

# INCREASING THE APPEAL OF INFORMATION TECHNOLOGY: INITIATIVES IN UNDERGRADUATE CURRICULUM

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## ABSTRACT

Throughout the United States, the declining participation of female students in undergraduate programs in IT fields presents a problem that has been very difficult to solve. The Computer Information Systems Department at Cal Poly Pomona is not unique, but it is alarming to the faculty that the proportion of female majors has now dropped to about 10 percent. This paper outlines the problem and steps that the faculty are taking to try to encourage females to enter the major and to persist until graduation.

## INTRODUCTION

Despite the weak economy, the job outlook for Information Technology (IT) is quite good; for example, projections indicate that from 2008 to 2018, computer and mathematical occupations will “grow more than twice as fast as the average for all occupations in the economy” [13, p. 85]. IT careers can lead to high pay, job security and promotion. However, the number of women in IT has been dropping steadily for the past 20 years. In 1991, 36% of the IT workforce was female; by 2008, only 25% were female [3]. In the Computer Information Systems (CIS) major at Cal Poly Pomona (CPP) in Fall 2009, 16% of the 70 first-time majors were female; in Fall 2010, only 10% of the majors were female. This trend is not unique to CPP. Similar academic departments throughout the country have been seeking ways to increase female enrollment. Further, this trend is not unique to CIS; it is true of computer science and information technology. Some universities, such as Harvey Mudd [1] and Carnegie Mellon [5], have had success in increasing the numbers of women in computer science majors. However, these private institutions can afford many strategic initiatives. State schools and public universities must also find creative ways to achieve balance in their IT majors in order for larger numbers of women to reach the IT workforce. Thus, this paper focuses on the initiatives being implemented in the CIS department at CPP under tight resource and budgetary constraints. The paper begins by summarizing the arguments for adding diversity to the major, and briefly notes some of the research that has investigated this topic. It then outlines several initiatives to increase female numbers, and the rationale behind each. The paper ends with suggestions for greater impact on the larger IT workforce.

### **Why Should We Care About Adding More Diversity to IT?**

*IT labor shortage.* Not enough college students, male or female, are seeking technical degrees. A US talent shortage is predicted for computer specialist occupations to 2018 [14].

*New products.* Women use social media more than men do [15]. Yet, when it comes to innovation and development of technologies, women are glaringly underrepresented [11]. Imagine all the never-developed apps in the Apple Store, because underrepresented groups do not participate in development.

For example, Fredros Okumu, an African scientist recently developed traps to fight malaria baited with the scent of used socks [17]. This effective, life saving technology was possible because of the unique experiences and perspectives of someone living in an area of high malaria. If we want to diversify our offerings, a broader workforce of backgrounds and experiences could help [2].

Diverse teams. When development teams have diverse membership, they can outperform homogeneous teams. Teams with diversity can run the risk of having too much conflict. However, when the conflict is resolved and brought to the surface, often the result is higher creativity, better decision-making and generation of more alternatives [2] [13]. Diverse perspectives also have been shown to reduce project risk [4].

Ultimately, firms lose money by not capitalizing on a diverse labor force. Also, developing an IT labor pool that resembles clients may foster better communication on product teams.

### **Why Women and Students of Color Tend Not to Select IT-related Majors**

It is disturbing that so few women and students of color select IT as a major, when disciplines like medicine, law and mathematics seem to have made greater progress on this problem [8]. As with these other disciplines, some of the issue has to do with culture, perception and unconscious bias. These problems are large, embedded in colleges and industries and not easy to change. Several academics have theorized about the lack of diversity in technological fields. Some thought the problem would fix itself, once enough women enrolled in IT undergraduate degree programs, while others felt that women simply did not like computers.

Myth = “It’s the pipeline”. Once enough women are earning degrees in technology, the critical mass will fill the IT jobs to balance the labor force [6] [7] [18]. In reality, just the opposite has happened [18]. The number of women seeking undergraduate degrees in IT has dramatically declined. Camp [6] describes the ‘Incredible Shrinking Pipeline’, giving evidence of the plummeting numbers of women between high school and graduate school. Not only is the number declining, but over time, the numbers of women at each stage of the pipeline is getting smaller. So, it is hard to believe that the numbers of women in IT will increase once the pipeline has a larger supply of women, because there is no promise of a growing supply.

Myth = “Women don’t have what it takes”. In 2005, Lawrence Summers, the president of Harvard made remarks that the underrepresentation of women in the sciences is due to what can be described as genetic differences. If the president of a prestigious university believes women are not capable, imagine how many employers feel the same way. When people think about professional images of computing, the stereotype is of socially awkward men with pocket protectors or male hackers that dominate the network. When women see men so excited about computing, women think they are missing something in their personalities that would make them more successful. However, academic performance does not show this to be the case. Often American women feel inadequate in the computing classroom, even if they earn higher grades than the men [12]. Malaysia and India do not suffer from this illusion. In both these countries, women hold half or more of the IT related jobs [19]. The computing jobs offer good employment and a safe working environment. In India, some of the jobs could be done at home which worked well for women with families. This shows, then, that women do have the brains and ability to hold technical jobs. They just do not do it in this country.

Myth = There isn’t enough human interaction. Another fiction that keeps women from IT careers is that IT jobs do not have any human interaction. Computers do things that people want and need. The most essential skill to making this happen is communication, not programming. If you are working a help

desk, designing a mobile app or installing SAP at a giant company, you will have to interact with people, work on a team, and use tact and diplomacy to get the job done well. The stereotype of computer jocks, sitting alone at a laptop, only communicating if you give them cookies, is funny in popular culture but not accurate when it comes to real work. Software development requires talented communicators and boundary-spanners at every stage of the life cycle. Better communication skills often lead to better products.

Reality = IT has a chilly climate towards women. Sadly, most of the research indicates that women do not select computing as a career because of its “chilly climate” [18] and continued subconscious bias towards women [6]. Subconscious bias means that people discriminate against you, not necessarily meaning to or in an overt way; for example, describing girls as cute and boys as active. Or, in employee hiring, often a man’s resume is viewed as accomplished and a woman’s is viewed as lacking, even if they have the same qualifications. A woman may need to prove her skill on the job, while a man’s qualifications are not questioned.

In addition, the ‘computer jock’ mentality intimidates people and may keep both men and women from seeking IT degrees. A more gender-balanced classroom can have a profound effect on transforming IT departments towards a culture of inclusion.

## POSSIBLE SOLUTIONS

CPP is most known for its learn-by-doing approach to learning. The CIS program is an option in the College of Business. Students take a business core that includes accounting, finance, human resources, marketing and operations management. Then as juniors, the students specialize in a CIS core that includes programming, analysis and design, database and telecommunications courses. Students take additional electives in a specialized area of IT, capped by an industry-based senior project as part of a team.

The CIS faculty at CPP are working on several initiatives to increase the persistence of women students in the major and to increase the numbers of female students. Among these initiatives are:

Female faculty and industry role models are often included in programs to attract and retain women. The CIS faculty has been 40% female for a long time. Once again, if the pipeline has no women coming into it, it would be hard for them to appreciate having a female faculty member as a role model. We have also developed a mentoring program, partnering women professionals with undergraduate women. Female students have an opportunity to network, seek career advice and learn from successful women IT professionals. This small program has grown to include men, requiring students to form professional networks as students and to examine different types of IT work.

Promoting scholarships to celebrate the achievements of female students and to retain them in the CIS program has been successful. Local industry women’s groups (Association for Women in Technology) and large companies (Boeing) have generously supported female students in our department. To get women to participate, a focused email campaign targets women with high academic achievement.

Student advising is available to all CIS students. With such a large student body, usually, the advising goes to students with very high academic achievement or those with very low academic achievement. The department advisor is a woman with professional IT experience. Having a woman advisor may be more welcoming to female students.

Preparation of a handbook for high school and early college age students that provides role models and strategies that are successful for women with IT careers, currently in development. This handbook will contain the short career stories that women tell about themselves and the kind of IT work they do. This handbook will try to dispel those misconceptions about the “nerdy” quality of the IT work that is reinforced by the numbers of nerdy males that the few females meet when they now walk into an IT classroom. This book will be available at little or no charge to female students, academic and career counselors, etc., and will try to resolve some of the “pipeline into the career” issues.

Marketing the course to women in other majors that initially attract women students, who then find their first choice is not what they want. The CIS department regularly attracts students who begin their studies in Computer Science or Computer Engineering and then discover the demands of physics and higher mathematics, and decide to change their majors. However, the numbers of females in these majors are also low. More likely fields from which to attract women students are Accounting and Mathematics. Both these fields have increased the proportions of female majors through special programs, cultural changes in academic departments, industry mentors, female role models, the efforts of professional organizations to draw in women, and the building of alliances between professional organizations [8].

Changing the curriculum to make it more female-friendly: The CIS faculty have developed a new introductory course for the major. In this new course, students will learn about the CIS field and its career opportunities, and participate in technical projects that are less frustrating than JAVA (the former introductory course), which appears to discourage women from CIS studies. Women students do not have the same technology backgrounds as males, and become frustrated and discouraged when they have difficulties with the work. They then believe that an IT career means they will never have work-life balance, even though there are IT career paths that do allow work-life balance. The course design includes interactive activities, speakers, and pair programming. Pair programming, is a practice in which two students work together on a project, constantly switching roles from “driver” (the one who types) to “navigator” (the one who checks for errors and researches solutions). This method helps less confident students (often women) be successful and finish the course [16]. Students in the class also are beginning to build their professional networks. They are connecting to a network of alumni mentors via LinkedIn, the professional social networking website. CIS alumni have indicated that they are eager and willing to give these students career advice. A number of alumni also will talk to the students about their careers and sit for interviews from groups of interested students. While this course is female-friendly and benefits from lessons learned during research on women in IT careers [8] [10] [20], it also should help males make better career decisions, and give them skills to begin working on their career success early in the CIS major.

The tactic that is still lacking to attract women into IT is a major outreach effort to educate female high-school students, parent and guidance counselors about the benefits of an IT career: namely, finding a job, great pay and promotion opportunities. The barrier to doing this is time and a lack of human resources. With the current economic climate in the university system, the availability of faculty time for such activities is very limited. Without relationships to local schools and active recruitment, it is difficult to impact the numbers of women entering IT majors as first time freshman. This confounds the problem of increasing the numbers of women IT professionals.

## **EXPECTED POSITIVE OUTCOMES**

Benefits to Female (and Male) Students: Attracting additional female students into the major so that there is a critical mass of female students in classes, will help them persist rather than find another major.

Current classes typically have three or fewer females (in a class of 28), and many classes are all male. The careers available to females with well developed social and organizational skills are waiting for them, and they pay very well.

Development of Supportive work environments, including networks that will move with the women as they go from company to company: Mentoring is a favored recommendation for female success in all STEM fields. However, one-on-one mentoring is hard to achieve without formal organizational structures in place, for example, those that exist in corporations such as KPMG. Research indicates that successful women have a more loosely formed network of mentors, who each provide assistance and advance for specific problems, and/or act as role models. By helping female students to develop this network of mentors they while they are in university, they may be able to continue to use them to support their professional careers once they seek jobs and start work.

Benefits to IT products for customers who use them: Since women tend to prefer a collaborative work environment [11], one can assume that they would develop IT products that are more appealing to other women, especially in such areas as social media. Social media technologies are very popular with individuals of all ages [15], and the demand is only growing.

Benefits to industry: The ability to use over half the college graduates (especially the half that seems to persist to graduation), to fill the highly skilled technical jobs of the future, would fill a gap that may be critical to the future of the US economy.

## CONCLUSION

The problem of low female participation in IT academic majors is not local to CPP, but exists across the country and across computing disciplines. Selected private universities with small enrollments have been able to implement successful programs to select and support female participation in their IT programs. However, public universities such as CPP usually do not have the resources to have similar programs. There is a need for others schools facing these same constraints and issues to attract and keep female students in their IT departments as well. If some of the methods in this paper can be implemented with fewer resources, so other academic programs may be able to adopt them to their context. We hope that the downward trend of female participation in IT careers can be reversed.

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