne University towards a PhD.

This research is associated with the "Digital Divas" program run at your school and you have followed a link to this survey from an email containing an explanatory statement about the study. Completion of this voluntary, anonymous survey implies consent to participate in the study.

There are 5 pages of questions and it will take approximately 10 minutes. There are no correct or incorrect answers to the questions. I am only interested in your personal opinion. Thank you for your help.

If you have a complaint concerning the manner in which this research, number CF09/2617 - 2009001507, is being conducted please contact:

The Secretary, Human Ethics
Monash Research Office
Building 3e Room 111
Research Office
Monash University VIC 3800
Tel: 9905 5490
Email: muhrec@adm.monash.edu.au

Please enter the name of your school:

What is your gender?	What is your age?	How many years have you been teaching?	Please indicate all the year levels in which you have ever taught: 7	8	9	10	11	12
▾	▾	.	☐	☐	☐	☐	☐	☐

Please list your methods from your teaching qualification:	Please list the subjects you have ever taught:	Please list the positions of responsibility you currently hold at your school (e.g. Year 8 coordinator, class teacher):

	Yes	No	If yes, please describe:
Have you ever studies Information Technology at a tertiary level?	○	○	
Have you ever taken any short courses or professional development (in-house or external) in computing?	○	○	
Would you like some (more) professional development in computing?	○	○	

	Yes	No	By whom?
Have you been encouraged to use computers in your classes?	○	○	

	High		Moderate		Low
Please indicate what you think is the priority given to computer education within your school.	○	○	○	○	○
How would you rate your computer skills?	○	○	○	○	○
How would you rate your enjoyment of using computers in the classroom?	○	○	○	○	○

	0 hours	1-5 hours	6-10 hours	11-15 hours	16-20 hours	21-25 hours	26-30 hours	31+ hours
How many hours per week do you use a computer at home?	○	○	○	○	○	○	○	○
How many hours per week do you use a computer at work (administration, class preparation)?	○	○	○	○	○	○	○	○
How many hours per week do you use a computer in class?	○	○	○	○	○	○	○	○
How many hours per week do you watch television?	○	○	○	○	○	○	○	○

In classes you have taught in the past, have you observed boys and girls behaving differently with respect to:

	Yes	No	Sometimes	Please explain your response
the computer hardware?				
the computing activities in which they engage?				
any other aspect of computing?				

	Boys	Girls	No difference	Please explain your response
Who is more confident using computers?				
Who is more competent using computers				
Who is more interested/enthusiastic about computers?				
To whom are the computing tasks used in your classes more likely to appeal?				

Listed below are a number of statements. Your opinion about each is important to us.
For each statement please indicate one of the following responses:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Using a computer makes learning more enjoyable					
Computing professionals have a lot of outside interests					
Boys are better than girls at fixing a computer					
I think computing subjects are very interesting					
Girls are more likely than boys to ask for help with computers					
Girls find it easier to work with a new program than boys					
Boys are more suited than girls to work in the computer industry					
My school is enthusiastic about students using computers					
People who work in computing work alone					
I would like it if people thought of me as a computer geek					
Boys are better than girls at working with computers					
Girls are better than boys at setting up a new computer					
A person who works in computing makes a lot of money					
People have to be very hard working if they want to work in the computer industry					
Computing jobs are good for people with families					
People who are really good at computing are popular					
Computing professionals work in teams					
My female students' parents want them to use computers					
My male students' parents want them to use computers					

Which TV shows do you watch that involve computer experts?

Can you name any females on TV who are computer experts or need computers for their jobs?

It is generally believed that girls are less likely than boys to consider computing as a career. What do you believe can be done to encourage girls' involvement and interest in computing?

Anything Else?
Please write about any facet of your experience of using computers in your classes that you would like to tell us about or to expand upon:

If you are interested in participating in a 30 minute focus group about girls and computing careers with other teachers from your school, please enter your name and email address or phone number and you will be contacted shortly:

Student Questionnaire

Community Survey: Student

This survey is part of a large research study aiming to find out students' beliefs about using computers. We also want to know how computers are being used by students. There are no correct or incorrect answers to the questions. We are only interested in your personal opinion. Your answers will be kept confidential.

You can complain about the study if you don't like something about it. To complain about the study, you need to phone 9905 5490. You can then ask to speak to the secretary of the Human Ethics Committee and tell him or her that the number of the project is **CF09/2617 - 2009001507**. You could also write to the secretary. That person's email address is: muhrec@adm.monash.edu.au

Postal address: The Secretary, Human Ethics, Monash Research Office, Building 3E, Room 111, Monash University, Clayton 3800, Victoria.

For each of the following questions, please indicate your response by filing in the spaces or by marking the appropriate boxes with a cross. e.g. ☒

1. The name of your school: _____

2. About yourself

2.1 Gender?	2.2 Age?	2.3 Year Level?	2.4 Do you regularly speak a language other than English at home? ☐Yes ☐ No
☐ Male ☐ Female			If yes, which language?

For each of these questions, please indicate one of the following responses:	Excellent	Good	Average	Below average	Weak
2.5 How good are you at computing?	☐	☐	☐	☐	☐
2.6 How good would you like to be at computing?	☐	☐	☐	☐	☐
2.7 Where would your teachers put you on this scale?	☐	☐	☐	☐	☐
2.8 How competent is your mother with computers?	☐	☐	☐	☐	☐
2.9 How competent is your father with computers?	☐	☐	☐	☐	☐
2.10 How competent are your teachers with computers?	☐	☐	☐	☐	☐

	None	1-5	6-10	11-15	16-20	21-25	26-30	31+
2.11 How many hours per week do you use a computer at home?	☐	☐	☐	☐	☐	☐	☐	☐
2.12 How many hours per week do you use a computer at school?	☐	☐	☐	☐	☐	☐	☐	☐
2.13 How many hours per week do you watch TV?	☐	☐	☐	☐	☐	☐	☐	☐
2.14 How many hours per week do you use the internet on your mobile phone?	☐	☐	☐	☐	☐	☐	☐	☐

2.15 List the main programs you use (e.g. You tube, Excel, Movie maker, games)_____

2.16 Do you use computers for homework? ☐ Always ☐ Occasionally ☐ Never ☐ If I have to

2.17 List the classes in which you use computers: _____

2.18 In the future, where would you like to learn more about computers (you may tick more than one box)

☐ VCE ☐ University ☐ TAFE ☐ Short course ☐ I don't want to learn anything about computers

3. Boys, girls and computers

	Boys	Girls	No difference	Why?
3.1 Who is more confident using computers?	☐	☐	☐	
3.2 Who is more competent using computers?	☐	☐	☐	
3.3 Who is more interested/ enthusiastic about computers?	☐	☐	☐	

3.4 Which TV shows do you watch that involve computers?_____

3.5 Can you name any females on TV who are computer experts or need computers for their jobs?

_____

3.6 Listed below are a number of statements. Your opinion about each is important to us.

For each statement please indicate one of the following responses:	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Using a computer makes learning more enjoyable	☐	☐	☐	☐	☐
Computing professionals have a lot of outside interests	☐	☐	☐	☐	☐
Boys are better than girls at fixing a computer	☐	☐	☐	☐	☐
I think computing is very interesting	☐	☐	☐	☐	☐
Girls are more likely than boys to ask for help with computers	☐	☐	☐	☐	☐
Girls find it easier to work with a new program than boys	☐	☐	☐	☐	☐
Boys are more suited than girls to work in the computer industry	☐	☐	☐	☐	☐
My school is enthusiastic about students using computers	☐	☐	☐	☐	☐
People who work in computing work alone	☐	☐	☐	☐	☐
I would like it if people thought of me as a computer geek	☐	☐	☐	☐	☐
Boys are better than girls at working with computers	☐	☐	☐	☐	☐
Girls are better than boys at setting up a new computer	☐	☐	☐	☐	☐
A person who works in computing makes a lot of money	☐	☐	☐	☐	☐
People have to be very hard working if they want to work in the computer industry	☐	☐	☐	☐	☐
Computing jobs are good for people with families	☐	☐	☐	☐	☐
People who are really good at computing are popular	☐	☐	☐	☐	☐
Computing professionals work in teams	☐	☐	☐	☐	☐
Teachers think it is important to use computers	☐	☐	☐	☐	☐
My parents encourage me to use computers	☐	☐	☐	☐	☐
I would like a job specifically in the computing industry	☐	☐	☐	☐	☐

3.7 Please draw a picture of someone who works in the computing industry. Draw them doing something.

3.8 Please describe the person and explain what is happening in the picture:

3.9 What do you think you would like about a job in computing?

3.10 What do you think you would NOT like about a job in computing?

3.11 Do you think your teachers or parents treat you differently when it comes to computers because of your sex? ☐Yes ☐No

If yes, in what way?

3.11 Do you think your teachers or parents treat you differently when it comes to computers because of your sex? ☐Yes ☐No

If yes, in what way?

3.12 If you are interested in participating in a 30 minute focus group about girls and computing careers with other students from your school, please enter your name and email address or phone number and you will be contacted shortly:

Thank you for your participation

Group Interview Questions

1. Look at the list below. Please indicate, with an 'x' next to the word, which adjectives apply to ICT professionals.

The following list of words was provided (Gough, 1979):

Capable, Honest, Artificial, Intelligent, Clever, Well-mannered, Cautious, Wide interests, Confident, Inventive, Egotistical, Original, Commonplace, Narrow interests, Humorous, Reflective, Conservative, Sincere, Individualistic, Resourceful, Conventional, Self-confident, Informal, Sexy, Dissatisfied, Submissive, Insightful, Snobbish, Suspicious, Unconventional

2. What additional adjectives describe an ICT professional?

3. What influence do parents have on a child's interest in ICT?

4. What do you think about an all-girl computer class?

5. What do you think about the ICT characters in this clip (Bellisario, McGill, Binder, Kriozere, & Wharmby, 2011, 20:35–24:40).

6. Do you know any ICT experts? – description of job and person

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DIGITAL DIVAS

PUTTING THE WOW INTO COMPUTING FOR GIRLS

JULIE FISHER, CATHERINE LANG, ANNEMIEKE CRAIG AND HELEN FORGASZ

The geek is male. Or so it seems. As is well documented, there is a distinct under-representation of girls studying computing at high school level and, correspondingly, going on to have careers in IT.

To address this problem, in 2007 the authors of this book, with backgrounds in secondary teaching or IT, trialled a new and revolutionary program in schools: 'Digital Divas'.

The Digital Divas program, based on the idea that it was possible to change girls' perceptions of IT careers with educationally sound materials that tapped into their interests and were delivered in all-girl classes within the school curriculum, was a great success.

In *Digital Divas: Putting the Wow into Computing for Girls*, Fisher, Lang, Craig and Forgasz recount what they did and how they did it, and reflect on the significance of this program, which has indisputably led to an increased self-sufficiency with IT amongst girls, challenged stereotypical understandings of IT as a male activity, and increased the pursuit of IT careers by young women.

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