Women and Information Technology: Research on Underrepresentation
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REVIEW
With recent news of A Level exam results in the UK indicating that although girls are outperforming boys in many STEM subjects they formed less than 10% of computer science entrants, it is clear that the issue of women's under representation in technology is still of major concern. Indeed, as the authors of this book state in their introductory chapter 'We have to face the fact that 25 years of interventions have not worked' (page ix). This edited volume brings together a collection of empirical studies that aim to unpick the persistent conundrum of women's lack of progress and visibility in computer science and IT. The starting point for the authors is that despite plentiful evidence of the problem, there is a need to 'shine the cold, hard light of scientific research on the situation' (page ix), and the book does this with some degree of success.

Most of the chapters are based on the results of US-based studies that were funded through the National Science Foundation (NSF) IT workforce program, a major government funded research programme in the early 2000s. For non–US audiences, some of the detailed nuances of the US education system

and social/ethnic stratifications may not translate easily into their own country contexts. One of the strengths of this book, however, is that it aims to avoid sweeping generalisations about gender and IT. Instead it examines the contextual differences between countries, ethnic groups, types of universities, and between courses and levels of study. This echoes a recent study of attrition from the US IT workforce, which argued that research and interventions must be responsive to the variations between women and within IT workplaces (Trauth et. al., 2009). Importantly, several of the studies in this book address the issue through the lens of intersectionality – i.e. they address both gender and ethnicity and the interplay between the two as contributory factors in under representation.

The book is divided into three sections that focus on schools, higher education and the transition into employment respectively, and thus the book is firmly focused on the educational 'pipeline' as the root of women's under representation in industry. The usefulness of the pipeline metaphor is, however, contested at various points in the book, mainly for being an unsuitable model for representing the multiple and often convoluted paths that many IT professionals have taken. Each of the sections is introduced by a literature review, and these introductory chapters are perhaps the most valuable in that they offer a comprehensive survey of existing literature, albeit mainly from the US and other English speaking countries. There is one caveat however – as a synopsis written originally in 2006, and drawing on research from the 'past 15 years', there are inevitably a number of papers cited that were published in the early 1990s. While the authors are clear to say that they have ignored issues about access to computer equipment and skills, which were considered to be the main source of inequality in the 80s and 90s, there have been such enormous changes in IT and computing during the intervening period that some research is really no longer relevant to current debates. This is particularly true of the third section - pathways into employment - which fails to represent adequately the changing nature of IT work in recent years.

In the first section, which focuses on schools, there are a couple of noteworthy points. Firstly, that most computer science educators in schools have often been, and still are, teachers who have picked up ICT skills rather than experts in their field. Consequently the ICT skills of pupils/students are often way ahead of the teaching curriculum. Similarly, computing in schools tends to be taught in a hands-on rather than theoretical way and is therefore not really a good preparation for higher level study. Secondly, despite widespread anecdotal acceptance that playing computer games leads boys seamlessly into IT careers and therefore disadvantages girls, there seems to be no firm evidence base for this conclusion. Other interesting observations relate to the anomalies of education systems. So, for example, in Chapter 3 the authors (Goode, Estrella and Margolis) find that high achieving girls are likely to drop computer science because it is not considered academically rigorous enough for entry to top colleges. The social context of learning is also important. In Chapter 4 Barker, Snow, Garvin-Doxas and Weston

conclude that recruitment of girls to computer science classes could be helped by encouraging groups of girls to sign up rather than targeting individuals.

The second section, which starts with a résumé of literature about postsecondary education, also offers some important insights. One clear conclusion is that research based on other STEM subjects cannot be easily transferred to IT. The trend in STEM subjects overall has gradually been towards greater equity in participation, but the opposite trend has been apparent in computer science and IT, including a high attrition rate of women already enrolled to study computer science courses. Contributory factors considered in the literature are familiar - masculine culture/values; early socialisation; essential/innate difference; rationale choice theory (linked to choices made in favour of work life balance); and, structural factors within institutions or educational systems. A quick summary of various interventions that have been reported in the literature comes up with the usual suspects, and yet surprisingly there is little in the way of evidence to support the success of any of them. Interventions such as changes to the curriculum, peer group support, role models and mentoring all have some impact, but none provide any sustainable results in terms of gender parity. Indeed, faculty mentoring appears to help all students, regardless of gender. As Cahoon (Chapter 7) argues, local environmental conditions can have an impact on retention, but these must be multifaceted. No single measure can make a difference on its own.

Charles and Bradley's cross national comparison (Chapter 6) provides a detailed analysis of Organisation for Economic Co-operation and Development (OECD) data from 21 countries. While data is often hard to compare between countries because of different ways of keeping records, they highlight the significance of different educational systems in shaping choices or career decisions and the potential gender impact this can have. Yet it is not just at a country level that comparisons can usefully be made. This broad statistical approach is complemented by the qualitative study in Chapter 10 Varma, Prassad and Kapur use Bourdieu's concept of habitus to look at cross ethnic differences in relation to gender and IT. They highlight how different groups respond to gendered encounters within the framework or dispositions formed by their own ethnically gendered experiences.

One of the difficulties in properly understanding the state of gender in computing education is the wide range of courses that are encompassed by this relatively new and evolving discipline. Chapters 9 (Ogan, Robinson, Ahuja and Herring) and 11 (Beyer and DeKeuster) deal directly with this issue and compare computer science with other IT based courses (such as management information science), concluding that differences between IT fields and courses are significant and cannot easily be generalised across disciplines.

While most of the studies are based within conventional university learning environments, chapters 8 (Jesse) and 14 (Bartol, Williamson and Langa) look at non-traditional students, i.e. older women and minority ethnic students, who are more likely to attend 'for-profit' private universities offering vocational and skills based degrees, or who have come into IT via community based training centres that specialise in supporting the educationally excluded. While their qualifications may not be as highly regarded in academic circles, these students form a significant pool of entrants into the IT labour force, and the inclusion of research relating to these students is a welcome addition.

This is not a book about solutions or initiatives, nor does it aim to develop new theoretical frameworks for understanding the gender/technology relationship, but as an evidence-based collection about the lack of women and girls in IT in the US it should certainly be required reading for anyone interested in this field. Reading this volume immediately immerses you in the wide range of debates and issues that surround women and IT. Despite some reservations about the currency of the literature reviews, this book is perhaps the most comprehensive collection of papers about under representation currently available.

REFERENCE

Trauth, E.M, Quesenberry, J.L and Huang,H. (2009) Retaining women in the U.S. IT workforce: theorizing the influence of organizational factors, *European Journal of Information Systems,* 18: 476-497.