

AC 2007-959: A MULTI-PRONGED APPROACH TO ADDRESS THE IT GENDER GAP

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Professor Mariga teaches in the Department of Computer and Information Technology (CIT) at Purdue University, in West Lafayette, IN. Her areas of interest include virtual technologies and increasing the number of women students within CIT. CIT offers degrees in both information systems development and network engineering technology. She has co-authored a textbook, edited a second textbook, and written five chapters for other texts. She has published over fifteen referred articles and has written or co-authored numerous grants aimed at increasing the number of women students in CIT. She has been the recipient of numerous teaching awards at the department, college, and university levels. She is actively involved in the academic alliance for the National Center for Women & Information Technology (www.ncwit.org), served as a co-chair of the Birds of a Feather session and on the Program Committee for the 2006 Grace Hopper Women in Computing Conference and serves on the Curriculum Writing Committee for the ACM SIG Information Technology Educators (www.sigite.org).

Alka Harriger, Purdue University

Alka Harriger joined the faculty of the Computer and Information Technology Department (CIT) in 1982 and is currently a Professor of CIT and Assistant Department Head. The CIT Department offers baccalaureate degrees in information technology. Additionally, CIT offers numerous service courses to the university in the areas of pc literacy and programming. Professor Harriger's current interests include reducing the IT gender gap, web application development, and service learning.

A multi-pronged approach to address the IT gender gap

Abstract

In 2005, the National Science Foundation reported that the ongoing under-representation of women in Science, Technology, Engineering and Mathematics (STEM) workforce areas threatens the economic strength, national security, and well-being of Americans.¹ The near-term impact in the IT arena is a serious shortage of IT expertise. This pervasive problem requires a multi-pronged solution to yield a positive, long-term result.

Faculty in the Computer and Information Technology (CIT) Department at Purdue University are employing a number of initiatives across all levels of the university to address this problem. Within the department, two female faculty are leading two separate, but complimentary initiatives. One faculty member is attending national meetings and conferences to gather ideas to bring back to Computer and Information Technology and network with other diversity leaders to ensure that Computer and Information Technology has representation on a national scale where gender issues are being discussed. The other faculty member is investigating the issue at the local level and working with various stakeholders to define solutions such as a departmental mentoring program. The stakeholders include members of the department's industrial advisory board and successful (female) alumni.

This paper will describe the multi-pronged approach employed by Computer and Information Technology in more detail and share the positive and negative results of the activities undertaken by various groups. It will also provide the impact of these programs on each other.

Background

It has been argued that if women in the information technology (IT) workforce were to equal the number of men, the critical shortage of IT workers would be non-existent.² However, despite abundant career opportunities in IT, women are not preparing themselves for IT careers.^{3,4}

“Where are Women and Girls in Science, Engineering, and Technology?” asks a July 2001 report released by The National Council for Research on Women.⁵ The proportion of women who earn bachelor's degrees from American colleges and universities has been increasing. The past two decades saw the implementation of a variety of programs that succeeded in attracting more women into the fields of science, engineering, and technology. However, the study also reported that much of the progress that women made in these areas had subsequently stalled or eroded. Of further concern is the National Science Foundation's recent publication describing 211 projects designed to attract and retain women and girls in science, engineering, and technology-related disciplines. More than more \$90 million has been poured into these projects, and still the numbers of women are declining.⁶

Male/female attitudes toward science and technology begin to diverge as early as elementary and middle school and continue into high school. It is during this period that girls develop an understanding of what social roles are appropriate for them.⁷ They have reservations about the seemingly male “computer culture” as they watch boys utilizing computers for violent computer

games and what they see as technology for its own sake.^{8,9} There is little software that appeals to them. The tendency of boys to monopolize classroom computers is accepted as normal male behavior, and hence not vigorously challenged.¹⁰ As a result, girls have less experience with computers at an early age,¹¹ perhaps, in part, explaining why they are much less likely to enroll in IT disciplines than are their male counterparts. Furthermore, those who do enroll are far less likely to remain. Some reasons cited are lack of confidence in their math and science abilities, and lower levels of self confidence and self-efficacy, resulting at least in part from their lack of technological experience in college compared to men.¹²

Rosser observes that the overwhelmingly male nature of science has not only afforded women limited access to participation in the discipline, but it also has shaped the very nature of the discipline itself. She notes that science is neither unbiased nor value-free. Everything from what is studied to subjects for experiments is male-dominated.¹³ When women begin to enter IT-related disciplines in larger numbers, different questions will be asked and assumptions challenged, potentially changing the way technology is studied, developed, and deployed.

Research indicates that a critical mass of women students is needed in order to encourage their full participation in courses, and to retain them within historically male-dominated fields.¹⁴ A recent MIT-conducted longitudinal study indicated that when the proportion of women students exceeds 15%, the self-confidence and professional aspirations of women students increase, and their academic performance becomes equal to that of men.¹⁴ However, critical mass is not enough to ensure women students' success in non-traditional disciplines; academe must provide a supportive culture for their women students and foster a sense of community.^{15,16} The absence of women faculty and mentors both within the classroom and outside of it, few women students in their classes, and the lack of supportive networks can create a "chilly climate" for women in non-traditional fields. It is during this critical period that many of them transfer into other fields.^{5,7,17} As educational institutions began recognizing the problem, they initiated programs to address it. This paper shares the efforts in the Computer and Information Technology Department at Purdue University by two female faculty, along with the positive and negative results.

National Efforts

There are numerous national efforts aimed at increasing the number of women entering STEM fields. This section of the paper will describe various efforts that one of the co-authors is involved with to gather information and resources at the national level to benefit the local student body.

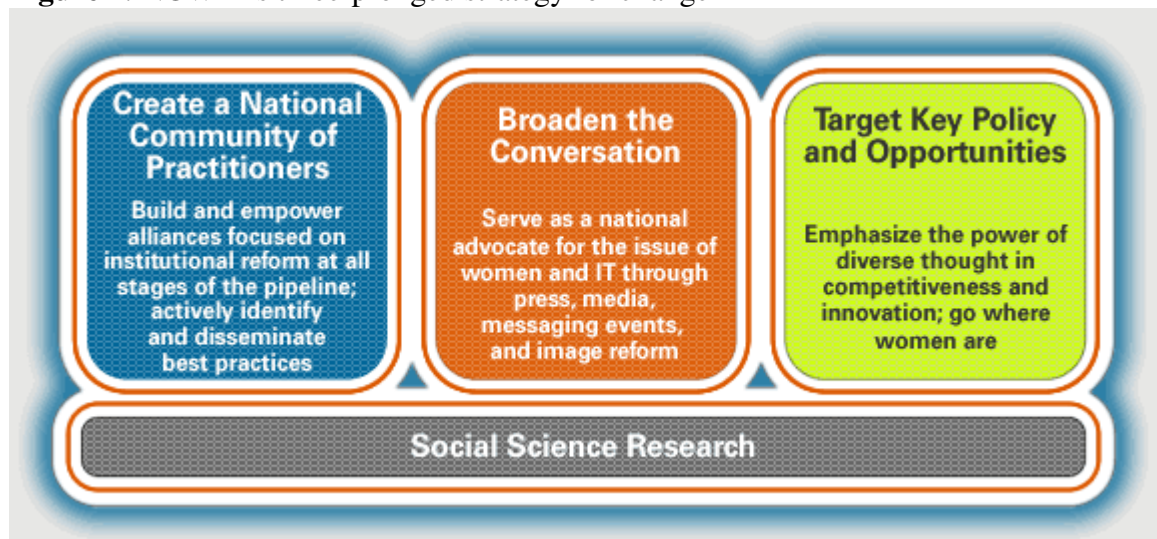
NCWIT

Professor Julie Mariga is a member of the academic alliance of the National Center for Women & Information Technology (NCWIT). Through her involvement in this national organization, she has met several faculty from other universities that are facing the challenge of increasing the pipeline of incoming female students into computing disciplines. NCWIT has put together a document center that allows faculty members from the academic alliance to share information about outreach programs and their overall success. NCWIT has created documents to help

university computing departments market their programs. Professor Mariga has met numerous NSF grant coordinators through her involvement in NCWIT and was a member of the 2006 Grace Hopper Women in Computing Conference Program Committee. She has been invited and accepted to be part of the Academic Advisory Committee, the Panels, Presentations, and Workshops Committee and act as the liaison between these committees for the 2007 Grace Hopper Women in Computing Conference.

The mission of the National Center for Women & Information Technology is to ensure that women are fully represented in the influential world of information technology and computing. NCWIT's overarching goal is parity in the professional information technology (IT) workforce, and the fundamental strategy is to educate, disseminate, and advocate a national, multi-year implementation plan that generates tangible progress within 20 years.¹⁸ One way to reach many people is through effective media advertisements. NCWIT is working with Cisco and other IT companies to create effective media about the IT profession. To support, sustain, and build potential for women in the IT workforce, NCWIT research and programs rely on a three-pronged strategy for change as seen in Figure 1.

Figure 1: NCWIT's three-pronged strategy for change



In addition to an Executive Advisory Council and Board of Directors, NCWIT has the following five alliances: Academic Alliance, Workforce Alliance, Social Science Advisory Board, K-12 alliance, Entrepreneurial Alliance.

Academic Alliance

The NCWIT Academic Alliance consists of more than 45 distinguished representatives from the computer science and IT departments of colleges and universities across the country, spanning research universities, community colleges, women's colleges, and minority-serving institutions. Charged with implementing institutional change in higher education, the Academic Alliance provides feedback on NCWIT programs, contributes and adopts effective practices, and serves as a national agent of change.

Workforce Alliance

The Workforce Alliance leads NCWIT's efforts in corporate institutional reform and helps NCWIT gauge its success in achieving workforce gender parity.

Social Science Advisory Board

The Social Science Advisory Board plays a key role in determining NCWIT's evaluation techniques and research agenda, and serves as a valuable resource to the Workforce and Academic Alliances.

K-12 Alliance

The K-12 Alliance seeks to increase the number of girls who study computing at the K-12 level by improving the image and teaching of computing. The K-12 Alliance leverages the efforts of multiple groups to address fundamental issues of inequity in the representation of girls in computing, and will ensure that computing is established as a critical skill set for the twenty-first century.

Entrepreneurial Alliance

This alliance brings together representatives from more than 20 established entrepreneurial organizations that understand the factors associated with entrepreneurial success and will work as change agents to enable more women to succeed as IT entrepreneurs.

Anita Borg Institute

The Anita Borg Institute for Women and Technology (ABI) is changing the world for women and technology. ABI believes that involving women in technology - how it is taught, learned, created and used - benefits everyone.¹⁹ ABI's mission is two-fold:

- to increase the impact of women on all aspects of technology, and
- to increase the positive impact of technology on the world's women

ABI provides resources and programs to help industry, academia and government recruit, retain and develop women leaders in high technology careers. By providing numerous platforms that ensure women's voices, ideas and spirits to influence technology ABI delivers programs that are changing the world for women and for technology. The programs sponsored by ABI include; Grace Hopper Women in Computing Conferences, Online Communities, Virtual Development Center, TechLeaders, Women of Vision, and Anita Borg Awards. Professor Mariga participates in two of these programs.

Grace Hopper Conferences

These conferences are designed to bring the research and career interests of women in computing to the forefront. Presenters are leaders in their respective fields, representing industrial, academic

and government communities. Leading researchers present their current work, while special sessions focus on the role of women in today's technology fields. There have been six conferences to date, and the 2007 conference will take place October 17-20 in Orlando, Florida.

At the 2006 conference, approximately 1300 women in computing for academia, industry and government came together to share their knowledge with one another. Professor Mariga was a member of the 2006 program committee for the Grace Hopper Women in Computing Conference and served as a co-chair for the Birds of a Feather (BoF) sessions for the 2006 conference. Through her involvement on the program, Professor Mariga was able to take two Computer and Information Technology female students to the 2006 conference where they made a presentation about the student organizations that they lead and how these organizations can help recruit and retain women students in computing.

Online Communities

ABI has a variety of online communities for various constituents. Some of the communities that Professor Mariga participates in include:

- Systems is the world's largest email community of technical women in computing founded in 1987.
- Entrepreneurs list seeks to discuss questions of interest to female IT-related entrepreneurs
- Latinas list was a result of a BoF at the 2006 GHC conference.
- PhD grads is a set of lists that seek to support women in computer science who are either finishing up their PhDs and looking for jobs, or are in academic positions and seeking tenure.
- ResearchHers list is a forum for women computer science researchers from industry and government labs and academia.

Through her involvement with these online communities, Professor Mariga has made contacts with other faculty who are researching gender diversity in IT. She has been able to expand her knowledge of gender issues faced by faculty in various geographical locations. A very useful outcome of the last NCWIT meeting, held in November 2006, was the development of "programs-in-a-box" that can be used by any member of NCWIT. These resources will enable faculty to implement outreach materials more efficiently. Some current programs-in-a-box include survey-in-a-box, outreach-in-a-box, and mentoring-in-a-box. Once the faculty or diversity office are able to mail or present these materials to middle school and high schools, the impact of these programs-in-a-box can be tracked.

Local Efforts

At the university level, the Diversity Resource Office serves as a central resource for students, faculty and staff on all issues related to diversity. In addition, the university holds an institutional membership in MentorNET, a web-based system that pairs students, postdoctoral students, and untenured professors with an IT professional for personalized, email-based mentoring. Finally, from 1997-2000 the university invested several hundreds of thousands of dollars in a special program to increase the number of qualified IT specialists to fill the open IT positions at the university. Although the program did not specifically recruit nor select applicants based on

gender, the proportion of females in the program was considerably higher than the proportion of female students that enter undergraduate computing programs.

At the college level, there is a Diversity office that plans and delivers special programs throughout the academic year and during the summers. These programs introduce girls from middle school through high school to some aspect of IT. Professor Alka Harriger has led several of these summer workshops. Eventually, the Diversity office hopes to demonstrate that participation in these diversity programs leads to eventual enrollment in a technology program. At this point, however, the incoming female freshmen numbers are too small to draw meaningful conclusions from such statistical analysis. Nonetheless, anecdotal evidence shows that as Computer and Information Technology is beginning to see a few more female students, many of these young women were participants in one or more of these special programs.

There is also a cohort group of female faculty who meet regularly to serve as a support structure for issues unique to women in fields dominated by men. Professor Mariga has been actively involved with this cohort group since 2005. Through this involvement, she has been able to have a support structure with a group of female faculty at the same institution. She has collaborated with one of the members on several grants.

At the department level, Professor Harriger has been leading the department's Industrial Advisory Board (IAB). The board consists of a diverse mix of successful IT leaders from industry and government. It was reinstated in spring 2005 and now has 32 active members of which 72% are Computer and Information Technology alumni. The advisory group has several committees, including one that supports diversity initiatives. Two key programs have resulted from this committee.

First, the recognition of a need for special programs to draw interest in computing by middle school and high school girls led to the development of a few grant proposals to the National Science Foundation. The proposals are based on using a special 3D tool developed at Carnegie Mellon University, Alice, to introduce the concepts of object-oriented programming in a welcoming, fun manner without the overhead of learning textual syntax.²⁰ Although the initial NSF proposals were not funded, the project team continues to discuss how to expand the Alice programs and find alternate sources of funding. The team currently has one NSF grant proposal under review. Although Professor Harriger has been leading these efforts, two male Purdue faculty have served on the various NSF proposal teams as co-PIs.

Two tests using Alice were conducted in two different 2006 summer workshops offered through Purdue's College of Technology. Faculty from the various departments, including CIT, offer short, hands-on activities to the participants in these summer programs. Toni Munguia, the College of Technology's Diversity Director, (personal communication, March 5, 2007) shared the following comments about the success of the Alice workshops:

In June 2006, at the Turned On to Technology And Leadership (TOTAL) camp, the Alice workshop was presented to 7th and 8th grade multicultural campers. The students that participated gave the Alice workshop the highest rating of all the workshops at the camp, with 26 "Excellent" marks, one "Good" mark and one

“Fair” mark. The students said it was fun to see animation at work. We asked the students what they found most beneficial about the camp and one student said, “Creating my own game/movie”, referring to Alice.

In July, 2006, at the Technology Advances Girl Scouts (TAGS) camp, the Alice workshop was presented to 5th, 6th, and 7th grade young ladies. The students that participated gave the Alice workshop the highest rating with 14 “Excellent” marks and two “Good” marks. The students comments were, “more than Excellent, fun game, I loved the game and It was one of my favorites”. When asked, “What was the most beneficial part of the camp?” some the comments are as follows...

- “The cool computer stuff”
- “Computer programming, **I think I want to go into that**”
- “All the fun, computer games”
- “I think it was the Alice software”
- “I liked the computer part and programming”
- “Alice software, because I never played it before.”

Because of the overwhelming success of the Alice workshops, we are hoping to have “Alice” sessions at our (technology) camps this summer. In July, we are having a Cheerleading Technology camp, to get more high school females interested in Technology, and we are incorporating an Alice-based workshop for cheerleaders. The Alice workshops definitely sparked the interest in computers of the participants.

Another program that resulted from the support of the IAB’s diversity committee and select female alumni is a mentoring program. A small group of faculty invited all of the female students in Computer and Information Technology to share their insights regarding the experience of female students in Computer and Information Technology. Several of these students began their collegiate career in a different program and suggested that Computer and Information Technology should initiate a mentoring program to support the incoming female student population. Members of the IAB had previously offered to serve as mentors for Computer and Information Technology students.

Professor Harriger polled IAB members, select alumni, and upper-class and freshmen Computer and Information Technology students in underrepresented groups regarding their background and interest in participating in a mentoring program. Surprisingly, no freshmen students showed interest; however, a few upper-class Computer and Information Technology students, IAB members, and Computer and Information Technology alumni indicated interest in serving as mentors. Because the response was low, all respondents were asked whether they would be interested in a pilot program. All confirmed their interest, so in late fall 2006 the IAB members became mentors to the upper-class Computer and Information Technology students. When the IAB meets in April to discuss ongoing projects, the mentoring program will be reviewed and updated action plan put into place. The authors will collect this information along with feedback from the participants and share this information in the presentation.

Conclusion

There are numerous efforts underway to increase the number of girls entering the computing fields. In order to make an impact all entities need to work together and continue to educate girls, teachers, educators, counselors, legislatures, and others regarding the importance of this issue. This paper described the complimentary efforts of two female faculty at Purdue University to educate students, parents, counselors, and other constituencies on what IT is and careers within IT. Support by a few male colleagues in various activities has also helped. All of these combined efforts have had some success, but clearly, much more work needs to be done.

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