AUSTRALIAN INTERVENTIONS FOR WOMEN IN COMPUTING: ARE WE EVALUATING?

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ABSTRACT

There are many reasons why the gender imbalance in computing should be of concern to the profession. Over the last 20 years there have been many intervention programs which attempt to redress this situation and encourage more women into computing. To determine whether an intervention program has made a difference requires evaluation. Program evaluation is the careful collecting of information about a program so that those responsible can make informed decisions regarding the programs. This multi-case study investigation into 14 major programs conducted in Australia shows that many projects are not evaluated due to a lack of time, expertise and money. Without dissemination of detailed evaluations it is not possible to work out which intervention programs should be replicated and which should be modified or abandoned.

Keywords: gender, women in computing, intervention, evaluation

INTRODUCTION

The lack of women in the computing profession is an ongoing concern in many places including Europe, North America and Australia, and this has been well documented in the literature (see for example Clarke 1990; Edwards & Kay 2001; Galphin 2002; Adam, Howcroft & Richardson 2004; Klawe, Whitney & Simard 2009, Prey & Weaver 2013).

Numerous reasons why we should redress this gender imbalance are also provided in the literature. Trauth (2011, p.2) argues that the 'best brains' are not just located in the male half of the population and, hence, the industry is missing out on the skills and abilities of an underutilised resource – women. This is the 'innovation argument'. The consumer argument states that since we are living in the information society where people regularly use information products, it is critical that the needs of this diverse consumer base are all represented (Trauth 2011). For example the content we read on Wikipedia has a male perspective with 90% of Wikipedia's editors being male. This has been attributed to Wikipedia's editing interface and the Wikipedia community's method of conduct which have been found to discourage some women from contributing (Lam, Uduwage, Dong, Sen, Musicant, Terveen & Riedl 2011). Another example is the voice recognition system in new cars, which allows drivers to change features such as the radio station they are listening to, or the temperature within the vehicle, but which do not respond well to women's voices (Carty 2011). While there is no guarantee that the problems with this voice activated technology, or the issues with Wikipedia's editing interface, would have been avoided if there were more women on their development teams, it can only be more likely. Another reason for advocating greater gender balance in computing is the demographic argument. In the western world, an ageing work force, plus expected growth in the computing sector over the next ten years, will produce a demand for computing professionals which women can help fill (Panko 2008). Economic security is the fourth argument: it seems to make good economic sense that in an era where job security is less certain women have the skills to hold a variety of jobs including those in the information sector. Finally, there is the equity argument with the current under-representation limiting women's career choices (Adya & Kaiser 2005). Trauth (2011) suggests that it is a matter of fairness

that everyone should have the equivalent opportunity to pursue any career. This is not just a matter of individual choice but requires 'addressing structural barriers that are enacted through cultural norms, societal stereotypes and institutional behaviors' (Trauth 2011, p. 2).

BACKGROUND

Australian women in the computing profession are not only a small, but also a decreasing minority, with a consequential reduction in diversity and creativity within the profession.

Given the considerable efforts by many to raise the level of involvement of females in computing the lack of apparent progress raises questions regarding the efficacy of these intervention programs.

Redressing the Gender Imbalance in Computing

To attract girls to computing, and to retain women once they are in computing courses and careers, requires 'formal' programs which are established specifically to confront the factors that discourage women's participation (Wasburn & Miller 2006). Formal programs, more commonly known as intervention programs, are activities usually designed to change a state of affairs for a specific group.

Over the last twenty years many intervention programs have been conducted, in Australia and elsewhere, to support and enable females to move beyond the obstacles which had previously prevented them from being part of the field (see for example Craig, Fisher, Scollary & Singh 1998, Clayton & Lynch 2002, Neilsen & Beekhuyzen 2009; Miliszewska & Moore 2010; Ross, Litzler, Cohoon & Sanders 2012, Clayton, Beekhuyzen & Neilsen 2012, Whitney, Gammal, Gee, Mahoney & Simmard 2013).

What effect have all these intervention programs had? In 2012 women represented only 19.73% of the total ICT occupation workforce in Australia (ABS Labour Market Survey as cited by Australian Computer Society 2012). It could be interpreted that with the continuing low number of women, in computing education and the profession, that the intervention strategies have had limited or no success at all. Alternatively it should be considered that the percentage of women in the discipline may have been worse still, if these intervention programs had not been conducted. The Australian Computer Society (2012) suggests that without specific interventions it is almost inevitable that the decline in females working in ICT will continue.

Lewis, McKay and Lang (2006, p. 135) argue that too many of the interventions conducted in the past have been focused on the 'women' and have therefore 'failed to turn around the sex stereotyping that has emerged'. Few interventions have looked at the curriculum or teaching practices within institutions and this has resulted in 'gendered practices in ICT education' as well as the industry. Lewis et al. (2006) suggest that the way forward is to have less emphasis on recruitment and retention intervention programs, which are directed at informing the choices women make, and to place more emphasis on research within ICT schools on inclusive curriculum and teaching approaches. They hypothesise that the 'apparent failure of intervention programs to intervene in the progressive decline in the numbers of women in ICT is, in part, the failure of higher education to review and reform their curricula and teaching alongside their women-centred recruitment and retention approaches' (Lewis et al. 2006, p. 139).

From the variety of programs and strategies tried, it would be useful to be able to spread good practice elsewhere, and identify and replicate the 'successful' programs in other situations. For this to be possible it is necessary to not only adopt the outward aspects of a program's success but to recognise what interplay of culture and organisation make it effective (Martin, Liff, Dutton & Light 2004). It is necessary to understand why it was successful and in what context. The evaluation of a program can shed light on these aspects.

Teague (1999) suggests that there is a problem with the evaluation of programs established to encourage more women in computing; very few detailed evaluations have been published. In fact there is only a 'paucity of intervention program evaluations' to be found (Teague 1999, p. 56). The literature regarding women and computing is predominantly focussed towards 'access' to computing and courses, and the 'process' of intervention programs, with little having been written about specific intervention program 'outcomes' (Parker 2004). Lang (2007 p. 224) reported that evaluations of programs 'over a longer time period to determine why sustainability has not been attained' are also lacking from the literature.

Program Evaluation

Evaluation is defined by the Australasian Evaluation Society (2006) as 'the process of obtaining and disseminating information of use in describing or understanding the particular program, or making judgments and decisions relating to past, existing or potential programs'. A subset of evaluation is program evaluation; the evaluation of social intervention programs. Program evaluation is the careful collecting of data about a program in order to make necessary decisions about the program (McNamara 2007). Rossi, Freeman & Lipsey (1999, p. 3) suggest a broad reason for conducting program evaluation 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'. Further Rossi et al. (1999, p. 54) suggest that there are five main types of evaluation questions:

1. Needs Assessment: Questions about the need for the program.
2. Program Theory: Questions concerning the program design.
3. Process Evaluation: Questions regarding the program's implementation/operation.
4. Impact Assessment: Questions regarding the program's impact or outcomes.
5. Efficiency Assessment: Questions about the program's cost and cost-effectiveness.

How a program will be evaluated should be considered and incorporated into the design of every program (Meyers 1981, p.2). These evaluations can be of a qualitative or quantitative nature.

The program evaluations that are reported in the women and computing literature tend to be qualitative rather than quantitative (Teague 1999). Teague suggests that one possible reason for the lack of published evaluations is that if typically small scale interventions are evaluated quantitatively, and there is no significant change, then the evaluations are not considered worth reporting. In the reports of evaluations that were published, the methods used to evaluate the programs also varied enormously, even if the intervention programs were of a similar style, such as conducting computing workshops (Teague 1999). A lack of expertise and resources is also contributing to the lack of program evaluations, with intervention programs for women in computing difficult to evaluate. Frequently programs lack the resources to 'deeply analyse' the outcomes of such programs (von Hellens, Beekhuyzen and Nielsen 2005, p. 2).

To improve our understanding of which programs are best, for whom, and in what context Weiss (1998, p.16) suggests a cumulative information base is necessary. Program evaluations need to be conducted, results need to be published and through these publications, each study then adds to the build-up of knowledge. Even when evaluation results show that a program has had no effect, little effect or an unintended effect, dissemination of these results is important so that knowledge grows and 'ineffective programs are not unwittingly duplicated again and again' (Weiss 1998, p. 16). Equally, when the results from a program are mixed, published evaluations enable others p to learn which of the components of the program were associated with the greater success. Only evaluations which are poorly conducted and may have misleading results are not worth publication.

Research Objectives

The aim of the research study reported here was to investigate intervention programs, focusing on the enrolment and retention of female students in computing courses in Australia. The aim of this paper is to describe the evaluation of the major intervention programs implemented in Australia in the last twenty years. To what extent have these programs been evaluated and how has the evaluation been conducted? This will determine if there is a need to improve the way such intervention programs are evaluated in the future.

RESEARCH DESIGN

The study employed a qualitative methodology, based in interpretive epistemology and constructivist ontology. Qualitative research involves the collection and study of a variety of empirical materials such as a 'case study; personal experience; introspection; life story; interview; artefacts; cultural texts and productions; observational, historical, interactional, and visual texts—that describe routine and problematic moments and meanings in individuals' lives' (Denzin and Lincoln 2000a, p. 3). A qualitative methodology was required as it enabled the researcher to understand the events involved in intervention programs, through the perspective of initiators of the programs and to obtain the rich detailed data required to make sense of the programs, their context and their evaluation.

Williamson, Burstein and McKemmish (2002, p. 32) suggest that it is acceptable that a qualitative study should be 'idiographic' in other words 'the intense study of an individual case'. A multiple-case study enables the particular phenomenon to be investigated in diverse settings (Darke, Shanks and Broadbent 1998). In this study a single-case was defined as a concentrated inquiry into a cluster of intervention projects, referred to here as an intervention program. To be able to gain as deep an understanding as possible, a look at different cases in their own organisational and political contexts would be beneficial. Therefore the study used a multiple-case design of 14 individual intervention programs. Myers (2002) queries why more than one case is actually necessary but Miles and Huberman (1994, p.173) suggest cross-case analysis enhances generalisability as it will deepen the understanding and ability to explain what has occurred. Eisenhardt (1989) proposes that at least four separate cases are required for multiple-case research. Miles and Huberman (1994, p.30) warn that a study with more than 15 cases can, however, become unwieldy.

Since 1994 a total of 17 major intervention programs have been conducted in Australia to encourage more women into computing. From these, the cases to include in this research were selected based on that a program's objectives included attempts to increase the number of females in computing; the program was a sustained activity but could consist of one or more projects; the program's Champion was able to participate in the research and finally that the programs chosen would provide diversity in terms of location and focus.

Fourteen cases met the criteria: eight cases from universities, three from government bodies and three from the industry sector (see Table 1). More cases were from the university sector because of the proliferation of programs in this sector. Some programs and projects were completed, others were on-going.

Educational Institutions				
Who	**Spectrum**	**Interviews**	**Other Data Sources**	
Uni1	School of CS	Megan; Champion	2 published papers	4 newspaper articles
Uni2	School of IS	Nikki; Champion	3 grant applications 12 published papers 3 unpublished reports 6 surveys	2 profiles 1 video tape 1 resource booklet
Uni3	Faculty of ICT	Sarah; Champion	1 grant application 7 published papers 2 unpublished reports	1 website 2 interview transcript with 5 facilitators
Uni4	School of IS	Kim; Champion Helen; Major contributor	2 published reports 3 proceedings 1 newspaper article	1 media release 1 newsletter
Uni5	School of Business and Technology	Ann and Alison; Joint Champion	1 grant application 8 published papers 1 unpublished paper 1 newspaper article	4 video tapes 7 profiles 1 website
Uni6	Faculty of IT	Jodie; Champion	2 published papers Promotional material 2 brochures	2 websites (for different audiences)
Uni7	Department of IS	Kerrie; Champion	1 published paper 1 draft evaluation report – unpublished	1 program outline 10 assorted surveys 3 profiles
Uni8	School of CS and SE	Tania; Evaluator and major contributor	1 published paper 4 unpublished reports 2 technical reports	1 newspaper article 1 award application
Government Departments				
Who	**Spectrum**	**Interviews**	**Other Data Sources**	
Gov1	Education	Clair; Champion	2 grant applications 4 published documents 2 unpublished reports 2 websites	Various support materials for teachers Numerous workshop materials
Gov2	ICT	Karen; Major contributor	3 research reports 1 task force report 1 evaluation report 2 websites 1 media release	1 video tape 22 profiles Various support materials for teachers
Gov3	ICT	Debbie; Champion	1 evaluation report 1 article 1 website 1 newspaper article	Various promotional material and brochures
Industry Organisations				
Who	**Spectrum**	**Interviews**	**Other Data Sources**	
Ind1	ICT	Cheryl and Bev; Joint Champions Joan; Evaluator	6 various surveys 2 evaluation reports	3 newspaper articles 1 website
Ind2	Technology	Lesley; Champion Fiona; Major contributor	1 constitution 2 newspaper articles 8 various surveys 1 project plan	1 final report 1 published paper 1 website
Ind3	Telecom-munications & IT	Stacey; Champion	3 reports 2 newspaper articles Promotional materials	1 media release 2 surveys 1 website

Table 1: Data Sources

The data sought for each case study included details about the intervention program in context, the way the program was expecting to work (the assumptions it was based on) and the level of success of the program from the perspective of the program champion. In-depth interviews with the program champion of each program were conducted as well as detailed document and artefact analysis (see Table 1). Nineteen interviews were conducted as in some of the cases more than one person was interviewed. The analysis of the documents and artefacts complement and provided some validation for conclusions drawn from the interviews. Exploring the evidence used to indicate or measure success provided an understanding of the nature of the evaluation conducted, both formal and informal evaluation, what its purpose was and how this evaluation was ultimately used.

The analysis of each individual case was followed by a cross-case comparison. All data was brought together in one NVivo project file enabling sorting, searching and linking. An initial set of categories for coding was created based on the themes identified in the gender literature such as awareness (Clarke 1990; Lang 2007), recruitment and retention (Clarke 1990; Clayton & Lynch 2002; Klawe et al 2009; Adya 2000). Additional codes came from the evaluation literature: program operation, success of program, purpose and design of evaluation, stakeholder involvement, resources available and dissemination of findings (Kellogg Foundation 1998; Rossi et al 1999; Weiss 1998). Concepts emerged from the source data which enabled further refinement of the categories (eg program operation; prior research conducted, the way it was expected to work, difficulties with program operation, follow up with target audience, grant requirements, support from others, sustainability/burnout, using stakeholder participation). Having all the data in one project file enabled the creation of a meta-matrix as described by Miles and Huberman (1994, p.178) to facilitate an analysis for patterns in responses and opinions. Yin (1994, p.54) agrees that this approach is a good method for analysing multiple-case study data.

Intervention Programs

Each of the intervention programs conducted by the case study entities was a multifaceted cluster of numerous intervention projects. For example Uni1's intervention program consisted of projects conducted at both the pre-tertiary and tertiary level (see Table 2). The time span of Uni1's intervention program was five years with limited activity currently taking place.

Pre-tertiary projects	Created secondary teacher awareness through a careers booklet
	Created a website profiling a wide variety of computer careers
	Had female undergraduate students speak at school careers events
	Conducted a shadowing program where girls in Years 10 and 11 were able to 'shadow' first year computing students
	Provided a series of interviews to newspapers and radio to dispel the nerdy image of computing
	All publicity (eg websites and brochures) was checked to ensure the photos in any publication incorporated 50% women. Frequently photos were of groups of students rather than computers to emphasise the people-side of computing
	An annual girls in computing day was held for 50-60 girls at a time
Tertiary level projects	A compulsory orientation camp geared towards networking was conducted
	A scholarship program was offered
	Female students were provided with professional development through industry partners

Table 2: The projects which made up Uni1's Intervention Program

Each of the 14 case study entities had a unique set of intervention projects which made up their intervention program. While some of the intervention programs are still relatively new, some have been operating for a lengthy period of time. Table 3 summarises the collective reach of the more common major activities conducted by the case study entities.

Table 3 does not capture the more local projects, that are too numerous to list, such as a Mentoring Breakfast with female ICT mentors through a city council for 30 students and seven teachers from six different schools. Nor does it capture other projects which are not measurable by the number of participants they directly reach such as the creation of a 'How to' kit for Girls and ICTs role models events; or the publicity that was generated by Girls and ICT articles appearing in numerous school and parent magazines, teacher journals and articles in local and national newspapers.

As can be seen from this section, the activities conducted by the 14 case studies were considerable.

Activity	**No. of events held**	**No. of Participants**
Girls in Computing Days or Role Model events	40	14,000 girls 500 educators 200 parents 200 role models
Multimedia workshops	9	200 girls
Professional Development for teachers	20+	400 educators
Awareness-raising events	370	23,044 students
Computer clubs established	150+	unknown
Videos produced and distributed	6	unknown
Significant websites created	12	34,700 hits in a two year period
Orientation programs for female tertiary IT students	3	unknown
National women in computing conferences	5	400+
Computer Camps for secondary girls	4	120+
State based technical workshops	2	unknown
Scholarship/awards/bursary schemes	8	unknown
Practical Ideas booklet for encouraging Girls with ICT	1	All schools in one state

Table 3: Direct reach of common major activities conducted by the case study entities.

FINDINGS AND DISCUSSION

Success of the programs

This research found that from the perspective of the program champions there was little doubt that their programs were successful.

> *Fantastic, incredibly successful. They had way more people there than they thought they would get … it is actually the whole movement that is successful. (Debbie_Gov3)*

> *The end result was that it was a mind-blowing experience. It was a fantastic effort by all, we just did the unimaginable and pulled it off and we had 1500 girls by the end and we were able to pay our expenses and still manage to do very well. (Cheryl_Ind1)*

Some of the program champions however did acknowledge that though the programs were successful, the programs might have had less impact then they would have liked.

> *I think all the events were successful, it depends how you are measuring the success. (Clair_Gov1)*

> *Were the conferences successful? Very much so. I probably would have liked more people at the second one. No, I think they were great. (Kim_Uni4)*

While the program champions were convinced of the success of their programs it was often not formal evaluation that lead them to their conclusion but anecdotal evidence. Almost all of the respondents talked about individual instances of having made a difference in one persons' life and that this was enough to make the program a success;

> *Yes. I know that I personally have touched lots of women's lives from that point of view. That satisfies me but does it really justify the amount of time and effort that I have put into it? I don't care. Really you cannot always measure things by the direct and tangible benefits so to me if we supported an activity and it made the difference between no girls going into a course and one girl going in I would be quite satisfied with it, I don't think it is an issue. (Stacey_Ind3)*

There were also many perceived outcomes of the programs that the program champions did not know how to evaluate or quantify:

- Increased ICT skills amongst participating girls;
- Increased confidence by girls in using ICTs;
- Increased willingness to take a leadership role in the use of ICTs;
- Better networks between entities and therefore better distribution of key information;
- Increased understanding of possibilities and options in ICT study paths and careers;
- Students who felt they were 'cared about', a sense of 'belonging' which assisted with their retention in courses;
- Workplace strategies which have been shared and professional development activities carried out;
- Improved curriculum in numerous universities and/or an improved learning environment developed; and
- Numerous supportive communities which have been created enabling networking and mentoring programs to be conducted.

The intervention programs at the focus of this study were mostly conducted by female volunteers who were passionate about the need for more females in computing and were prepared to devote large amounts of their own time to make a difference. This meant that frequently the tasks to implement the program were on top of their 'day' job and family responsibilities (Craig 2009). For many of the projects the champions were practitioners and being time-poor, they were more concerned about the implementation of the program, which they 'knew' would work anyway, then evaluating how it did work. Almost all of the intervention programs were considered successful yet this was often based on anecdotal evidence since only limited formal evaluation may have been conducted.

The next sections will explore how the programs were evaluated and whether the key elements as identified in the literature were taken into consideration by those conducting the evaluations.

Purpose of Conducted Evaluations

Using Rossi et al.'s (1999, p. 54) five main types of evaluation questions, if evaluation was conducted on a particular project by the case study entities, it was mostly to assess the implementation or operation of the project (Process Evaluation) or an assessment of its outcomes or impact (Impact Evaluation). A few of the evaluations also assessed longer term outcomes which, although not articulated as such, is moving towards assessing the assumptions made in the project design (Program Theory). A Needs Assessment was conducted before the implementation of a number of projects:

> *The entire research program is aimed at gaining a deeper, conceptual understanding of this phenomenon as the basis for informed intervention at a range of levels. (Sarah_Uni3)*

None of the evaluations looked at a cost-benefit analysis of their programs, the fifth purpose of evaluation which Rossi et al (1999, p. 54) describe as efficiency assessment.

The audience for whom the evaluation was conducted was either the project champions or program committee so that they could modify and improve the project; the sponsors of the project so that they would see that the project had the desired outcome; or for future sponsors to show the impact of the interventions and to encourage their contributions.

> *The purpose of this report is to provide feedback to the organising committee of the [event] … The report summarises students' and teachers' views about IT careers and analyses the impact of this event on the students' IT career intentions. (Uni8_documents)*

A large number of individual projects were not evaluated at all; Kim (Uni4) indicated that their project of running women in computing conferences was a great success but when asked how they were evaluated the response was '*we didn't because we didn't think about it*'. When queried further, it was the enthusiasm of the participants and anecdotal comments which had led to her conclusion that the intervention was a success. Similarly websites were not tracked to see for example how many unique visitors came to the site (Uni5_documents) and artefacts such as videos were not formally evaluated either (Nikki_Uni2, Anne_Uni5). Nikki explained: '*I think we just put it out there. I do not even know if we followed up to find out how many times it was used. It was literally a product we put out*'. Fiona (Ind2) described the development of a comprehensive information kit for teachers which was made freely available, was not formally evaluated, but was considered a success. A role model day was also not evaluated but it too was considered successful because;

> *… it was aimed at year eight and nine girls from memory and yet we had one of the women that was involved in the committee she brought along a group of her grade five students to help out on the day. At the end of the day they were so excited, these grade five girls, they went back and started a girl's computer club. (Fiona_Ind2)*

Sarah (Uni3) and Kerrie (Uni7) explained that as part of their funding applications there was no need to mention how the project would be evaluated. Clair (Gov1) and Megan (Uni1) agreed;

> *I think we looked at numbers at events and those sorts of things. I think that was all we indicated. We had to say what our outcomes were; we didn't have to say how we were going to evaluate it if that makes sense. (Clair_Gov1)*

> *The University Special Projects Funding was part of it in the days when there was actually a budget with money in it. It was maybe a three or four page proposal outlining what you wanted to do and what it was going to cost and what you hoped the outcome of it would be. (Megan_Uni1)*

Sarah (Uni3) whose program is still in its early stages, has not yet considered when and how the evaluation will be conducted: '*The evaluation of that, I do not know, we have not discussed how that is going to happen*'.

Nikki (Uni2) explained that it was the project itself which was the priority and evaluation was not the main concern;

> *... we had a very much practitioner view. There was not a lot of evaluation… We were not required, as part of our funding, to deliver anything other than the product. As teachers I think we always evaluated at a level of have your sheet checked with people afterwards and I know Emily did a lot of follow-up work on statistics on numbers as evidence to see whether we had made any difference. With attitudinal change, it is very hard to have a good evaluation instrument anyway. So evaluations would have been against whatever the funding criteria was. If, as a practitioner, you wanted a product like a video, that was really probably our early focus and it was only when it became seen as appropriate to take what we were doing to research conferences rather than practitioner gatherings, that we started to look more seriously at the validity of what we had done and whether we had made any difference. (Nikki_Uni2)*

Bev (Ind1) also felt that evaluation was not the priority. The program itself was the primary focus though having better evaluation could make it easier to encourage potential sponsors to support the initiative;

> *[The role model day] produces the survey that shows [students'] perceptions have shifted from this opinion to that opinion on the day. Very subjective stuff. Anybody with a statistical background is going to go well that's great. What were they thinking the next day? Three months, six months? Where is the follow-up work? Of course we are not doing any, we are not researchers. We are working stiffs who are volunteers in our "spare" time … (Bev_Ind1)*

Each of the program champions had some understanding about how and why they expected their program to work but this process or theory, was not tested through evaluation. While there are good resources available in the literature and online (see for example: http://www.olt.gov.au/evaluation), to guide the development of evaluation for social intervention programs, these were seldom used by the program champions. Reasons provided by the champions included a lack of time; lack of priority compared to running the program; and the general nature of the sources that were explored which did not focus specifically on intervention programs to raise awareness, recruitment and retention. While the program champions would not have undertaken implementation of the intervention programs unless they thought they could make a difference, the reality is that in they have little evaluation- based evidence of the success or worth of their programs.

The Evaluator and Inclusion of Stakeholders

When evaluation of a project was designed and conducted, in almost all cases it became the responsibility of a team member, or members, from within the program, and rarely involved other stakeholders.

> *These evaluations were conducted by the project team members. (Uni8_documents)*

An exception to this was the evaluation of Uni7's summer school intervention and evaluations performed by Government entities which were frequently conducted by external consultants to the projects such as the following;

> *...we have commissioned a consultant to do the evaluation of that and that is twelve months in now and it runs through to the end of this year… Their report will probably come in to us early next year. (Karen_Gov2)*

The analysis of major role-model interventions conducted by Ind1 and Uni8 were undertaken by external evaluators however they did not contribute to the design of the actual evaluation itself;

> *My involvement started with the [completed] forms that we got. We didn't have any input into the design of the forms which was a bit of problem, the questionnaire. When we got the questionnaires we looked at them and thought well we could have done quite a lot better knowing the analysis that we could do on it. We could have done a lot better if we had some input into the design of the questionnaires. (Joan_Ind1)*

There was minimal indication of any other stakeholders being involved in the evaluation process therefore any evaluation that was conducted did not consider the perspectives or the needs of these stakeholders.

Resources Provided for Evaluation

To conduct evaluations requires access to sufficient resources in terms of time, funding and skills. These resources were hardest to come by for the university sector. Anne (Uni5) indicated that '*we didn't ever conduct any official investigation or surveys on how much impact it has had simply because we didn't have the time or funding to do it*.' As far as the tertiary interventions were concerned at Uni5, a lack of funding also contributed to the type of evaluation conducted: '*Only in 1996 and 1997 did we have sufficient funds to employ a part-time research assistant to conduct structured interviews and focus groups'* (Uni5_documents).

The Government entities on the other hand, had greater access to funding for evaluation;

> *I think we are spending 40 to 50 [thousand dollars] on the evaluation, that is OK … Typically 30 to 40 will give you a good evaluation. I know the attitudinal research was whole lifecycle too so that was a lot more, that was probably close to 200 I reckon. I think that went out to selective tender. That was depressing, but good stuff. (Karen_Gov2)*

Karen also spoke about a project which was regarded as being resource-intensive and hence was not sustainable; '[This project] *was a major resource-heavy showcase opportunity for schools around the state to see the breadth and excitement around IT careers pathways. That ran for about two or three years'*. It was decided to discontinue the project. It was only after the decision to wind-up the project was made, that an evaluation of the project was commissioned;

> *My understanding of it is that it had been closed off; we are not doing this again. But I guess it is part of government process that you evaluate everything. You plan it, you run it, you evaluate it. Regardless of its future. That just finishes the research cycle. (Karen_Gov2)*

Yet not all interventions conducted by the Government entities had access to the same level of funding;

> *No further funding was available to commit resources to investigating what impact the funded projects had on participants in their career choices and whether some projects worked better than others. (Gov1_documents)*

A lack of knowledge of how to conduct evaluations and having the required skills were also problematic:

> *The other thing is we are project officers writing these questions. We don't have a background in writing valid survey questions either and we don't pay anybody to do that but that is something I would be interested in; looking at how valid our questions are and whether we should look at rewording them. (Clair_Gov1)*

> *Participants do not believe that males write better programs than females. These results could be an indication that perceptions are changing in this cohort. However, such an interpretation*

> *may be premature. The question may have measured the general issue of differences in capabilities between females and males rather than this specific skill. Further research is required to resolve the issue and a redrafting of this question will be attempted for administration at the next Summer School. (Uni7_documents)*

Clair (Gov1) also spoke of a project involving establishing a 'brand name' for a series of girls and computing initiatives. When queried on whether she had tried to evaluate how well-known the brand was becoming, her response was *'I have no idea how to do that but I would love to'*. Fiona (Ind2) raised several issues regarding a lack of confidence with evaluation skills and the difficulty of getting useful evaluation;

> *Again it is a volunteer thing, who has time to do something with it and who has the skills to maybe do something with it? Susan and I have the research interests and maybe nobody else really has that research interest on the committee. It has pretty much come back to us each time.*
>
> *[What we do] is more research analysis of the results. Susan then puts it through SPSS …so how many girls thought this was influential? Who was their most influential role model and things like that? Then we got some of the qualitative stuff as well.*
>
> *We haven't really had anything concrete to go back to [sponsors] with and I know that is part of the problem of getting money to run projects, is not having that written on paper saying this is what is really going on…How do you measure that anyway to say this is what is really happening? And give us funds that equal that. It doesn't work that way … We just don't have a way of doing that so it is really hard. (Fiona_Ind2)*

The evaluation that was conducted by the case studies was predominately dependent upon the time available, skills and expertise of the program champion or other key team members. Scarce resources were used to implement the program with seldom sufficient funds and time to consider what evaluation was necessary and appropriate to be conducted. A lack of evaluation expertise among the team members contributed to a lack of understanding of its pivotal role in informing the team of the true worth of the intervention programs.

Design of the Evaluation

The methods used to evaluate the intervention projects formally did not vary greatly. Most frequently questionnaires, interviews and focus groups were used. Some projects also incorporated observation.

> *The quantitative analysis will provide a statistical evaluation of the intervention program and identify other factors in the students' backgrounds which are associated with success in the first programming subject …A variety of data collection methods were used including diaries, structured interviews, and focus groups involving the first year women computing students and end of semester written reports from the senior student. … The qualitative analysis will provide detailed accounts of the female students' experiences in the intervention program and in the first year of the computing course. It will also be used to help interpret the results of the quantitative analysis. (Uni5_documents)*

For evaluation of changes in attitude, confidence or skills it was common to adopt a pre- and post-event survey. However as some events became larger this proved to be problematic and the pre-event survey was abandoned:

> *I think a couple of years ago we did a pre-survey and a post-survey. That was our approach in the beginning. I think by the next year it was just too much work because there were too many girls and we ended up just having the one survey. (Fiona_Ind2)*

In the case of Gov3 the post-event survey then incorporated two questions which still tried to gauge the students' self-perception of any change in attitude;

Q16. Would you consider IT as a career option? Yes □ No □

Q17. Had you considered IT as a career option before today? Yes □ No □

(Gov3_documents)

A number of comments surfaced around post-event surveys of Role Model or Girls in Computer days really being a 'happy sheet' and indicating whether the girls had had an enjoyable day rather than whether their awareness of, or interest in, computing had changed at all. Lesley (Ind2) suggested that '*happy smiley is not a fair evaluation'* but evaluating whether the girls had had a good day was easily measurable. '*Is it because they are suspecting that they are not going to get good results and they don't want to hear it - is this why people use happy sheets?*' asked Lesley. Tania (Uni8) agreed and suggested that asking the right questions can, however, be difficult;

> *The way a lot of people think about evaluation is that you just give them a survey and we will be fine. Just ask some questions and then we will get some information back and that will be fine. That is the level that a lot of people think. There is no understanding of how difficult it can be to design something that is appropriate, or to think ahead. What information do we want? They just know they want some feedback as a general rule. (Tania_Uni8)*

Some surveys therefore did not provide quality feedback;

> *When you get a box of survey forms like that it is quite a lot. That is why it was so disappointing the second year when the form itself wasn't well-designed and you could see that the students really weren't able to give a proper evaluation of what they had been to. The second day they couldn't say anything was boring because they didn't have that column. (Joan_Ind1)*

> *The surveys told us that the girls had a wonderful time and they thoroughly enjoyed it and they thought technology was great. But when we did the longitudinal study. It would have been a couple of years later. It really didn't show anything. There was no clear cut outcome. When it was written up and when the results were looked at it really showed nothing. I think you could say with confidence that it demonstrated nothing. (Kerrie_Uni7)*

Gov2 was the only entity who had the resources to use external consultants to undertake each of their evaluations and Karen explained how this would happen;

> *The way that we will go out to market is we will write a brief and scope it out ourselves saying these are the things that we want to find out about. We will put it out to the market with three or four selected companies ask them to come back to us on how they will approach it. Some methodology around how they will approach it and some recommendations, which is vital for us. We will just select on the best proposal. (Karen_Gov2)*

To be effective evaluation must have a clear purpose. Specific data can then be carefully collected and analysed to answer the evaluation questions. The process or theory of how an intervention program should work requires testing through evaluation yet this was rarely undertaken.

Learning and Sharing

It was strongly suggested in the literature (Rossi et al 1999, p.24; Weiss 1998, p. 16) that not only do program evaluations need to take place, but results of these evaluations need to be used, and then disseminated so that each evaluation can add to the build-up of knowledge.

The purpose of many of the evaluations undertaken by the case study entities revolved around improving the process and implementation of the project;

> *The group that organised the day used [evaluation]. Primarily it was to tweak the program for the next time around. (Nikki_Uni2)*
>
> *It was predominantly [used by] me, for planning for the future ones. (Megan_Uni1)*
>
> *We learnt lessons from 2002 where schools don't read emails because they just don't. You need to fax to about five or six different parts of the school to make sure that somebody reads it. We asked them "which part of the year would you like to have it? Is November suitable?" It came back that March was the appropriate time. So we collated a lot of lessons learned and we tried to implement them for 2004. (Cheryl_Ind1)*
>
> *Using an overall-rating of the project on a Likert scale of 1 to 5, all students rated the project 3 (Good) or above, with 33% of the students nominating 5 (Excellent). It was pleasing to find that in the following year 55% of the students rated the project as excellent showing a positive reaction to the improvements made in the project delivery from the feedback of previous years. (Uni8_documents)*

Tania (Uni8) expressed frustration that the funding for the summer school intervention was cut off and that this decision was not based on the evaluation of the project. There were other instances where it was unclear if the evaluation conducted was actually used;

> *I haven't seen it to be honest; I have never seen anything from it, no. Because I was still on the ground running everything, she was collecting the feedback and helping me out a lot …and I have never actually seen it to be honest. (Fiona_Ind2)*
>
> *Jo has got all the analysis of the data and I just get to flick through it and have a look. I wanted to do that a lot earlier but I just didn't have the access. (Jodie_Uni6)*

In some situations the evaluation was used to affirm the project leader's decision to conduct the intervention; 'we just looked at it and thought Oh didn't we do a good job' and 'it told us that it was worthwhile doing' or to apply for an equity award; 'we were just using it for an award that we went for'.

For government entities evaluation reports were either internal documents or posted on an external website for interested parties to obtain.

> *We either post it on the website as a complete report …or we just picked the eyes out of the report which was 200 pages and we just made some highlighted comments and we have sent that out as a media release and we have sent it out to stakeholders and also posted that on the website. (Karen_Gov2)*
>
> *Yes [we wrote reports]. Usually they are just internal though. (Clair_Gov1)*

It is not clear who should write up the results of the evaluation and where it should be distributed. The funding agency and the program committee generally receive copies but members of the project do not necessarily see the results, nor is it easy to access results of projects that other people have conducted;

> *We wrote a report for the grant, the final status report for that and I know that Marg and Sue from the University actually presented some papers on those events at conferences. My role isn't to write academic papers but I did do the final status report. (Clair_Gov1)*
>
> *I think in the end Sally did … quite a lot of it and she wrote up a big report and things because it was government [funded] and I don't believe I really saw that report but I am sure she would have a copy. Again, this doesn't come back around. Being in government and having funds I*

> *think they had to do a formal evaluation of it but I am not quite sure what that was but I know she had a really hard time with it. (Fiona_Ind2)*

Some grant applications indicated that dissemination would occur but not specifically who to and how other interested parties could access the information;

> Thirdly, the dissemination of research outcomes to interested parties and increased enrolments in IT courses will enhance Uni3's reputation as being a female-friendly university and progressive in its approach to course design and delivery, which assist positive branding for the University. (Uni3_documents)

As previously mentioned by Nikki (Uni2) and others, numerous projects started as 'practitioner' based with the focus on conducting the project and without concern to any evaluation that might be of interest to others. In these situations the university sector does not allow dissemination of results as the university's ethical committee will not have sanctioned the project before its commencement:

> *[We have not published the results]… because we didn't have ethical clearance for it... This is the beauty of having Jo around because she does this kind of thing and I just don't have time and also her background is in ethics. In fact in future any of the projects we plan we will actually get ethic clearance first. (Jodie_Uni6)*

There was little evidence that the dissemination of the outcomes from the conducting of interventions was a priority for the team members of the case studies. Yet without this, a build-up of knowledge regarding what makes a program effective, or ineffective, will not occur within the women in computing community. Therefore unsuccessful programs may continue to be conducted taking scarce resources away from those programs that evaluation shows do have the desired effect.

Difficulties with Evaluation

An inability to conduct anything beyond short-term evaluation was a common concern. This difficulty arose through being unable to track students due to privacy laws, lack of resources, or project restrictions.

> *The timeframes weren't such that you could necessarily evaluate very much anyway. (Nikki_Uni2)*

All of the case-study entities undertook some intervention projects aimed at pre-tertiary girls. Consequently the participants were under the age of 18 and by law, not yet adults. As a result there are legal requirements that must be abided by such as parental permission is required before these girls can be interviewed or take part in any research endeavours. This severely restricted anything other than anonymous short-term feedback;

> *We have not been able to do any follow-up with any of the girls. I would like to but no, we haven't. In terms of looking at young school girls and ethics it is a bit tricky and nobody has had the time to be honest. I think it does need to be done, as well as looking at where these girls go, and what they are doing, and things like that, but again it is getting the resource and getting the ethics to do a privacy thing and things like that. I think no, we just haven't. (Fiona_Ind2)*
>
> *We can't really do that for privacy reasons. (Clair_Gov1)*
>
> *We could not follow up more due to the privacy act; we could not get their addresses; we would have kept in contact but it was just not possible. (Megan_Uni1)*
>
> *You can't use the information that you have got from one survey or one contact with the students for something else without making it clear to them. They are very strict on that. (Tania_Uni8)*

Most of the large events did not get a list of the names of the students that were attending the event, and only registered the name of the school with the number of students and staff attending. Therefore even the checking, in future years, to see whether these same girls enrol at their university, was often not possible. Surveys conducted on the day were all completed on a voluntary basis and without any identifying names or addresses. Consequently any follow-up would have to go via the schools to the parents. This could only be done after clearance from ethics committees at the university level and from the education department have been obtained (a process which can take many months) and then also requires the consent of the principal of the school as well as the cooperation of individual teachers to encourage students to return the surveys. This would also require that the school actually had retained a list of the attending girls.

Constraints placed by sponsors and funding agencies also dictated that if evaluation was to be undertaken then it often needed to be reported back within a short period of time. The largest and most ambitious of the intervention programs was expected to show results within a three-year period while smaller projects' timeline was generally from a few months to one year in length.

> *When you get funding grants you have to indicate how you are going to evaluate but the evaluation measures are not medium-term or long-term, they are all just kind of on the spot. You do have to say what your performance indicators will be and you have to quantify them, but they tend to be things like, we did a survey on the day and 80% of the girls that came in that said they were not interested in IT said that when they left that they are. So that is a bit of a measure about the culture and the impact on the day … But yeah, it does ask for evaluation but there is no follow up or medium or long term evaluation associated with it because you have to report back in a certain time. (Lesley_Ind2)*

> *I am not going to get numbers in three years. That is where we have got to convince them that qualitative is important…. (Sarah_Uni3)*

A common difficulty with evaluation was what criteria to use and how to measure the criteria accurately, so that it did provide useful information;

> *How can you measure how successful you are? At this point we can't. The only proof is the fact that we have bums on seats. Absolutely. If it was a negative experience for the girls there would have been no registrations, the schools would have found out by now. (Cheryl_Ind1)*

> *It is very hard to measure when we are talking about attitudes towards technology and the way it is being used in the classroom obviously if it is being used across the curriculum more that is good, but how to measure that is near impossible as far as I know. (Clair_Gov1)*

> *.. you need that quantifiable information on; did it make a difference and all this kind of stuff. Susan was really struggling with it because how do you quantify this? (Fiona_Ind2)*

> *We tried to measure it quantitatively and we couldn't. You will see that in the journal paper. We couldn't relate anything really to the program but our qualitative work tells us that women students perceived that the program was just a great benefit and that is enough for me. (Alison_Uni5)*

Not consulting with all stakeholders was problematic with Ind1's evaluation resulting in much less-rich data then might have been obtained otherwise;

> *The design of the survey questionnaire with the 3 and 4 point-rating scales made analysis of responses difficult. Providing a 5 point-rating scale for the participants to rate the sessions would allow more meaningful analysis of the data. Furthermore, the career-interest questions on the questionnaires were not relevant to the teachers. For future events, we recommend that a separate questionnaire be designed for them. (Ind1_documents)*

> *We said that we would be happy to give our time to help with the design of the questionnaire… we asked if we could have some input into this, … but things get underway and things get forgotten and things happen before you realise they are done and we thought, well we did give feedback last time and so they will pay attention to that … The next year they made it worse. The format wasn't very good. Nor were the questions wonderful. (Joan_Ind1)*

Even when evaluation had been undertaken it was not always possible to enact the recommendations (such as moving a role-model day to earlier in the year when the sponsor provided facilities were not available any earlier) and there was not always confidence in the results;

> *So the first evaluation was exceptionally positive, much more positive then the second one but I am sure the [consultants] got the facts wrong because the second one was in my opinion as positive when we were reading the evaluation forms. The statistics came back a little bit lower than the first one which was something like '88% would do IT that weren't thinking about doing IT before they came to the showcase' and the second one came a little bit lower at 69% or something. All in all it was very positive. (Cheryl_Ind1)*

To conduct effective evaluation on intervention programs designed to encourage girls into computing was not a trivial task. Those program champions who did recognise that it would be useful to be able to conduct formal evaluation found many difficulties which hampered their ability to provide rigorous evidence-based evaluation.

CONCLUSION

To determine whether an intervention program has made a difference requires evaluation. The purpose or aims of conducting an evaluation will guide the design of the process (Rossi et al 1999) while evaluation skills are necessary to create the evaluation instruments. The evaluation should represent the needs of all the stakeholders with sufficient resources provided to ensure that the appropriate data is collected and analysed (Weiss 1998 p.79). The learnings from an evaluation should be published or shared so that others in the community can learn from what is, or is not, successful (Weiss 1998 p. 17).

Fourteen major intervention programs, conducted over the last 20 years for women in computing in Australia, were investigated. Each of the program champions had some understanding about how and why they expected their program to work yet this theory was rarely tested through evaluation.

Program champions conducting the intervention programs were passionate about encouraging and supporting girls to move into higher computing education and/or careers. This was expected to come about from the intervention programs that they conducted and 'knew' would be successful. Therefore little priority was given to formal evaluation. When evaluation was considered a lack of time, funding and expertise restricted its conduct. The evaluation's design and application rarely included multiple stakeholders. Problems with privacy laws, project restrictions and resources also hampered the ability to evaluate the longer term impacts of the programs. Frequently the analysis of the evaluation data was used only by the project team rather than disseminated more widely to enable the build-up of knowledge in the women in computing community.

Champions of intervention programs such as those highlighted in this study do not currently have access to sufficient resources (time, money and skills) to enable them to undertake appropriate evaluation of the girls in computing programs that they are conducting. Nor do they always recognise its importance. Yet detailed evaluations would provide the evidence to point to programs which should be replicated and those which should be modified or abandoned. Without this knowledge there is a real danger that the efforts of creating intervention programs will not translate into more girls undertaking computing in the future and that program champions may burn-out and abandon their efforts.

Future research needs to focus on the development of an evaluation framework which can be implemented by practitioners who are not expert in evaluation and who have limited resources at their disposal. Such a framework should be based on a theory of change and guide the program champions in what needs to be evaluated, who should be involved and when. Such a framework may not be able to address all the difficulties faced by program champions such as issues related to privacy laws and project restrictions. However it will enable those without skills in evaluation to articulate the way their programs are expected to work and then better evaluate the components within their control. Better evaluation should enable the creation of a knowledge base to show which intervention projects work for whom and under what conditions, and which have only limited effects. This information is urgently needed by the computing profession.

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