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Toward Gender Equitable Outcomes in IT Higher Education

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ABSTRACT

This research-in-progress paper reports on a National Science Foundation funded project aimed at examining ways to engage women and girls in courses of study that will qualify and motivate them for information technology (IT)-related careers. This Information Technology Work Force (ITWF) award provides support to investigate 15 tertiary education programs in information systems, information science, instructional systems technology, and informatics, with computer science programs as a baseline comparison, in five major IT degree-granting institutions. The purpose of the study is to systematically investigate the contribution of organizational culture to student experiences and outcomes, determining factors that favor female success over time.

The programs are hypothesized to be differentially responsive to female students due to differences in academic culture, operationalized in terms of the availability of mentorship, role models, peer support networks, grant programs, and other resources at the departmental, university, and disciplinary levels. These measures of organizational culture will be correlated with measures of student outcomes and self-reports of student experiences. Data about students' experiences will be collected through a web-based survey of a sample of 5,000 students, followed by three face-to-face interviews with an estimated 155 students, over-sampling for females, over a two-year period. In addition, faculty, administrators and staff in the study programs will be interviewed by telephone and in person. **We will have collected and analyzed the broad-based survey data by March 2004 and will be able to report these findings at the SIGCPR conference.**

The project will identify encouraging and discouraging factors, and produce comparative statistics, that can be used as a baseline in future research on IT education and gender. Findings can be used to inform programmatic recommendations aimed at moving more women into the IT pipeline through a diverse range of educational programs. To the extent that new IT paradigms such as are taught in schools of information, informatics, education, and business help to create those cultural associations, they can contribute to reducing the persistent gender segregation in academic IT-related programs and thus IT employment.

Toward Gender Equitable Outcomes in IT Higher Education[1]

1. INTRODUCTION

As the need for information technology (IT) professionals continues to grow, so too does the need to engage women and girls in courses of study that will qualify them for IT-related careers. The growing number of professions that do not require training in computer science, but rather in cognate IT disciplines, offer the potential to correct the pattern of gender inequity traditionally found in computer science. This project proposes to investigate tertiary education programs in information science, information systems, instructional systems technology and informatics, with computer science as a baseline comparison, in major IT degree-granting institutions across the U.S. in order to determine which are most successful at recruiting and retaining female students, and what factors favor success over time. Findings can be used to inform programmatic recommendations aimed at moving more women into the IT pipeline through a diverse range of educational programs.

The study will systematically investigate the contribution of organizational culture to student experiences and outcomes via surveys and in-depth interviews of students, faculty, and administration. We will have collected and analyzed the broad-based survey data by May 2004 and will be able to report these findings at the SIGCPR conference.

2. THEORETICAL DEVELOPMENT

Despite much concern over the past 20 years about low numbers of female students in computer science and IT departments (e.g., Klawe & Leveson 1995), and some recent successful efforts to increase their numbers (Margolis & Fisher 2002), women remain a significantly underutilized resource in the IT workforce (National Council for Research on Women 2001; National Science Foundation 2000). For example, as recently as 10 years ago, only 5% of upper

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management in IT industry (Science 1992) and 6.5% of IT faculty positions (Frenkel 1990) were held by women. By 2000, women still comprised only 13% of computer science faculties in the United States (Taulbee 2001).

However, while a gender imbalance in computer science is still strongly evident, the prospects for women may be brighter in the growing number of IT-related professions that do not require training in computer science, but rather in cognate disciplines such as information science, management information systems, instructional systems technology, and the nascent field of informatics. Together, these fields train more IT professionals than does computer science, and their importance is likely to grow in the future. University-level programs in cognate IT disciplines are potentially more attractive to women than degree programs in computer science, for a number of reasons discussed below. As yet, however, few studies have focused on the experiences of female students in IT programs outside the domain of computer science. Nor has any systematic comparison been attempted of such programs to determine which are most successful at recruiting and retaining female students, or what factors favor success.

Research suggests that one critical factor that discourages girls and women from studying IT-related fields is its professional culture. We define culture as traditions, attitudes and practices. Indeed, as Margolis & Fisher (2002) stated, “women are further alienated by a stifling "geek culture" that celebrates obsessive computing at the expense of broad interests”. The abstractness of much computer science instruction exacerbates the gender bias, in that girls are more likely to be interested in real-world problem solving in contexts involving human users than in machines and programming languages per se (Clarke 1992; Ray, Sormunen, & Harris 1999). A related deterrent for women is that most introductory computer science courses focus on programming skills rather than concepts of computer science. Girls and women like IT, the findings suggest, but want to do something with it to improve the world; they are not satisfied with mastering computing skills for their own sake.

For several reasons, applied fields such as information science, information systems, and instructional systems technology have an advantage over computer science when it comes to attracting future female professionals. First, they are grounded in the contexts of real-world problems: business, education, information management, etc. Second, they are not as male-dominated as computer science: information science and instructional systems technology are both traditionally associated with female-dominant professions (librarianship and education, respectively), and business, although traditionally male-dominated, has been changing rapidly in this regard. These fields, whose cultures are traditionally more "woman-friendly" (Cohoon 2001), may produce more successful educational outcomes for women. Success here is defined both in terms of the quantity of women who enter and finish IT-related educational programs, and the quality of their educational experiences.

As IT expands into cognate domains, it also carries with it elements of masculine computing culture. Moreover, the cultures of business, education, and library science do not attract female students to the same degree, as noted above. Thus, we suggest that that some obstacles to gender equality will persist in cognate IT fields, but that they will vary in importance according to the disciplinary context. Specifically, we expect that fields such as information science and instructional systems technology will attract and retain more women than fields such as information systems. Informatics, as a new field lacking in traditional associations with either male or female practitioners, has the potential to attract both in equal numbers; alternatively, it could carry over the masculine connotations of computing technology.

Even within a single field, practices vary from institution to institution. Some institutions have been more successful than others in achieving gender equity, as the recent Carnegie Mellon study shows for the field of computer science (Margolis & Fisher 2002). Factors such as the availability of role models, mentoring, networking, curriculum, advising, and financial and

administrative support have all been identified as making a positive difference in female students' experiences in computer science programs (Ahuja, 2002; Spertus 1991). We propose that this will be the case in applied IT programs as well. Specifically, we expect that more female-oriented institutional cultures, as determined by the availability of resources such as those mentioned above, will produce more successful outcomes.

Finally, in recognition of the currently lower numbers of women in IT professions and the need to provide additional incentives to encourage more women to train for such professions, we suggest that institutions that provide recruitment and retention initiatives will be more women-friendly than those that do not. Based on the above, we propose the following:

Proposition 1: More women will choose to pursue training, and have more successful educational experiences, in settings where more women are present – especially in visible, high status roles – than those in which few women are present.

Proposition 2: Settings that provide opportunities for real-world applications and collaborative learning will be more women-friendly than those that do not.

Proposition 3: Institutions that offer programs exhibiting cognizance of the ways in which women students have been marginalized and dissuaded from continuing in IT and in science more generally, will be more women-friendly.

Proposition 4: Institutions that provide recruitment and retention initiatives will be more women-friendly than those that do not.

3. METHOD

For the purposes of this study, the notion of academic culture is operationalized at national (e.g., the policies and practices of each discipline's primary national associations), university (e.g., campus-wide policies and programs), and department or school levels (e.g., resources and curricula). In order to test Proposition 1, we will collect the demographic data on number and distribution of women faculty, graduate and undergraduate students in the discipline, university and departments/schools, and administration. To test Proposition 2, we will collect data on content of

the curriculum in IT, opportunities for engaging in small-group research or internships and for working with other women, as well as cross-disciplinary programs that encourage the application of IT to human problems and aesthetics. Proposition 3 will be tested based on data on mentoring, networking, and internship programs specifically for women, faculty-training on issues of under-representation of women and minorities in IT, career-support and services for women entering IT related professions, departmental ties to gender studies/women's studies programs that provide theoretical insight into the challenges faced by women in IT.

To test Proposition 4, we will collect data on outreach to high schools and secondary–level students (through summer programs, special weekends, workshops, etc.), level of administrative support for recruitment and retention of female students into IT, programs to recruit and retain women faculty in IT, fellowship availability and distribution of funding to IT graduate students and undergraduates, funding opportunities and distribution to IT women faculty, professionals, graduate students and undergraduates (including travel grants, research funding, and summer opportunity funding).

IT Disciplines and Study Institutions

Five IT disciplines and five research universities in the continental United States will be included in the study. The IT disciplines are: computer science (CS), informatics (I), information science/studies (IS), instructional systems technology (IST), and management information systems (MIS). These disciplines were selected because they represent the major IT paradigms in higher education at the present time. The target study institutions are: Indiana University Bloomington, State University of New York at Buffalo, University of Illinois at Urbana/Champaign, University of Michigan at Ann Arbor, and University of Washington. The institutions were selected based on the minimum requirement of having a computer science unit and at least two other IT-related units. Additionally, we gave preference to institutions with programs in instructional technology and/or

informatics, as these are relatively less common, albeit important IT paradigms in terms of their potential to create gender equity.

Data Collection and Analysis

Data will be collected about the attitudes and experiences of students in the study programs. We will do this by two principal means: a Web-based survey administered to 5,000 students in the first semester of the study, and follow-up face-to-face interviews with approximately 155 students once a year over a period of three years. Also in the first semester, an estimated 440 faculty and administrators at the study institutions will be surveyed by telephone.

In addition, we will make use of available data about the study institutions, provided such data are sufficiently current, so as not to duplicate previous data collection efforts. These will be supplemented by institutional data provided by the universities themselves. The universities will also provide information about student enrollments and outcomes, and each study unit will provide names and email addresses of all undergraduate majors and graduate students enrolled in the target programs. This data collection will take place during the early stages of the study.

We will also collect data about the availability of resources hypothesized to contribute to the "woman friendliness" of the institutions and programs from a variety of sources, including the World Wide Web, on-campus observation, and direct questioning of administrators and faculty at the study universities. This data collection will take place primarily during the campus visits. For each discipline, relevant data will be collected periodically from workshops, conferences, and programs targeted to women, following initial collection of statistics on women in the discipline from national professional organizations. Details and time-line for carrying out the data collection is shown in Appendix 1.

Correlational analyses, hierarchical regression and other tests that allow us to examine the relationships among groups will be used. The findings will be triangulated with the qualitative environmental observations.

4. CONCLUSION

The ultimate goal of the project is to articulate recommendations based on the empirical findings to encourage the creation of circumstances that favor successful outcomes for women in IT-related disciplines. Findings can be used to inform programmatic recommendations aimed at moving more women into the IT pipeline through a diverse range of educational programs. To the extent that new IT paradigms such as are taught in schools of information, informatics, education, and business help to create those cultural associations, they can contribute to reducing the persistent gender segregation in academic IT-related programs and thus IT employment. Ultimately, the challenge is cultural – IT needs to be widely seen as a domain that women enjoy and in which they can excel. More studies like this are necessary if we are to meet the demands of the IT workforce and benefit as a society from the contributions of the entire population.

References

Ahuja, M., (2002) "Information Technology and the Gender Factor", European Journal of Information Systems, 11, 1, pp. 20-34.

Clarke, S. (1992). Strategies for involving girls in computer science. In C. Martin & E. Murchie-Beyma (Eds.), *Search for Gender Free Paradigms for Computer Science Education* (pp.71-86). Eugene, OR: International Society for Technology in Education.

Cohoon, J.M. (2001) Toward improving female retention in the computer science major. *Communicationsof the ACM*. 44(5), 109-114.

Frenkel, K.A. (1990). Women and computing. *Communications of the ACM* 33(11), 33-46.

Klawe, M. & Leveson, N. (1995). Women in computing: Where are we now? *Communications of the ACM* 38(1), 29-35.

Margolis, J. & Fisher, A. (2002). *Unlocking the Clubhouse: Women in Computing*. Cambridge, MA: MIT Press.

National Council for Research on Women (2001). *Balancing the Equation: Where Are Women & Girls In Science, Engineering & Technology?* New York: NCRW.

National Science Foundation (2000). *Women, Minorities, and Persons with Disabilities in Science and Engineering: 2000*. http://www.nsf.gov/sbe/sis/nsf00327/pdfstart.htm

Ray, C. M., C. Sormunen, & T. M. Harris (1999). Men's and women's attitudes toward computer technology: A comparison. *Office Systems Research Journal* 17(1), Spring. http://www.nyu.edu/education/alt/beprogram/osrajournal/ray.PDF

Science. (1992). Women in science. 255(1050), 1365-1376.

Spertus, E. (1991). "Why are there so few female computer scientists?" ftp://ftp.ai.mit.edu/people/ellens/

2001-2002 Taulbee Survey (2003). Computing Research News. 15, 2, pp. 6-13.

Appendix 1

Time line for data collection and analysis

Phase 1-Year 1 ▪ September 2003	▪ Solicitation emails seeking participation in the survey sent to 5,000 students and a census of faculty, administrators and academic advisers on all campuses
Phase 2-Year 1 ▪ October 2003 – January 2004 ▪ October 2003 – January 2004 ▪ February 2004	▪ Web-based surveys of 5,000 students (total) on all five campuses ▪ Telephone surveys of an estimated 440 faculty, administrators and academic advisers (total) on all five campuses ▪ Follow-up emails to non-respondents
Phase 3-Years 1, 2, and 3 ▪ February/March 2004 ▪ February /March 2005 ▪ April/May 2006 ▪ September/October 2004 September/October 2005	▪ In-depth face-to-face interviews of an average of 15 undergraduates, 8 master's and 8 Ph.D. students (total 155 students), and key faculty and administrators, at each of the five universities at three points in time ▪ Follow-up contacts through email/telephone with interview subjects