

Increasing Participation of Women in Cyber Security

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Abstract – Over half of the population in the United States is women, yet less than 20% of the students who study computing in this country are women? Why is that? Worse, much less than 20% of women study computer security, and it is one of the most important subjects of our time. In 2010, Mississippi State University (MSU) began a project to try and change the attitudes of women in Mississippi toward computing in general, but more specifically about computer security as a career path. The problem is certainly not ability. Women are certainly as capable as men in succeeding in these fields. It is more of a problem of women being attracted to these fields, and feeling like they can make a difference. Supported by an NSF grant to figure out how to tackle this problem, researchers at MSU devised a three phase approach to changing women's attitudes about computer security. Phase I is a week long summer camp, exclusively for women moving into the 11th and 12th grades of high school, where they live together in the dorm, are mentored by women university students, and given the opportunity to see computing and computer security topics from the perspective of how they can make a difference in society. Phase II is an eight to ten week research experience for women between their freshman and sophomore years of college. At this point, they are not really ready for cooperative education or internships, but are ready to have a real research experience that can light a fire in them for learning more about the field. Phase III comes at the end of the sophomore year, and is getting them involved in an internship in the computer security field.

Keywords: Cyber Security, Increasing Participation, Women

INTRODUCTION

This paper describes an effort at Mississippi State University (MSU) to increase the participation of women in Information Assurance (IA) and more specifically in the National Science Foundation Scholarship for Service (SFS) program. MSU has been a National Center of Academic Excellence in Information Assurance Education since 2001, and has been giving scholarships under the SFS program since 2002. To date, approximately 67 SFS scholarships have been awarded to MSU students. MSU awards SFS scholarships to support BS, MS, and PhD students in IA fields, such as computer science, computer engineering, software engineering, electrical engineering, industrial and systems engineering, and business information systems. Mississippi State University has enjoyed a very successful Scholarship for Service program, including nine women who have applied for and received the scholarship. Two of these women left the program before completing the scholarship. One of these two decided to withdraw from the scholarship program before starting, and the other was asked to leave the SFS program due to her inability to satisfy the conditions of the program, leaving seven who completed the SFS program and went to work for the government. These seven women represent only 10% of the total SFS scholarships given at MSU. Considering that the percentage of women in disciplines at MSU suited to IA education is higher in most cases than the number of women applying for the scholarship, it seems that something should and could be done to encourage more women to apply. The problem of a low percentage of women applying for the SFS program is really a symptom of a much larger problem. The engineering and computing disciplines have been suffering from low female enrollment for a long time. When the majority of students in colleges and universities are women [6], it is a sad fact that the percentage of women in computer science is less than 20% of the total student population [9]. Jane Margolis and

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Allen Fisher wrote a book entitled *Unlocking the Clubhouse: Women in Computing* [5], and in that book they explored the reasons why women shy away from the computing curriculums. One of the many suggestions that they provide to make computing more female-friendly is to explain to girls the "... breadth and social relevance of computing..." [5, p. 121]. In another book, *Stuck in the Shallow End: Education, Race and Computing* [6], Margolis explores why disadvantaged students in Los Angeles, even when resources are made available to them, do not take advantage of the opportunities as often as other students. In a conversation with a minority female student, the student stated, "... while she really enjoyed the subject and wanted to continue her computer science studies, she had no interest in persisting in what she felt was an unfriendly and somewhat exclusive environment." [6, p. 93] MSU is a university with excellent programs in IA Education and Research, and a history of using innovative approaches to IA education. MSU has developed a culture of using "discovery learning" in the IA curriculum [1, 2, 3, 7, 8], and that approach tends to favor students traditionally uncomfortable with technical education. Even so, MSU also suffers from low enrollment of women in these disciplines. Increasing the number of women participating in IA activities may provide incentive for more women to apply for these disciplines as well. Based on participation in the first year of the project, and on exit surveys conducted at the end of Phase I, it appears as if a significant percentage of the women participating in the summer camp are inclined to apply for a computing discipline. Since they were rising juniors and seniors, we will not know until next year if they follow through on that interest.

OBJECTIVES OF THE PROJECT

Our overall objective in this project is to increase the interest of women in IA as a career field. IA is a field that has long been dominated by men, but not for good reason. Women possess the capability to perform in this field, and when you get a woman excited about IA, they are extremely motivated to succeed. The primary objective of this project will be to find ways to spark the interest of women in IA fields of study. Efforts currently underway to broaden the participation of women in computing will be leveraged to attract women to the IA fields. At MSU, Dean Sarah Rajala of the Bagley College of Engineering, past president of the American Society for Engineering Education has made it part of the MSU culture to increase the participation of women in Engineering. Existing programs, like summer camps for young women will be leveraged to encourage participation in this endeavor. Additionally, several women who are supporting this effort through participation in the Advisory Board are involved in the Broadening Participation in Computing program, and are intimately familiar with the issues that keep women from applying in greater numbers.

An additional objective of this project is to increase the number of female applicants for SFS programs at Mississippi State University. As we increase the visibility of the SFS program among women at MSU, and more women get involved in the summer camps, research experiences, and internships that will be developed for this program, a side-effect will be that more women will apply for the SFS scholarship program. These activities will be designed to get them excited about IA opportunities, and specifically the opportunities provided to recipients of the SFS scholarship.

We also want to increase the ability of all CAE institutions to recruit female applicants for the SFS program. As the project develops, and MSU gains knowledge of the benefits to the SFS program at MSU, results will also be shared across the entire CAE program, allowing other institutions to benefit from the knowledge and experience gained at MSU.

Additionally, we hope to develop marketing materials that can be used by all CAE institutions to recruit female applicants. An objective of this project is to develop some marketing materials for the CAE program depicting women involved in IA and SFS activities. People tend to feel more comfortable with materials containing pictures of people similar to themselves than others. So, marketing materials featuring women in primary roles in IA should help to attract more women to the programs.

WHY MISSISSIPPI STATE UNIVERSITY?

The MSU Center for Computer Security Research (CCSR) was founded in academic year 2001-2002 to promote the scientific exploration of computer vulnerabilities with the objective of improving prevention and detection techniques through research. The CCSR is organized within the Department of Computer Science and Engineering as a framework within which our faculty and students can work and publish. We promote computer security education and research through the involvement of our students in supported research and through classroom and laboratory experiences. We have involved more than 40 students in our research to date – several of whom were undergraduates. The Department of Computer Science and Engineering has a robust interdisciplinary IA research program, involving faculty from the areas of software engineering, artificial intelligence, and high performance

computing (HPC). Our research is in the areas of high performance computing security, control systems security, and digital forensics. These areas are the “applied” focus of our students’ learning experience. The primary sponsors of this research effort are the National Science Foundation, the Army Research Laboratory, and the U.S. Department of Justice. This successful research effort has been the catalyst in our department to graduate students that not only know the theory behind IA, but also have some practical experience in applying it. We have built a very strong base of instruction, faculty research, and capability from which we can expand, but through this program, we need to increase the number of women in the program.

THREE PHASE APPROACH

This problem is a broad spectrum problem. We need to tackle the problem at several levels, getting women excited from before they leave high school and enter the university to involving them in activities while they are in the first couple of years of college. To accomplish this, our project is being carried out in three phases, with all phases starting simultaneously. Since it is a two year project, we do not have time to introduce each phase in succession. We will work to show the increased effectiveness of the later phases, as the graduates of the earlier phases move into the later ones. In this way, we can validate the effectiveness of the earlier phases along the way. A mentoring program has been developed in the project as women involved in the program are being asked to act as mentors for the newer women in the program. We have an advisory board comprised of women working in the field of IA to provide advice and assessment of the project. This advisory board has met twice since the project began. The first meeting was used to solicit input from these women on how the project should proceed. The second meeting, in November 2011, was used to report out assessments from the first summer’s activities and solicit “mid-course corrections.” The project activities are described next:

Phase I: Summer Camps for High School Juniors and Seniors

This first phase is directed at getting girls interested in IA through educational activities in a summer camp format. MSU has extensive experience in running summer camps for kids of all ages, and the Bagley College of Engineering has made an extensive effort to offer summer camp opportunities to minorities and women to build their interest in engineering fields. These summer camps have been offered successfully for a number of years, so institutional experience aided in the success of our first year’s phase one activities. Girls were recruited from selected high schools in the state of Mississippi to attend a focused IA summer camp no-cost to them in order to build their interest in the field and show them that through IA they can provide a useful service to society. Research has shown that women are much more likely to pursue fields where they feel like they can make a positive difference in society. [5A] Figure 1 shows the women participating in the summer camp in June 2011. Figure 2 shows all of the participants in the summer camp, including the authors and the Research Experiences for Undergraduates (REU) participants who served as mentors for the summer camp participants.



Figure 1: Rising Juniors and Seniors from Mississippi High Schools participating in the 1st Summer Camp



Figure 2: All participants in the summer camp, including mentors and authors.

Phase II: Research Experiences for Undergraduates Between the Freshman and Sophomore Years

This phase of the project focuses on women attending community college and university programs that can feed into the IA field. These include computer science, computer engineering, electrical engineering, industrial engineering, information technology, and business information systems. A concerted effort was made to recruit these women as broadly as possible to participate in this paid⁴ REU summer experience between their freshman and sophomore years. Six women from three different departments at MSU participated in this first year's REU. They were provided with a problem in digital forensics and were asked to spend two weeks researching the subject of digital triage. The women worked as a team to develop a product that was demonstrated by summer's end. Future iterations of this REU experience will have the opportunity to work on other forensics tools, or to develop some penetration testing tools as part of our cyber operations efforts.

Phase III: Internships for Sophomores

During their sophomore year, women that show an aptitude for and an interest in IA careers will be invited to attend the annual SFS job fair in Washington, DC. Through this experience, they will be exposed to students from other CAEs, both men and women, in a collegial, supportive environment. They will also get to show potential employers the skills and positive attitudes that they would bring to a summer internship. Through this experience, we hope to convince these women to apply for the Scholarship for Service during the Spring semester of their sophomore year, and to participate in a summer internship with a government agency. Our experience has shown that once students are exposed to the work that is available in the IA field, they are very excited and work very hard to prepare for the demands of these jobs. Experience has also shown us that once a graduate of the IASP or SFS scholarship programs goes to work in the Federal Government, very few leave government service. Of the few that do leave, many return to the federal government after a very short absence.

MENTORING PROGRAM

One of the benefits of the three-phase approach is that students participating in the later phases can serve as mentors for the students in the earlier phases. For the first summer, one of the authors, Kendra Carr, a graduate student in computer science was asked to provide mentoring for the women in Phases I and II. Additionally, the women in Phase II during the first summer were asked to serve as mentors for the women attending the summer camp. As the program continues to develop, this mentoring program will expand to include the women that participated in an activity in earlier years providing mentoring to attendees in the activities that they have graduated from.

⁴ REU participants were paid \$2000 stipend for the summer, as well as reimbursed up to \$100 per week for meals, and provided a free room in the dorm.

ADVISORY BOARD

To ensure that the project stays focused on the primary goal of making IA and the SFS program more attractive to women, an advisory board made up of influential, experienced women in the computing and IA fields was formed to guide the project. This board is comprised of six women, five of which come from institutions that have been designated Centers of Academic Excellence in the IA Education and Research:

- Dr. Julia Hodges, a professor of computer science and engineering with nearly thirty years of experience as an educator. Dr. Hodges recently completed ten very successful years as the Head of the Department of Computer Science and Engineering at Mississippi State University and now serves as Associate Vice President for Academic Affairs at MSU.
- Dr. Donna Reese, a professor of computer science and engineering with over twenty years of experience as an educator. Dr. Reese recently completed six successful years as Associate Dean of the Bagley College of Engineering, and currently serves as the Head of the Department of Computer Science and Engineering at MSU.
- Dr. Kara Nance, a professor of computer science with approximately 22 years of experience as an educator. Dr. Nance recently served as the Head of the Department of Computer Science at the University of Alaska at Fairbanks, and has extensive experience in broadening the participation of women in computing.
- Dr. Lorie Liebrock, an associate professor of computer science with over ten years of experience as an educator. Dr. Liebrock currently serves as the Chair of the Department of Computer Science at New Mexico Institute of Mining and Technology, as well as the Dean of Graduate Studies.
- Dr. Barbara Endicott-Popovsky, an associate professor of information studies and urban planning with over ten years of experience as an educator. Dr. Endicott-Popovsky currently serves as the Director of the Center of Information Assurance and Cybersecurity at the University of Washington.
- Ms. Chanel Evans, a graduate of the SFS scholarship program at MSU who completed her obligation with the scholarship, and now lives and works in Nashville, TN.

RESULTS

After the first year of the project, we have made a lot of progress. The summer camp was a great success, and several of the women attending the camp have contacted me saying that they now intend to apply to Mississippi State University to study computer science and specialize in computer security. One of the six women participating in the summer research experience has already taken the scholarship and four others have expressed the desire to receive the scholarship. One of these will not be eligible due to grades. The sixth woman has shown little interest since the research experience, and we believe that she participated solely for the money and free room and board. We are now seeking resources to have two summer camps next summer, and to extend the project to a four year study. Only then will we be able to observe participants in the summer camp make to their junior year and receive the scholarship. Thus far, results are very favorable that our three phase approach is a viable method of increasing the participation of women in the SFS program.

REFERENCES

- [1] Dampier, D. and J. Cohoon, "Educating Tomorrow's Digital Forensics Examiners", Innovations 2008, INEER, July 2008, pp. 273-282.
- [2] Dampier, D. and R. Vaughn, "Hands-On Discovery Learning in Computer Security and Forensics," Proceedings of the 2009 International Conference on Engineering Education and Research (ICEER), Seoul, Korea, August 25-28, 2009.
- [3] Dampier, D., "Building an Education Program for Engineers in Digital Forensics," Proceedings of the 2008 ASEE Conference, Pittsburgh, PA, June 22-25, 2008.

- [4] Gorski, E., "College 'gender gap' favoring women stops growing", Seattle Times, January 25, 2010, http://seattletimes.nwsourc.com/html/nationworld/2010890292_apuscollegendergap.html, downloaded January 30, 2010.
- [5] Margolis, J. and A. Fisher, *Unlocking the Clubhouse: Women in Computing*, MIT Press, December 2001.
- [6] Margolis, J., *Stuck in the Shallow End: Education, Race, and Computing*, MIT Press, September 2008.
- [7] Vaughn, R. and D. Dampier, "Outreach, Teaching and Research Facilitated by a Forensics Training Center in Direct Support of Public Safety and Criminal Justice," *International Journal of Computers and their Applications (IJCA)*, Vol.16, Num. 2, June 2009.
- [8] Vaughn, R. and D. Dampier, "A Discovery Learning Approach to Information Assurance Education", *Proceedings of the 2009 Hawaii International Conference on the System Sciences, Minitrack on Digital Forensics*, Waikoloa, Hawaii, January 5-9, 2009.
- [9] Vegso, J., "CRA Taulbee Trends: Female Students & Faculty", <http://www.cra.org/info/taulbee/women.html>, downloaded January 30, 2010.

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Dr. Dave Dampier is a veteran of 20 years in the U.S. Army, and currently serves as Associate Professor of Computer Science and Engineering at Mississippi State University. He also directs the university's Center for Computer Security Research and the National Forensics Training Center. He teaches information security and digital forensics courses, and his research interests are in the areas of digital forensics and the application of software engineering to the development of tools for digital forensics.

Kimberly Kelly

Kimberly Kelly, PhD, is an assistant professor of sociology at Mississippi University. Her research interests focus upon gender inequality in higher education, particularly in STEM fields. Kelly's work examines topics such as gendered salary disparities among faculty, the gendered effects of parental and marital status upon STEM faculty, and recruitment efforts aimed at attracting high school girls into STEM fields.

Kendra Carr

Kendra Carr is a graduate student in the Department of Computer Science and Engineering at Mississippi State University. She is a former varsity cheerleader for MSU, and is currently pursuing her M.S. in Computer Science on the SFS scholarship and specializing in IA. She is planning on pursuing a career with the Department of Defense after she graduates.