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Evaluating Intervention Programs for Women in IT

Annemieke Craig
School of Information Systems
Deakin University
Email: Annemieke.Craig@deakin.edu.au

Julie Fisher
School of Information Management and Systems
Monash University

Linda Dawson
School of Information Management and Systems
Monash University

Abstract

This paper describes Australia's gender segregated workforce in relation to the current imbalance of women in computing. It explores reasons why this issue should be of concern to the ICT industry and society as a whole. Despite the fact that there have been many attempts to redress the imbalance via intervention programs the continuously falling numbers would indicate little success. While evaluation could determine program effectiveness there is evidence of a lack of evaluation of intervention programs. This paper reports on work in progress on an investigation into the evaluation of such programs.

INTRODUCTION

Only 21% of the ICT workforce in Australia are women (Poole 2005). Australia's workforce is more gender-segregated than that of most other industrialised countries (Gray 2003) although having fewer women in specific areas of employment is not unique to computing. There are fewer women who are trades people and fewer women who are mathematicians. Equally there are areas of employment where men are underrepresented; there are fewer male teachers in our schools, there are fewer men in the health and community services sector and there are fewer male clerks (ABS 2002).

Gender imbalance in specific areas becomes a problem when the gender spread has a detrimental effect on some sections of society.

Women have dominated the teaching profession in Australia, particularly at the primary school level, for a long time. In recent years the number of male teachers has fallen to a point where many primary schools have no men on staff at all (ABC 1999). Consequently many young children have no male role models at school. Many children also do not have male role models at home as there are 1 million single-parent households in Australia, most of them run by mothers (ABS 2002). The lack of daily contact with a male role model is a situation which is detrimental for these young children. Gender inequity is then, of concern in teaching and a number of studies are currently looking at ways to encourage men back into the classroom and schoolyard. In 2005 the Federal Government has responded by making changes to the Sex Discrimination Act, enabling them to be able to offer 500 scholarships for young men to undertake education degrees and to become primary school teachers (Guerrara 2005).

Wulf (1998) explains that with a gender imbalance in the engineering workforce 'we limit the set of life experiences that are applied, and as a result, we pay an opportunity cost, a cost in products not built, in designs not considered, in constraints not understood, in processes not invented'. This is equally true of computing and consequently computing is another area where gender imbalance is of concern and needs to be addressed. New technologies bring about changes that have the potential to affect all society and 'would be most likely to achieve maximum benefit if each significant section of society was represented in the planning decisions' (Ryan 1994, p. 548). Without women in the ICT workforce the different perspective, priorities and operating styles women bring to the design and development of systems is lost (Women in Science Technology and Engineering Advisory Group 1995) resulting in systems that do not meet the needs of all.
This paper provides background statistics of women's participation in IT education and programmes that have been established to address this issue. It then describes an approach to establishing an evaluation framework which will enable better understanding of whether an intervention programme has been successful or not.

BACKGROUND AND MOTIVATION

The ideas, curiosity and advanced thinking that led to the creation of the computer evolved over time, with many people from around the world making a contribution. Australia moved into the modern computing era with the development of the CSIR Mk1 in the late 1940s (Pearcey 1994). This machine, later renamed CSIRAC, was the first computer in Australia and it was arguably the fourth or fifth electronic stored program computer ever developed in the world (Jones and Broomham 1994).

Computer education commenced in numerous universities in the late 1950s (Pearcey 1994). In high schools, computer education was initiated in the mid 1960s 'by a handful of enthusiastic maths and science teachers, [who were] mostly male' (Sale 1994, p. 155). It was the mid 1980s when the lack of female computing students emerged in the literature as an 'issue' (see for example Symons 1984; Kay et al, 1986; 1989). The Federal Government responded in 1990, by setting targets for Universities to increase the proportion of female computer students to 40%.

This imbalance of women in computing is not unique to Australia. The literature describes similar situations, or even worse, in countries such as the United Kingdom, America, Germany, the Netherlands, and South Africa (Galpin 2002). In other parts of the world such as Malaysia, Singapore and Hong Kong the industry is much more gender neutral (Edwards 1998).

In many countries, where imbalance has been an issue, numerous programmes aimed at encouraging more female students to consider computing and successfully complete courses have been conducted over the last twenty years. Programmes have also been created to equip these students with the necessary skills and contacts to obtain jobs and career recognition and then for support to stay in the industry (see Table 1).

<table>
<thead>
<tr>
<th>Stage</th>
<th>Initiative</th>
<th>Discussion references and examples</th>
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<tr>
<td>Pre-tertiary</td>
<td>Adopting different teaching methods</td>
<td>Bernstein 1990</td>
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<td></td>
<td>Providing accurate information</td>
<td>Jepson and Perl 2002; Martin and Staehr 1994; Van Der Vyver, Crabb and Lane 2004</td>
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<td></td>
<td>Creating teacher awareness</td>
<td>Razz 1993</td>
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<td></td>
<td>Profiling successful women</td>
<td>Clayton et al 1994</td>
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<td></td>
<td>Providing equal access</td>
<td>Kushan 1995; Jepson and Perl 2002</td>
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<td></td>
<td>Creation of engaging videos</td>
<td>Clarke and Teague 1993; Egea 1994; Frenkel 1995; Townsend 1996; Craig et al 1998</td>
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<td></td>
<td>Improving the curriculum</td>
<td>Duplantis et al 2002; Martin 1992</td>
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<td>Tertiary</td>
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<td>Teague et al 1996</td>
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<td></td>
<td>Creating mentoring programmes</td>
<td>McGrath Cohoon 2002; Sampson 1993</td>
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<td>Telementoring</td>
<td>Hakkila and Beckhuyzen 2005</td>
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<td>Creating orientation sessions</td>
<td>Cartwright and Colville 1994</td>
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<td>Providing positive role models</td>
<td>Hemenway 1995; Pfleeger 1995</td>
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<td></td>
<td>Providing extra tutoring</td>
<td>Martin et al 1996</td>
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<td></td>
<td>Using pair programming</td>
<td>Werner et al 2005</td>
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<td></td>
<td>Creating single-sex classrooms</td>
<td>Logan 2004</td>
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<td>Post tertiary</td>
<td>Creating support communities</td>
<td>Gabbert and Meeker 2002</td>
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<td></td>
<td>Providing workforce strategies</td>
<td>Scollary et al 2003</td>
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In Australia, undergraduate female enrolments peaked in Computer Science and Information Systems, during the early 1990s, at 27.2% (Lang 2003). In 2004 approximately 20% of commencing tertiary information technology students were female (DEST 2005). The 40% target set by the government in 1990 was never reached. Falling numbers of women entering ICT courses also continues in many of the countries previously mentioned.

This leads us then to question the efficacy of these programmes and provides a major motivation for this research, that given the considerable efforts of many to raise the level of involvement of women in ICT, the numbers are still falling. Were any of the initiatives therefore successful? How can their success be measured? If success is measured by the current percentage of women in computing courses and graduation rates, across the nation, then the programmes must be seen as a failure with a decline from 27.2% female students to 20% in 2004. This view however, is too simplistic as there is no way of knowing what the percentage of women in computing would have been without the intervention programmes.

Many programmes have been initiated with very good intentions. These are often costly, such as the case of producing an informative and appealing video and many videos in fact have been produced over recent years. Only limited evaluations however have been conducted to establish the extent to which any of them have achieved their objectives. The expected outcomes of this research therefore are:

- The development of an appropriate evaluation framework that can be applied to intervention programmes and therefore make it more likely that outcome evaluation will take place, sound conclusions can be drawn and results will be disseminated.
- A greater understanding of the factors that contribute to successful intervention programmes, focusing on the enrolment and retention of female students in computing courses

Even after almost 20 years of effort by many, the imbalance of women in the ICT field in Australia and elsewhere is a continuing problem. Clayton (2005) indicates that not only is the situation worsening but 'we are no closer to [finding] a solution'. While Teague (1999) suggests that change will require a wide range of different interventions over a long period of time and in particular government initiatives, directed at large populations, to make inroads into the issue, some fresh ideas and new approaches may be required.

EVALUATION OF INTERVENTION PROGRAMMES

It is not enough to implement a program or service – it is imperative we know if it has made a difference (Slatter 2003, p4).

A recent analysis by Parker (2004) of the research papers related to gender and computing, presented at eleven Gender and Science and Technology (GASAT) conferences (held from 1981 – 2001) categorised the research described by the papers according to: access to learning, process of learning, and outcomes of the teaching/learning process. The majority of the papers presented focused on various dimension 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.

Darke, Clewell and Sevo (2002) evaluated the impact of the National Science Foundations (NSF) Program for Women and Girls (PWG). An in-depth study of a random, stratified sample of 40 of the 100 separate programmes was conducted. The study categorised the impact of the programmes on three areas; knowledge capital, social capital and human capital. Recommendations from this study included:

The evaluation of gender equity programs would benefit from the development of standard measures of program outcomes to encourage the collection of uniform evaluation data by programs (p. 300).

and

The development of creative approaches to evaluating the impact of intervention programs will deepen our understanding of the effects of these programs (p. 300).

Along with the NSF, the American Association of University Women (AAUW) Educational Foundation is another strong supporter of gender equity projects. The report Under the Microscope (AAUW 2004) examined a
decade of gender equity projects in the Science, Technology, Engineering and Mathematics (STEM) fields funded by either the NSF or the AAUW. The aim of the study was to find programme patterns including strengths and weaknesses in each of the four discipline fields. A case study method was used with every one of a total of 416 final project reports regarded as a separate case study.

In the Technology area, 123 projects were investigated of which 71% were interdisciplinary in nature (combining technology with one or more of the other STEM fields). Every one of these technology projects specified a goal, unlike many projects in other fields (AAUW 2004). The main type of technology projects related to the use and development of software applications and the second major type focused on providing career information. 76% of the projects were aimed at middle or high school students and 12% of the projects focused on university level students. The principal finding of the analysis of these projects indicated that too few of these projects targeted an increase in the depth of ‘technical’ knowledge of the participants by offering career advice without ‘providing the necessary skill and content development’ (AAUW 2004, p. iii).

A major conclusion of the report was that across all STEM fields ‘a lack of project evaluation make[s] it difficult to determine who is being served and if and how project outcomes are measured’ (AAUW 2004, p. iii). The fact that the literature on women in computing is predominately focussed towards ‘access’ and ‘process’ with little being written about ‘outcomes’ highlights a problem with the evaluation of intervention programmes established to encourage more women into computing. Very few detailed evaluations have been published in the scholarly literature. In fact, Teague (1999, p. 56) suggests that there is a ‘paucity’ of intervention evaluations in the women in computing literature. One possible reason is that if typically small scale interventions are evaluated quantitatively, and there is no significant change, then the evaluations are not considered worth reporting. Of the programmes which Teague (1999) found that had been evaluated the majority of the evaluations were conducted qualitative rather than quantitative. Equally von Hellens et al (2005) suggest that intervention programmes can be difficult to evaluate and frequently there can be a lack of resources to ‘deeply analyse’ the outcomes of such programmes.

The aim of the work described in this paper is to provide an evaluation framework which will support the evaluation of intervention programmes (be they small or large scale). This would therefore make it more likely that outcome evaluation will take place, results will be disseminated, and sound judgements can be drawn.

EVALUATION THEORIES

Here lies the great promise of evaluation: it purports to offer the universal means with which to measure ‘worth’ and ‘value’. Evaluation, in short, confers the power to justify decisions (Pawson and Tilley 1997, p. xii).

Evaluation is described by Pawson and Tilley (1997, p. 1) as a ‘young discipline’ which has evolved since the late nineteenth century. Guba and Lincoln (1989) suggest that there were problems with early evaluation as they relied on scientific methods which failed to take into account the social, cultural or political context of the evaluation and of the project being evaluated. Wadsworth (1997, p. 57) suggests that currently there a ‘bewildering range of ways presented for people to carry out evaluation’ including summative, formative, process, output, outcome or impact evaluation. However, she clarifies this by indicating that many of these ways actually focus more on a ‘particular stage of the matter being evaluated’ (p. 57) as if it were a separate section, than being an entirely different type of evaluation.

Rossi, Freeman and Lipsey (1999) suggest that one particular evaluation activity is the assessment of programme outcomes though acknowledged that evaluation can also focus on the need for a particular programme, its design, operation and service delivery or efficiency. Outcome evaluation, which they equate to impact evaluation, is a study that answers questions about programme outcomes and the ‘impact on the social conditions it is intended to ameliorate’ (Rossi et al 1999, p. 36). Other researchers (eg Lowe, Kinder and Nutbeam 2001) differentiate between ‘outcome’ evaluation and ‘impact’ evaluation: Outcome evaluation can be seen to be linked to assessing the endpoint of interventions while impact evaluation can be considered as the evaluation of the immediate effect that the programmes have on people, stakeholders and settings.

Wadsworth (1997, p. 31) believes that evaluation conclusions need to ‘shape and drive’ the next cycle of evaluation research by providing the ‘comparative frame of reference’. Pawson and Tilley (1997, p. 115) suggest however, that too many evaluations are ‘one-off affairs’ which do not refer back to findings from previous evaluations nor are they forward looking to future evaluations. Pawson and Tilley (1997) argue that it is necessary to create ‘cumulative evaluation’ if the purpose of evaluations is to bring about improvements in policy and practice. Rossi et al (1999) contend that if the purpose of programmes such as intervention programmes is in some way to improve human condition, the purpose of evaluation, in turn, is to improve the
programmes. They argue that it is important to evaluate not only the social programmes that are currently in operation but also those in various stages of design and testing. The definition they put forward for evaluation of programmes is 'the use of social research procedures to systematically investigate the effectiveness of social intervention programmes' (Rossi et al 1999, p. 4).

When evaluating intervention programmes researchers also need to consider unforseen effects and external factors which may have impacted on the delivery of the programme and outcomes. It can also be difficult for researchers to compare outcomes where programmes have not been implemented.

Performance indicators can provide the evidence to compare the outcomes of the programme to the objectives. Owens and Rogers (1999) calls this type of indicator an effectiveness indicator and suggest that there are also efficiency indicators which consider the cost of obtaining the outcomes from the programmes. Wadsworth (1997) is concerned with how the indicators are developed and suggests that a 'bottom-up' approach will generate better indicators. These can be created by asking programme stakeholders questions such as 'How would you know if this was a good programme?' etc which force stakeholders to reflect on what they are experiencing. Indicators that are generated from a top-down approach may be 'crude or even distorting' (Wadsworth 1997, p. 99).

Kavanagh and Henry (2002, p. 1) suggest that evaluation is an 'enquiry process that can deliver outcomes across the three registers of accountability, improvement and understanding'. They suggest that there are a number of issues which need to be considered when undertaking evaluation; whether quantitative or qualitative paradigms are used, whether the evaluation is conducted externally or internally, the empowerment of evaluation and ways of having findings used from the evaluation.

Pawson and Tilley (1997, p. xiii) reason that there is no single evaluation strategy that will be able to answer all the questions of 'why a programme works, for whom and in what circumstances'. The evaluation literature however provides a number of frameworks to assist in the process of evaluation. Examples include the Owens and Rogers (1999, pp. 53-4) conceptual map for evaluation which provides a clearer perspective for the possible processes for completing evaluations. Wadsworth (1997) describes her conceptual framework as The Action Evaluation Research Process which has the cycle of: current actions; reflection; design; fieldwork; analysis and conclusions; feedback; planning; new actions in a spiral process - so one cycle feeds into the next creating a helix of evaluation. Funnell (1997) suggests that Program Logic is a useful and adaptable tool for designing and evaluating programmes.

McDonald (in Rogers 2002) declared 'Some people think evaluation is always good for you – it's like brushing your teeth'. However not all evaluations make a positive difference or are helpful. Evaluation has been used by some programme proponents to show that ineffective programmes are indeed effective (Meyers 1981) or to make overly optimistic claims about a programme (Rogers 2002). There may be inadequacies in the handling of the evaluation or constraints on the evaluation which affect its results. When evaluation is added as an afterthought or is under funded then it is not being treated seriously (Meyers 1981).

Useful and meaningful evaluation however, can support learning (Patton 2001) question assumptions, generate new knowledge (Earl et al 2001) and improve programmes (Meyers 1981). Scarce resources need to be directed were they will do the most good. Evaluation is a means to see which programmes are the most effective and which programmes are not having the desired consequences. The quest then, is to ‘make a difference through evaluation’ (Rogers 2002). Patton (1997) however, warns that conducting the evaluation may be simpler then ultimately getting the findings of an evaluation used, a notion support by Rossi et al.(1999) who argue that evaluation studies must be used, to be worthwhile.

PROPOSED RESEARCH APPROACH

This research project aims to identify appropriate intervention programmes as a unit of analysis and use case study methods to examine the success or failure of such intervention programmes by interviewing the participants who were involved in establishing and running the programmes. This examination will include an investigation of how, and if, each programme was evaluated (formally or informally) and whether the evaluation, or lack of evaluation, contributed to the success or failure of the programme. Ultimately this study will provide a framework for the evaluation of intervention programmes and a better understanding of how to design, implement and evaluate future intervention programmes.

A qualitative multiple case study approach will be adopted for this research utilising cross case analysis, in-depth interviewing and document analysis. 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 2000, p. 3). This research study will use a qualitative approach as it enables the researcher to understand the events involved in intervention programmes, through the perspective of initiators of the programmes and to obtain the rich detailed data required to make sense of the programmes, their context and their evaluation.

The research questions are:

• What are the major intervention programmes which have been established in Australia in the last twenty years?
• How did, or do, these programmes operate?
• To what extent have these programmes been successful from the initiators perspective?
• To what extent have these programmes been evaluated by those initiating the programmes?
• What evaluation criteria can be included in a framework which could be applied by those looking to develop future programmes?
• What evaluation criteria should be used to evaluate such programmes to increase the likelihood of their future success?

The intervention programmes which will become the case studies for this research will be selected on the following basis:

• Its objective will have been to increase the number of women studying computing;
• It will have been a sustained activity (For example a workshop aimed at secondary girls that was conducted once would not be considered a sustained activity. However a series of such workshops held over a number of years would be considered a sustained activity);
• The principal leader of the project is prepared to participate in this research (the corporate memory must be around – and they need to be able to recall enough of the detailed information about their project to be able to participate in this work);
• The programme can include completed projects or be ongoing.
• The length of time in operation and range of influence of the programme will also be considered.

Within the context of research in the information systems discipline the cross-case analysis enhances generalisability but a more fundamental reason to do this is to deepen our understanding and explanation (Miles and Huberman 1994). Currently six intervention programmes have been identified for investigation. Each of these individual programmes has been a sustained activity with multiple intervention activities conducted. Each of these case studies will be a concentrated inquiry into that particular intervention programme. However the number of cases that will be included in the final study is not known at the outset. The results of each case will inform the research into the next case until no new data emerges.

CONCLUSION

This paper has described a research project which aims to explore issues in intervention programmes that have been designed to redress the imbalance of women in computing education programmes and the computing workforce. The study is motivated by the apparent ineffectiveness of intervention programmes as evidenced by the falling numbers of women participating in computing.

This research will explicitly explore the evaluation of intervention programmes and the relationship between evaluation and the success or failure of intervention programmes. The outcomes of this study will also include the development of an evaluation framework based on the results of the case studies; and an improved understanding of whether successful intervention programmes can be set up and, if so, how to design, implement and evaluate them.

REFERENCES


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