

The Pipeline and Beyond

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INTRODUCTION

Women have been involved with IT since the 19th century, when Ada the countess of Lovelace was the first programmer for Charles Babbage's analytical engine. Grace Murray Hopper's contributions to COBOL and computing several decades ago are considered so significant that an annual conference is held in her honor (see <http://www.gracehopper.org>). In fact, the earliest computer programmers tended to be women more often than men (Panteli, Stack, & Ramsay, 2001). As the IT field progressed, however, it evolved into what many still view as a male-dominated domain, some say due to its increasing association with power and money (Tapia, Kvasny, & Trauth, 2003). Today, women make up at least half of World Wide Web users (Newburger, 2001), but this has apparently not translated into a proportionate participation in IT careers.

IT managers must recruit and retain a skilled and diverse workforce in order to meet the needs of increasingly global enterprises where cross-cultural, heterogeneous work groups are the norm. However, numerous sources (Information Technology Association of America [ITAA], 2003; Zweben, 2005) agree that the proportion of females to males selecting and completing degrees in IT-related fields is declining. Not only are women missing out on career opportunities, but the IT profession is also missing

potentially valuable alternative perspectives on system design (Woodfield, 2002).

Worldwide, the digital divide is more extreme for women than men (Hafkin & Taggart, 2001), with the result that in many developing countries, women's access to computers is more limited than men's access. However, IT is an important driver for economic development and should provide women with new opportunities to better their circumstances, provided that a variety of challenges, such as technical education and social and political norms, can be addressed (Hafkin & Taggart, 2001).

Even in more developed countries, females face well-documented (Margolis & Fisher, 2002; von Hellens, Nielsen, & Beekhuyzen, 2004) obstacles all along the pipeline beginning as early as middle school and continuing through college, graduate school, and the career. Developing solutions to recruit and retain women in IT may serve other underrepresented groups as well, making IT classrooms and IT workplaces more inviting and ultimately more productive environments for everyone.

BACKGROUND

Part of the challenge of recruiting and retaining women in IT stems from a lack of knowledge by the public in general about the changing nature of IT work. The original focus of IT in the 1950s was on

writing code to create computer programs. Unfortunately, many today, including the media, still see programming as the primary IT job (Denning, 2004). Earlier investigations into women and computing suggested that IT work by its nature was a poor fit for females, seen as solitary and boring, a double-edged stereotype that apparently still exists today (American Association of University Women [AAUW], 2000a; Galt, 2002; Symonds, 2000). It is double edged because it perpetuates myths about IT, as well as about women, and so restricts their access to the field.

Another part of the challenge of recruiting and retaining women in IT is related to the definition of IT work, which is difficult to pin down (Gallivan, 2004). The field has evolved, and IT has become more integrated into most business organizations and into the work and home lives of many individuals, creating a wide variety of IT jobs. Today, IT work includes not only job titles such as programmer, systems analyst, system administrator, and software designer, but also software engineer, business analyst, database designer, database administrator, network analyst, network administrator, Web developer, Web engineer, human-interface designer, project manager, applications developer, security administrator, and help-desk technician.

Concurrent with the expansion of IT job titles and responsibilities, there has been an expansion of the venues in which IT is taught. For example, the computer-science (CS) curriculum focuses primarily on technical and related theoretical concepts with emphasis placed on software creation. The information-systems (IS) curriculum integrates technical skills and knowledge with applied business and organizational concepts. IS programs are sometimes found in business schools, other times in schools of science, engineering, or even stand-alone IT units. Variations include business information systems (BIS), computer information systems (CIS), and management information systems (MIS). The information-technology curriculum may focus on a specific subset of technology such as fourth-generation languages and maintenance. For the purposes of this article, IT is defined as an umbrella term that encompasses a variety of job categories that continue to evolve as hardware, software, and methods continue to increase in sophistication.

EARLY INFLUENCES

A growing body of educational research documents many factors that influence female attitudes, perceptions, and behaviors toward computers in K-12 (Ahuja, 2002; AAUW, 2000b; von Hellens et al., 2004; Young, 2000). In addition to general sociocultural trends that appear to dampen girls' enthusiasm and self-efficacy regarding math and sciences around middle school, girls seem to be influenced by the following:

- Low interest in computer games
- Teacher, parental, and peer attitudes
- Lack of access to and experience with computers
- Perceived usefulness, or lack thereof, of computers to themselves and to society
- Lack of IT role models and mentors
- Media images

These variables may be grouped into two main categories: environmental and individual. Environmental variables are those that make up the context within which career decisions are made, such as school or work, while individual variables are characteristics of individuals, such as aptitudes and preferences (Woszczyński, Myers, & Beise, 2003). Both interact to influence the choices and behaviors of individual girls and women (Trauth, 2002).

COLLEGE, GRADUATE SCHOOL, AND THE IT WORKPLACE

Some of these same factors apply as women move into college and graduate school. In a survey of Canadian college freshmen, both male and female students' perceptions of a career's prestige, required education, and starting salary were inversely related to their estimate of the percentage of women employed in it (Harris & Wilkinson, 2004). Often, due to less previous experience with computers and less preparatory coursework, women continue to experience ambivalence about their interest and abilities in IT, in spite of equal performance regarding computer skills. They often encounter hostile

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