Indian Perspective on Women in Computing

Roli Varma
School of Public Administration
University of New Mexico, Albuquerque

Abstract

In the United States, women pursuing higher education in computing fields has been low. Scholars have focused on the reasons behind under-representation of women in computing. The dominant trend in the scholarly literature is that the computing fields themselves are gendered. In contrast, there has been a significant increase in the number of women enrolling in computing fields in colleges/universities in India. The image of computing in India is of a women-friendly field, as it offers lucrative jobs, high salaries, professional careers, indoor office working environments, and economic independence. This paper challenges the masculinity of computing fields in the U.S. from the experience from India.

Introduction

In the United States, women are under-represented in computing fields. *Science and Engineering Indicators*[1] noted that in 2015, women earned a mere 18% (9,209) of bachelor's degrees in computer science (CS), which is less than (14,431) of what they earned in 1985. Between 2000 and 2015, the proportion of master's degrees earned by women declined in CS (33% to 31%). In 2015, women earned less than one-third of the doctorates in CS. In the United States, women make approximately 24% of computing workforce. This is when demand for people with computing skills has been increasing. For instance, employment of computing related occupations in the U.S. is projected to grow 13% from 2016 to 2026, which is faster than the average for all occupations. These occupations are projected to add about 557,100 new jobs[2]. It is, therefore, no surprise that a number of governmental, corporate and non-profit group initiatives exist in the United States to increase representation of women in computing[3].

Women's underrepresentation in computing in the United States has been scrutinized from many angles in the last two decades[4,5,6,7]. Scholars have identified a range of factors namely, gendered socialization, limited early exposure to computing, competent preparation in science and mathematics, lack of self-efficacy to succeed in computing, the small proportion of women among computing faculty and student populations, differential treatment by male peers, prominence of geek culture, and a pervasive sense of not belonging to computing[9,10,11,12,13,14,15,16]. This has led some to see computing as a masculine field[17,18].

In contrast, women in many developing countries have increased their presence in computing. In recent years, scholars have begun to turn their attention to women in computing outside western countries[19,20,21]. Studies show that computing is a popular major among women in most developing countries. This is despite the fact that women in developing countries have fewer resources and opportunities in comparison to the United States. This paper studies women in

computing education at undergraduate level in India, a developing country. It examines how women in India have been able to outperform their peers in the United States in studying CSE. Yet, it shows that even though computing does not appear to be a male dominated field in India, gender remains an important variable within Indian socio-cultural system.

Push for Information Technology

After its independence from the British colonialism in 1947, India emerged economically and technically underdeveloped in relation to the West. Since then, India has sought to catch up to scientific and technological advances made in the West with its industrialization policies. Till 90s, India merely explored computing technologies and had limited indigenous development under strict licenses and regulations. In 1991, India opened its economy to foreign direct investment and reduced government control on the private sector. In 1998, India took a number of proactive measures to promote national and international software companies. India's Prime Minister Vajpayee declared "IT [information technology] as India's tomorrow"[22]. Since then, the Indian IT sector has grown tremendously. Currently, the IT market is estimated at $180 billion and is projected to grow to $350 billion by 2025. The IT sector growth rate is over 9% per year and it contributes about 9% of India's GDP[23]. The IT industry is creating over 3.7 million jobs per year[24]. It is expected to provide quality employment to a large number of qualified people in the coming years.

Both men and women in India are well aware of bright futures with computer science engineering (CSE) education. Recent enrollment data show that women constitute over 40% of students in CSE at undergraduate level, 65% at master level and 50% at doctorate level. A recent survey across India about the number of students who graduated in CSE stream in fiscal year 2016 shows gender parity in CSE education. For instance, there were around 81,3000 male students and 79,2000 female students who graduated with CSE degree in 2016[24]. In fact, a 2018 survey by HackerRank found that 33% developers are self-taught and 37% picked up the skills partly from school and partly on their own[25].

Why Indian Women Select Computing Fields?

An empirical study conducted by Varma[26.27,28,29,30] with a support from the National Science Foundation shows that women are interested in computing for a number of reasons. A significant factor is encouragement from family members. They influenced women by conveying that computing has a great potential for women, because it requires mostly mental against physical power, and work is indoors rather than outdoors on a construction site. Computing jobs were seen as secure office desk jobs; in contrast to construction sites were seen as dangerous with unknown men and with out toilet facilities. Parents believe their daughters would be protected if they are indoors in an office and interact with a small number of office workers; construction sites and factories are seen as places for teasing and sexual assaults.

Women believe that with a computing degree, they could work in multiple sectors and locations, including in big multinational companies. In addition, computing jobs come with a higher salary

compared to other fields. High pay offers women a better standard of living and a better future for themselves and their families. Furthermore, a computing job is perceived to provide women with independence and the freedom to dictate how they want to live their lives. The fact they could get a job rather quickly after finishing degree, they could evade marriage. With a high-paying job, they look forward to standing on their own feet instead of being homemakers and even after marriage they anticipate a high social status by supplementing the household income.

In India, the typical computing culture is considered as people-friendly especially women-friendly. It consists of dedicated, hard working, intelligent, meticulous, and smart people. Women who study computing are well respected by faculty and peers in the educational arena and by family members, friends, and neighbors in the social arena. This is in sharp contrast with the geek image, which is rather prevalent in the U.S. Typically, geeks are seen as eccentric people who are obsessed with computers and are socially awkward. American women do not desire to be associated with geeks. In India, on the other hand, people in computing are seen as an inspiration for others, so it is considered pleasant to be around them. Most importantly, they are socially and culturally active like anyone else.

Gender Issues

In the Indian patriarchal social system, a man is the head of the family who controls a woman's education, mobility, labor participation, reproduction, and sexuality.[31] A family considers the sons' role as staying home to provide for the family, whereas girls are expected to leave home after marriage. Consequently, women receive less financial support and encouragement for higher education than their male siblings. Even teachers have greater expectations in the education of male than female students. Because of their gender, female students face curfews at their hostels and at home. As a result, female students are unable to stay in laboratories longer to complete group projects and network with male peers. During job placements on campus, it is common for employers to ask whether female students have their parents' permission to work, as well as their marriage plans. Because women are not expected to travel alone, female students miss out on internships, additional training, and job interviews. In other words, gender remains a viable factor in female students' lives.

Conclusions

Since India's independence in 1947, Indian women have been getting education, which was seen as a means to learn social and home skills; it was not seen as a means to have a job unless there were economic needs. Women were expected to pursue medical and teaching career paths; engineering was seen as suited for men. Of all career options open to women in India, IT has become more popular than medical and teaching. This is mostly because computing has been constructed as a field suited for women, which is not true with other fields in engineering. The reasons computing are viewed as well-suited for women is not in contradiction with the Indian social context. Parents favor computing because it assimilates with their perception of the type of work girls should be doing. Without parental permission, women could not have enrolled to study computing. Nonetheless, underrepresentation of women in computing education in the U.S.

cannot be considered to be a global phenomenon; indeed large numbers of women are opting for computing majors in India.

Acknowledgements

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ROLI VARMA
Dr. Varma is Carl Hatch Endowed professor in the School of Public Administration at the University of New Mexico, Albuquerque. Her research focuses on women and minorities in information technology education and Asian immigrants in the S&E workforce. She is the author of *Harbingers of Global Change: India's Techno-Immigrants in the United States* (2007). She is an invited member of the Social Science Advisory Board of the National Center of Women in Information Technology in the USA.