REBUILDING THE PIPELINE OF WOMEN IN ENGINEERING

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Abstract — *Although there is a tremendous shortage of skills in the information technology industry, we continue to see a drop in the number of women entering the engineering field. Studies have shown that a larger number of girls do better in science and mathematics in elementary schools compared to boys. However, by the time the children are in middle school, there is already a significant drop in the number of girls interested in or doing well in these subjects. Hence, we see an urgent need for outreach programs targeting girls in middle schools, if we are to successfully rebuild the pipeline of women in science, engineering and technology. Findings from various studies should convince corporations that it is now a business imperative that corporations get involved in sponsoring and supporting such outreach programs as well as other efforts targeted to young girls. This paper also describes some outreach programs sponsored by IBM and the experience gained.*

Index Terms — girls, outreach programs, middle schools, science, engineering and technology pipeline.

INTRODUCTION

Although there is a tremendous shortage of skills in the information technology industry, we continue to see a drop in the number of women entering the engineering field. Studies have shown that a larger number of girls do better in science and mathematics in elementary schools compared to boys. However, by the time the children are in middle school, there is already a significant drop in the number of girls interested in or doing well in these subjects. Hence, we see an urgent need for outreach programs targeting girls in middle schools, to show that science and technology can be fun and exciting and that there are a large number of jobs and careers for women in engineering. If we are to successfully rebuild the pipeline of women in science, engineering and technology (SET), we must increase our efforts in the middle and junior high schools, or even earlier. Findings below from various studies should convince corporations that it is now a business imperative that corporations get involved in sponsoring and supporting such outreach programs as well as other efforts targeted to young girls. The number of female role models in the arts, actresses, singers, models, far outnumber those in the engineering industry. We cannot count on general communications in the media to inform and educate girls on the achievements and accomplishments of the successful women engineers and women leaders in the IT industry. Additionally, girls are not well informed of the job opportunities available to them in the areas of science and technology.

FINDINGS

The following sets of findings need to be broadly advertised and communicated to parents, teachers, businesses and most importantly to young girls. These findings should send alarming signals to businesses. Per the Freeman and Aspray 1999 study on the supply of IT workers, the huge shortage of IT workers would be filled if the number of women in the IT workforce were raised to the same level of men. [1]

- Only 19% of the science, engineering and technology workforce is female, compared to 80.6% for men, whereas in the general population, as well as in the workforce, women are almost equal in numbers compared to men (further breakdown in figure below). [2]
- By the eighth grade, twice as many boys as girls show an interest in science, engineering and mathematics careers. [2]
- Fewer girls than boys enroll in computer science classes, feel self-confident with computers, and use computers outside the classroom. [3]
- By the eighth grade, girls' interest in mathematics and confidence in their mathematics abilities have eroded, even though they perform as well as boys in this subject. [4]
- Nearly 75% of tomorrow's jobs will require use of computers; fewer than 33% of participants in computer courses and related activities are girls. [5]
- 9% of engineers are women. [2]
- Girls are significantly less likely than boys to decide on a SET major, no matter what their race, ethnicity or physical ability. [2]
- Once they have selected a SET major, women are much more likely than men to switch to a non-science major. [2]
- Degrees awarded in computer science decreased among both men and women from 1985 to 1995, and women went from earning 36% of those degrees in 1985 to only 28% in 1995. [6]

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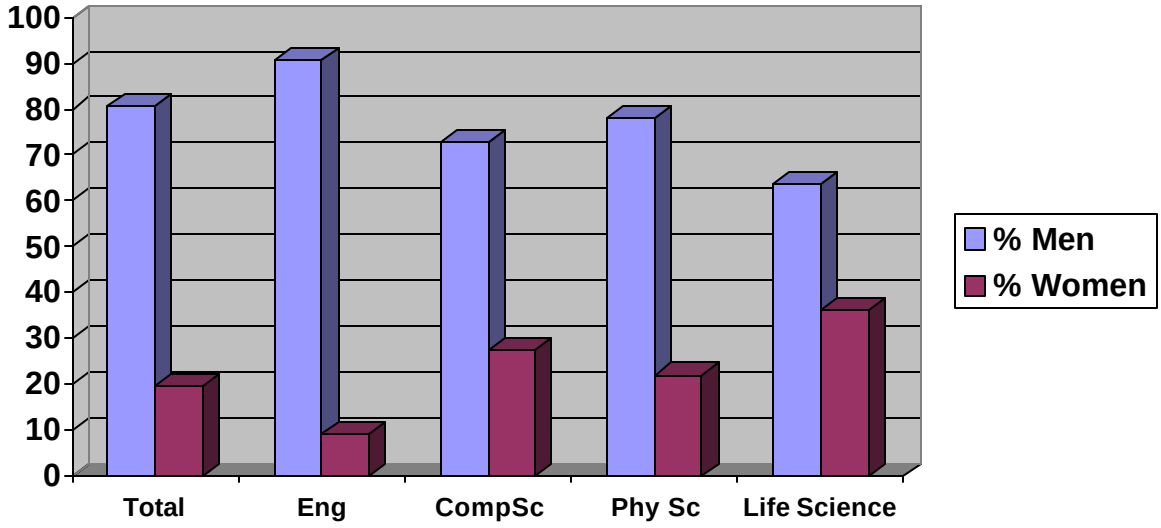

USA SCIENCE, ENGINEERING AND TECHNOLOGY WORKFORCE BY GENDER AND SUBJECT AREAS, 1997 [2]

PUBLIC IMAGE

"The current image of computer scientists as smart, rich, skinny, thick glasses, pale, no life, no people skills ….. is completely inaccurate and discourages many young people, including the vast majority of young women." Marie Klawe, Ph.D., Dean of Science, University of British Columbia.

This geeky, nerdy, socially inept image of computer scientists, IT workers and engineers continues to be perpetuated by the media. This is clearly a strong, and very wrong, message to young women. One of the reasons cited by girls for dropping out of science in middle schools is that they did not want to be viewed as geeks or nerds. Additionally, the lack of female role models, further accentuated by the lack of female scientists coverage in the media, further discourages girls from pursuing science and technology careers.

OUTREACH PROGRAMS

Studies have shown that targeted interventions can reverse the misperceptions in girls. [7] These intervention programs need to be targeted at girls in middle schools. By the time they reach high schools many girls have already lost interest in mathematics, science and technology, and many have dropped out of mathematics and science tracks, so that by the time they graduate high school, they have already excluded themselves from the options to pursue a career in science and technology.

IBM's Outreach Programs

IBM Women In Technology Workshops

A successful outreach program is IBM's Women In Technology (WIT) workshops initiative targeted at 7th and 8th grade girls. There are now over 45 chapters worldwide. The objectives of these workshops are:

- To build awareness of exciting career opportunities for women in IT.
- To encourage young girls to pursue mathematics and sciences for future careers in IT.
- To give girls access to female role models in the IT Industry.
- To show young girls that technology can be fun.

The workshop is typically a half-day program, where girls learn about the use of technology in every day life, such as shopping, entertainment, sports in addition to more traditional uses such as in medicine. They learn that science and technology can be fun, by working with computers to build presentations on how science can be exciting. A very important component is that the facilitators are all IBM women, who have successful careers in science and technology. These women help to dispel the distorted public image of computer scientists, are real live role models, who also offer to be mentors to the girls after the workshops. Some of the workshops include phone or in person interviews that the girls have with female executives in IBM.

Recently, a six-hour WIT workshop was held November 30, 2001, on the Akwesasne Indian Reservation in NY, to introduce 36 middle-school girls to

science and engineering and demonstrate that they can be successful in these fields.

These workshops are structured in such a way that there is no requirement for special funding to support them. Support from the sponsoring organization is in the form of support for the women who participate. The women facilitators volunteer their time and skills, bring their laptops with software, and any other resources already available to them from their respective organizations as part of their jobs. For example, they may bring in a wafer with computer chips on them to show what chips look when they are being manufactured.

These workshops provide an excellent forum for mentoring, role modeling, and inspiration to young girls.

Student Feedback from WIT Workshops

"I really enjoyed the Women In Technology workshop. Knowing all of the past information on women making history influences me to be more proud to be a young woman. On my behalf, I thank Avida for her time and patience."

"I think that this is a good way to open our minds to new opportunities that we can look forward to in the future. IBM also gave us another reason to stay in school. I think this program is excellent! Thanx!"

"I was delighted by the way the staff was so cheerful and helpful to all students. They also showed us that using a computer is not as hard as it looks. I enjoyed all the presentations and the way we got to do group work. Thanks to Lisa, Nancy and the rest of the staff for a wonderful day!"

"I enjoyed myself the whole time. I really like the activities but especially the helpers. They are really polite and interesting. Thanks for such a great day!"

"Thank you for helping me realize that a woman can have a job in technology and it's not just for men. You have shown me that if I stay in school I can get a wonderful job. I especially thank June and Nancy."

"IBM is great. I learned lots of things about computers I never knew. I also learned some history. IBM is a great place and I want to work here when I get older."

"Today was great because we got a chance to learn what technologists do in a day's work and that technology is not just a guy thing but, a woman thing too!"

"Your presence had a profound affect on the students, teachers," commented an Elder from Akwesasne Indian Reservation in New York, USA.

IBM's EXITE Technology Camps

In 1999, IBM launched the IBM EXITE [8] (**EX**ploring **I**nterests in **T**echnology and **E**ngineering) Camps, a one-week technology day camp, held during the summer school break. The EXITE program is targeted at girls entering 7th and 8th grades. The first camp was held in 5 locations in the US. These camps are hosted at IBM sites or local university campuses. By 2001, IBM had expanded the program to 21 sites around the world, hosted at various IBM sites in the US, Canada, Mexico, Scotland, Japan, Peru, Spain and Australia. 1250 IBM volunteers from around the globe contributed more than 22,000 hours to plan and manage the EXITE camps and to demonstrate, interact, and serve as positive role models for the 600 young women participants. The young women participated in activities many could not even imagine performing prior to the camp, including building web sites and computers, programming robots, constructing towers and bridges, making ice cream with liquid nitrogen, work with laser optics, animation, robotics, and using Lotus QuickPlace technology to collaborate on projects with other young campers half a world away.

Participants are nominated by counselors and teachers at middle schools that are located near an IBM facility and have an established IBM relationship through programs such as Reinventing Education and IBM MentorPlace.

Most EXITE campers were matched with IBM technical women who will serve as their e-mentor through IBM MentorPlace, [9] to allow the young girls to remain in touch with the female role models they met.

Feedback from EXITE Campers

At the Vancouver EXITE camp, 22 out of 25 students stated they would like to pursue a career in technology; 28 out of 32 Rochester campers said they would consider a career in technology or engineering after attending the camp; interest in technology careers grew from 46% to 64% after the Madrid EXITE camp; Toronto reported a long waiting list of students anxious to attend; and young women in Tokyo spoke proudly and frequently on how they enjoyed the camp. Several young women attending the Burlington camp changed their dream careers to ones related to science and technology; a Raleigh camper declared, "I can do anything!" and a Beaverton camper commented, "This camp helped me realize that women can be engineers too."

CONCLUSION

Considering the current downward trends, it may be necessary to even consider targeting programs at even younger girls, in 5th and 6th grades. While girls are at this age, while many more of them may still be interested in science and technology, it may be more effective to further peak their interest so that there is greater desire and self motivation to carry them through the middle school years, to overcome peer pressure and other adolescent distractions. It is not uncommon to hear middle school girls say that "it is not cool to be a geek",

someone who is good in mathematics, science or technology.

We believe strongly that outreach programs run or sponsored by corporations can be particularly effective. They can show how science and technology can be fun and exciting, as well as offer insight into interesting careers in these areas for young girls, delivered by real live professional women in technology. It gives young girls the opportunities to interact with real professional women in science and technology and hear first hand about their exciting jobs and careers. It helps to dispel the general misperceptions of scientists and technologists, but more importantly, offers young girls the opportunities to be mentored by a woman professional with a career in science and technology. As noted earlier, even after girls or young women have selected SET courses and decided on an SET career, there is still an alarming attrition rate in the pipeline. Mentoring can play a strong role in preventing this leakage.

ACKNOWLEDGMENT

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These outreach programs would not have been possible if not for the many IBM women who have given their time and shared their valuable experiences with over 19,000 young girls in the various programs above, as well as having served as mentors, and their supportive management in IBM.

REFERENCES

[1] The Supply of Information Technology Workers in the United States (Washington, DC: Computing Research Association, 1999), P.Freeman and W.Aspray.

[2] Congressional Commission on the Advancement of Women and Minorities in Science Engineering and Technology Development: "Land of Plenty", Sept. 2000.

[3] AAUW: Gender Gaps: Where Schools Still Fail Our Children. (Washington, DC, 1998).

[4] S. Catsambis, "The path to math: Gender and racial-ethnic differences in mathematics participation from middle to high school", Sociology of Education 67 (1994): pp. 199-215.

[5] U.S. Labor Statistics: JOBS 2000.

[6] The National Science Foundation. Women, Minorities and Persons with Disabilities in Science and Engineering: 2000. Sept. 2000.

[7] P.B.Campbell and L.Hoey, "Saving Babies and the Future of SMET in America" (white paper prepared by Campbell-Kibler Association for the Commission of Women and Minorities in Science, Engineering and Technology Development, Washington, D.C. 1999); B.C.Clewell, B.T.Anderson, and M.E. Thorpe, "Breaking the Barriers: Helping Female and Minority Students Succeed in Mathematics and Science".

[8] IBM's EXITE Technology Camps for Girls, www.ibm.com/software/info/students/news/exite.html.

[9] IBM Mentorplace, www.mentorplace.org