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GENDER DIFFERENCES WITHIN THE OPEN SOURCE COMMUNITY: AN EXPLORATORY STUDY

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ABSTRACT

Current statistics and previous research provide a number of reasons why females are being discouraged from initially entering into computing fields. These reasons as well as other additional factors provide insight into the disproportionate ratio of males to females within the open source community. Our research addresses the factors surrounding females' overall lack of involvement within the open source community on several levels including engagement, alienation, confidence, and commitment. Our findings provide additional insight into why females are avoiding or being discouraged by the open source community.

Keywords: Open source, women, computing, technology, IT, gender socialization

INTRODUCTION

The term "open source community" refers to a large group of individuals committed to the collaborative development and maintenance of Open Source Software (OSS) or Free/Libre Open Source Software (FLOSS). OSS is freely made available to download, alter, and redistribute to the public. The open source community thrives on a culture that is based on inclusion and equality, thus being dedicated to providing free software to the public [14].

As our society becomes increasingly dependent on information communication technologies (ICT), available software is critical to meet the requirements of a globally diverse range of users. Additionally, multiple methods must be employed in order to meet these same needs. OSS development is just one of those methods, but is quickly becoming the most successful. Inclusion of both males and females is necessary when it comes to a society based on ICTs, because software is gendered in both design and use [16]. The absence of female developers, in fact, can disadvantage the open source community as it has been proven that diversity in developers can lead to better technologies.

It is commonly understood that the IT work force lacks *gender* diversity. In 1983 women made up approximately 43% of the IT work force according to the United States Bureau of Labor Statistics Current Population Survey. By 2008, while the total IT work force had more than doubled, the female percentage had dropped to 26% [5].

As the development process within the computing field is constantly growing and changing, more input should create better output. Furthermore, since the gap is narrowing between men and women in their levels in the use of computers, the Internet, and other information systems, the problem is not about increasing the number of female computer users, but rather that of female developers. In terms of FLOSS, opportunities can be made more available for women to learn how to communicate and interact with software designers and offer the opportunity to deliver the kinds of software that businesses or the general public might want or need. Certainly, environments that are women-friendly can offer a holistic environment which is based on a collaboration-oriented approach based on that of competence and not of gender.

LITERATURE REVIEW

Since the latter part of the twentieth century the economic growth of a society has been intimately linked to the rate of growth of its human capital and its technical progress [3, 6, 7, 8, 9]. Thus, the development of a sustainable knowledge base becomes critical to economic growth

Because the engine of a knowledge economy is the *information economy* - that portion of the labor force engaged in the production and deployment of information and information technology [19, p. 5] - the sustainability of a knowledge economy is directly linked to the robustness of its information technology (IT) labor force [19]. In this regard, an important concern is the under-representation of women in the information technology workforce as well as women involved in the development and usage of open source software.

A review of the literature reveals that women are confronted with the dilemma of masculinizing themselves in order to integrate into the masculine workforce or else they must challenge the cultural system and attempt to feminize the workforce [1, 21]. Quite frequently, many feminist critiques of technology are aligned with the social construction perspective. These perspectives are particularly useful as they are typically attentive to differences among people and, in particular, among women. For instance, the liberal feminist view [18, 22] accepts that technology is not neutral. Rather, what is at issue is the different ways in which men and women are positioned in relation to it. In this sense, it is argued that women's potential for participation in technology use and development has been distorted by gender stereotyping [19].

Women who want to pursue a career in the open source community face many obstacles. Between the years 2000 and 2006, the number of women employed in the information technology field in positions such as computer scientists, systems analysts, programmers, software engineers, support specialists, as well as other computer administrators showed a decrease of 7.7% [4]. From 2000 until 2005, the percentage of undergraduate females majoring in computer science decreased by 70%. In the OSS community, statistics from 2006 show that only 1.5% of all Open Source Software (OSS) developers are women. "Research suggests that barriers to women's participation may be deeply embedded in the culture of OSS" [14].

One large deterrent for women is that the open source culture creates the impression that its participants have a long history with computers. In reality, women do tend to engage themselves with computers later in life than men and at less advanced stages. This action further limits females in an environment that almost entirely emphasizes independent learning. Women who have tried to advance themselves in the development area of OSS often find they are undervalued simply because they have not been coding since a young age. Rather than being encouraged for becoming active in a stereotypically male-dominated environment, most females face a discriminating environment. This reaction not only turns those females away who make an attempt to enter this realm of computing, but it also facilitates an image that the community is rejecting them due to a lack of experience.

Another barrier is the "hacker" ethic that is deeply rooted within the open source culture. The hacker ethic is often described as controversial, competitive, and brutal. Some common means of communication for the diverse range of users within open source development include, but are not limited to, Internet Relay Chat (IRC) and online message boards. Most open source companies and software developers provide their source code on their website and offer these communication media to the public in order to receive instant and effective feedback so that they can continuously tweak and improve their product [14].

It is within these modes of communication that a great deal of controversy is created among contributors. These arguments, and occasionally heated debates, are often referred to as flame-wars. For the open source veteran, this experience may not be offensive, but for

many females entering this area for the first time, it can be daunting and discouraging. This may also be another reason why such a large portion of females are immediately discouraged [14].

There exists a strongly prejudiced mentality within the open source social world. In theory, since there are few barriers in gaining access to open source projects and their communities, there should be little or no problem for participants. In spite of this openness, there are still many complaints from female developers regarding the unfriendly atmosphere both online and offline. In addition to verbal and targeted discrimination, more discrete forms of discrimination in open source development are found in the developers' documentation. A common form is the use of "he" rather than "he or she" or "they" [16]. While this may or may not be the developers' intent, it still does not offer the welcoming atmosphere most newcomers would desire and often leaves females feeling alienated. This feeling of alienation, coupled with the attitude often conveyed by a competitive, male-dominated group, has a tendency to discourage women [16].

One of the biggest stereotypes attached to technology-related fields in general is the anti-social aspect of it. Unlike proprietary software development, the open source community does not really have its own "face." This is something the open source community is looking to change simply because of the typical stereotype that portrays developers of open source software as pale, anti-social geeks working out of their basement and living off of junk food. This stereotype gives the open source community a less than accurate image of what the field is really like and tends to be a deterrent for people who are not already involved within the community, particularly females. It also gives the impression that open source development is not a collaborative field, which is often a quality more females than males in the workplace prefer [13]. People who have participated in open source projects know that this is far from the truth and that open source software development is all about collaborating to make the best products. Software development is as social as one makes it.

If a person prefers to sit alone and code, it will be more of an anti-social activity. If someone prefers to work in a truly collaborative environment instead of just participating collectively on a project, sitting with a group of people writing code will be equally or more effective. Sitting in front of a computer all day writing and talking about code is not a requirement of working in the open source community [10]. There are times when a situation calls for independence in order to get a job done, but that is true in all professions.

More often than not, people involved in open source software development have been working with computers for a long time. Being a male-dominated field, many of those males started playing with computers when they were very young and were naturally attracted to the machine and figuring it out [11]. Computers became a passion for them at an early age. Because of this fact, a lot of females have the perception that in order to be involved in the open source community you have to "dream in code", read computer books, work with computers as a hobby, and if you are not doing any of those things you do not belong in that department [11]. "Dreaming in code" is the concept where developers who are completely engrossed in their work are unable to stop thinking about it—even in their sleep. "Dreaming in code" is not required in order to become a successful contributor in the open source community. The fact that a person does not spend every waking hour coding, researching, or learning more about computers does not mean they are not capable of performing at an equal or higher level. Other countries have also experienced a male to female ratio difference in the areas of the open source community. As an example, three years ago, Iran decided to run its government computer system on open-source software. The Islamic Republic had long relied on pirated copies of Microsoft's software, a result of the U.S. embargo that forbids American companies from providing technical support to Iran. A recent European Union survey found that only 1.5% of European open-source coders are female. Similar patterns are now emerging elsewhere in the Middle East. In Syria, which is also under a U.S. embargo, women are estimated to make up at least 50% of the coding workforce [20].

Social construction theory has played an important role in the study of the relationship between gender and technology. Marini [17] argues that the influences of societal factors, rather than biological forces, are the primary constructs that shape individuals and their relationships with technology. As a result, a social construction perspective asserts that there are no universally male or female qualities that are emphasized within the IT field but rather certain cultural characteristics are gathered on the basis of gender. In this sense, the IT workplace may be deemed a 'male' domain.

METHODOLOGY

After a review of the literature a survey was created and administered to participants in an online voluntary setting. To further enhance participation a blog was created (http://osfemales.short-stack.net) to document the research progress using Drupal, an open source content management system. Through this system,

organizations such as the Anita Borg Institute and other groups for women in technology were informed of the survey. Thirty-seven females from nine different countries, who are active members of the open source development community, completed the survey hosted through survs.com.

FINDINGS

In order to properly depict the results, we first asked several open source specific questions at the beginning of the survey. Eighty percent (80%) of the respondents indicated they use open source software on a regular basis. Forty-four percent (44%) stated that they preferred open source software to proprietary software.

As shown in Figure 1, sixty-four percent (64%) confirmed they were already actively involved in the open source community. Active was defined as bug reporting, development, participating in open source forums, and giving input on open source projects. Eighty percent (80%) also said they were interested in learning more about open source development.

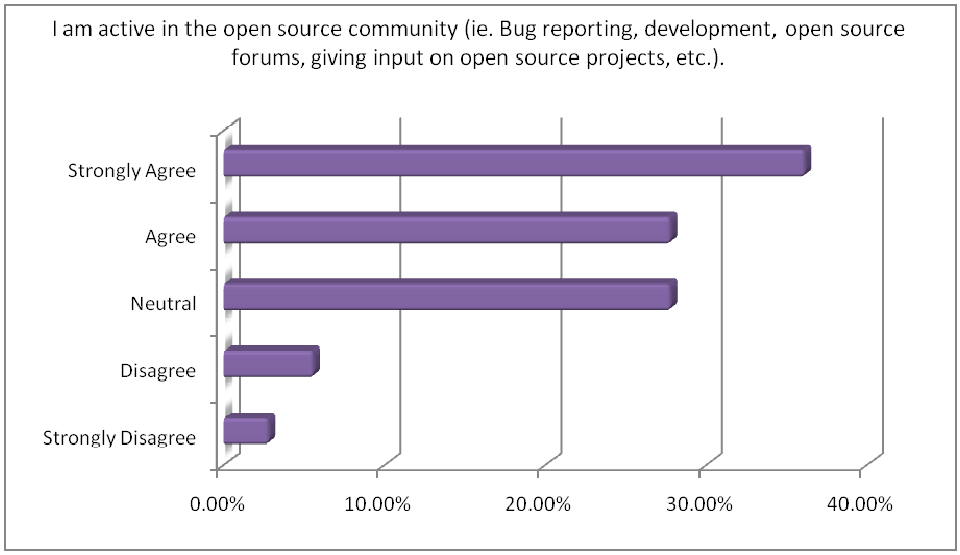

Figure 1: Activeness in the Open Source Community

Male to Female Ratio

We asked respondents whether being in a male-dominated field was a contributing factor for women in order to further understand whether the ratio of males to females influenced their decision to be involved in the open source community. When asked if they felt outnumbered or alienated within the open source community, 72% said they felt outnumbered; however, only 24% said they felt alienated. Fifty-four percent (54%) of those surveyed said they would be more inclined to participate if there were more females involved.

Awareness

Forty-one percent (41%) of the females surveyed said they were unaware of active Linux users' groups (LUGs) at universities. Ninety-two percent (92%) said they felt that universities do not do enough to encourage females to participate in computing fields in general. When asked if similar LUGs or groups for females interested in open source and development would interest them, 52% either agreed or strongly agreed. Seventy-five percent (75%) said they knew other females who would be interested in involvement within the open source community.

Discrimination & Harassment

Some of the questions on the survey were posed in order to determine whether or not discrimination and harassment are causal factors to the low number of females involved in this field. As shown in Figure 2, about 50% of the women indicated they had witnessed gender-based discrimination within the open source community either online, in meetings, or in class.

Regardless of that fact, 80% said their interests in open source software and development are not influenced by gender socialization or discrimination. Fifty percent (50%) said they had experienced harassment online or offline, but 38% said that harassment is not a deterring factor.

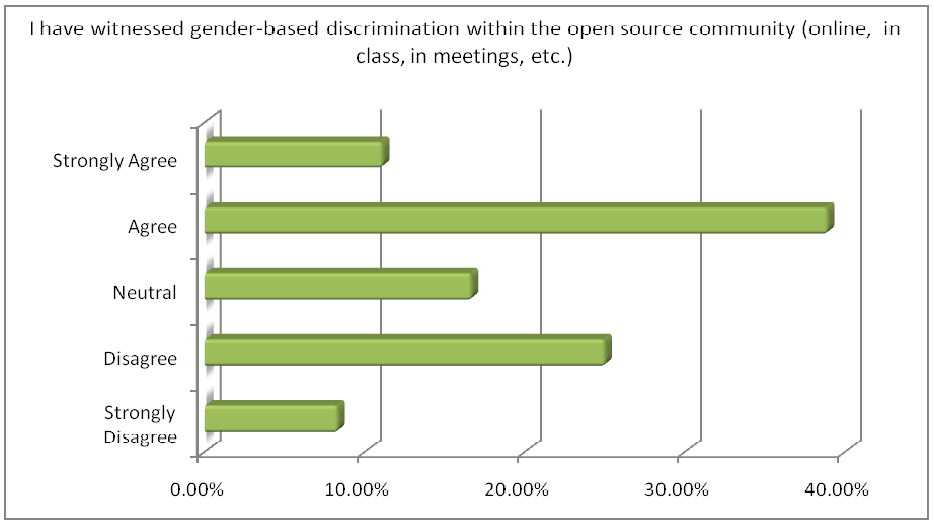

Figure 2: Witnessed Gender Based Discrimination

Confidence & Commitment

As shown in Figure 3, 100% of the survey participants said they believe confidence is an important factor when entering the open source community. Seventy-two percent (72%) indicated that prior experience with computers is important in becoming successful. Eighty-nine percent (89%) said they participated in the open source community both at home and at work. Fifty percent (50%) said they agreed with the concept of "dreaming in code" and thought it was applicable to open source development [11].

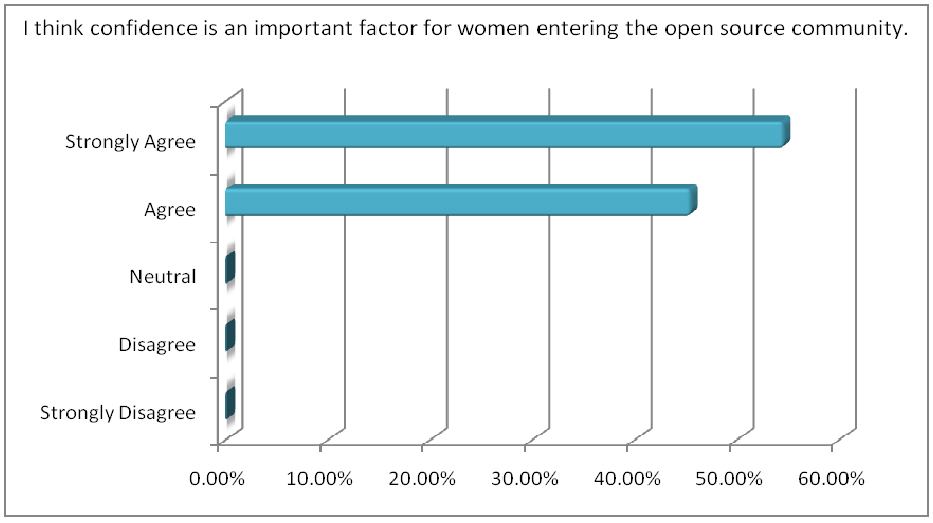

Figure 3: Confidence Levels Within The Open Source Community

Stereotypes

Seventy-seven percent (77%) of the women surveyed said they prefer open source due to the community and the support it provides. Fifty-three percent (53%) said they prefer participating in the community within a collaborative environment rather than working independently. As shown in Figure 4, 66% disagreed or strongly disagreed to the stereotype that open source software development is an anti-social field.

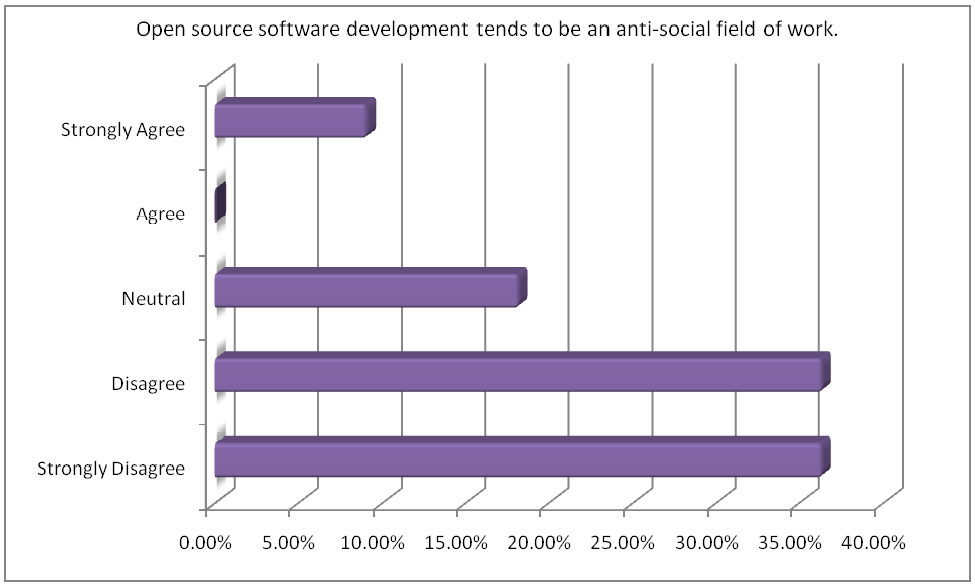

Figure 4: OSS Is An Anti-Social Field

DISCUSSION

Because the females who participated in our survey were already involved in a technology-related field, they have seen firsthand the social aspects, advantages, and disadvantages of being a woman in a male-dominated field. The purpose of our research is to better understand the factors that influence female's involvement within the open source community.

As found in the survey results, seventy-two percent (72%) said they felt outnumbered but only 24% said that caused them to feel alienated. Again, the participants were women already involved in a computing field. For women directly outside of the computing field or open source community, the percentage of alienation would most likely be higher. Like any other new experience, the level of comfort will adjust accordingly, but making women feel welcome instead of alienated is certainly a goal worth working towards. The feeling of alienation, while still a relatively low percentage, should be minimized in order to increase female involvement and attract newcomers. As mentioned in the literature review, more input will create better output. According to the survey results, more female involvement will allow the open source community to attract more females, as the male to female ratio declines.

Based upon the percentages included in the awareness section of the findings, we found that many females may be interested in technology are not provided with the knowledge of the opportunities available in order to participate within the open source community. The majority of the females (92%), stated they felt like universities did not encourage females enough to become involved in computing fields and 41% said they were not even aware that Linux users' groups existed. Females already involved in these types of organizations need to reach out to women they know and encourage them to join. The survey results showed that 75% knew other females who would be interested in becoming involved in the open source community.

Discrimination and harassment are not as easy to identify, as there are many varieties of both. While half of all women surveyed said they had witnessed

discrimination or harassment within the open source community, the percentage of women affected by it was low. Something as seemingly harmless as ignoring their contributions or pointing out the obvious fact that they are a female are forms of discrimination that occur frequently within the open source community. Harassment usually comes in the form of snide remarks and jokes and is meant to be harmless; however, newcomers may misinterpret it to be an unwelcoming message instead. Even hearing something along the lines of, "There's a girl here," can be discouraging. It may be a celebratory moment when the ratio begins to decrease, although, pointing it out only creates discomfort. Despite the existence of both discrimination and harassment, the survey results suggest these are things we should not have to worry about as much as attracting female involvement initially. In any ideal work environment, these factors should be kept as low as possible.

Commitment is only going to come from people who are passionate and confident about the input they are giving within the open source community. Women in open source are as passionate about their work as men, and some take more pride in their work because they are women. According to the survey results, 89% said they worked on open source projects both at home and at work. This includes taking their work home with them as well as participating within the open source community during their leisure time. Seventy-two percent (72%) agreed that prior experience with computers is a contributing factor in becoming successful, but many also added that because it is not a requirement it allows for new people to enter and learn from the community as well as on their own. Everyone who took the survey agreed that confidence is an important factor. This also applies to entering a male-dominated field and opening themselves to the discrimination and harassment that exists, in addition to subjecting their ideas and suggestions to the public for critiquing.

After reviewing the survey results related to social aspects of the open source community, the previously established stereotypes are contradicting. It seems as though there is a general misunderstanding of the nature of the open source community and how it functions. According to the survey, the majority of participants believe that open source software development is not an anti-social field and prefer open source software over proprietary software, because of the community and the support it provides. The high percentage of females who prefer to work in a collaborative environment rather than independently suggests that is how they do most of their work. The open source community thrives on collaboration because of the superior quality work that stems from it. The suggestion that the open source community is the polar opposite is misleading for outsiders.

Given the fact that ninety-two (92%) stated that they felt that universities do not do enough to encourage females to participate in computing fields in general, we are led to believe that stronger marketing for these groups could generate interest for many more females at campuses worldwide. Therefore, it becomes incumbent upon universities to identity strategies that will openly encourage women to become actively involved in computing fields.

RECOMMENDATIONS AND CONCLUSION

In order to shift the male-to-female ratio within the open source community, changes will have to be made in an attempt to get more females involved. The biggest issue is promoting awareness and dynamically recruiting more women to become actively engaged. This might include steps as small as encouraging them to submit bug reports for different open source software or share their input in open source projects.

Stronger and more diverse marketing of Linux users groups will help in recruiting potential contributors, as well as promoting more events specifically for females interested in open source development. Events for females in open source will create enthusiasm among a group of females.

Previous research indicates that females get involved with computers later on in life than males. For many of them, college could simply be the first time they have been exposed to Linux or any other open source software. More publicity and marketing for Linux users' groups in the right places could interest a lot more people, both males and females. Linux users' groups are not in any one place; they exist around the globe.

In the meantime, there needs to be emphasis put on how to encourage women who are already involved or who are looking to get involved. Specifically, we need to correct the social stereotypes that are associated with open source software development. The open source community needs to show less discrimination and more inclusion to tone down the male-dominated atmosphere into something that promotes participation and not strictly individual work.

By taking all of these ideas into consideration, confidence levels will be higher for females who may be hesitant to contribute, and the ratio will begin to even out. Future research can use the findings from this study to create a more comprehensive survey based upon a theory such as the theory of planned behavior [2] that can be

distributed to a larger sample size. This will allow us to test hypotheses and relationships among constructs. This study was designed to help us better understand some of the factors that discourage females from entering or staying in the open source community.

REFERENCES

[1] Adam, A., Howcroft, D., and Richardson, H. "A Decade of Neglect: Reflecting on Gender and IS," *New Technology, Work and Employment* Volume 19, Number 3, 2004, pp. 222-240.

[2] Ajzen, I. "The Theory of Planned Behavior," Organizational Behavior and Human Decision Processes, Volume 50, Number 2, 1991, pp. 179-211.

[3] Becker, G. "Human Capital and the Economy," *Proceedings of the American Philosophical Society,* Volume 136, Number 1, 1992, pp. 85-92.

[4] Chabrow, E. "Numbers Show Big Decline of Women in IT", CIO Insight. http://www.cioinsight.com/c/a/Past-News/Numbers-Show-Big-Decline-of-Women-in-IT, 2007.

[5] Coder, L., Rosenbloom, J.L., Ash, A., and Dupont, D. "Viewpoints: Economic and business dimension Increasing gender diversity in the IT work force," *Communications of the ACM*, Volume 52, Number 5, 2009, pp. 25-33.

[6] Denison, E.F. *Accounting for Slower Economic Growth: The United States in the 1970s,* Brookings Institution: Washington D.C. 1979.

[7] Denison, E.F. *Trends in American Economic Growth, 1929-1982,* Brookings Institution: Washington D.C. 1985.

[8] DeVol, R., Koepp, R., Ki, J., and Fogelbach, F. "California's Position in Technology and Science," Milken Institute: Santa Monica, 2004, pp. 86.

[9] DeVol, R., Koepp, R., and Fogelbach, F. "State Technology and Science Index," Milken Institute: Santa Monica, 2002, pp. 80.

[10] Fisher, A. and Margolis, J. "Geek Mythology and Attracting Undergraduate Women to Computer Science", http://www.cs.cmu.edu/afs/cs/project/gendergap/www/papers/wepan97.html, 2005.

[11] Fisher, A., Margolis, J., and Miller, F. "Caring About Connections: Gender and Computing", http://www.cs.cmu.edu/afs/cs/project/gendergap/www/papers/IEEE99.html, 1999.

[12] Fisher, A. and Margolis, J. "Unlocking the Clubhouse: Women in Computing", Cambridge, MA: MIT Press. http://delivery.acm.org/10.1145/550000/543836/p79-fisher.pdf, 2002.

[13] Henson, Val. "HOWTO Encourage Women in Linux", The Linux Documentation Project. http://tldp.org/HOWTO/Encourage-Women-Linux-HOWTO, 2002.

[14] Holliger, A. "The Culture of Open Source Computing", http://www.ncwit.org/pdf/OpenSourceComputing_Web.pdf, 2007.

[15] Krieger, B. and Leach, J. (2006) "Gender: Integrated Report of Findings." Accessed 24 Nov 2008, http://flosspols.org/deliverables/FLOSSPOLS-D16-Gender_Integrated_Report_of_Findings.pdf, 2006.

[16] Lin, Y. "Gender Dimensions of Floss Development", http://www.liminar.com.ar/txt/genderfloss.pdf, 2005.

[17] Marini, M.M. "Sex and Gender: What Do We Know?" *Sociological Forum,* Volume 5, Number 1, 1990, pp. 95-120.

[18] Swords-Isherwood, N. "Women in British Engineering," in Faulkner, W. and Arnold, E. (Eds.), Smothered by Invention, Pluto: London, UK, 1985, pp. 72-86.

[19] Trauth, E. M., Quesenberry, J. L., and Yeo, B. Environmental influences on gender in the IT workforce. SIGMIS Database, Volume 39, Number 1, 2008, pp. 8-32.

[20] Vaisman, D. "Coding a Revolution." *Foreign Policy*. Washington: Mar/Apr, 2007, pp. 159, 93.

[21] Von Hellens, L.A., and Nielsen, S. "Australian Women in IT." *Communications of the ACM,* Volume 44, Number 7, 2001, pp. 46-52.

[22] Walby, S. "Gender and the New Economy: Regulation or Deregulation?" Presentation given at ESRC Seminar "Work, Life and Time in the New Economy", http://www.lse.ac.uk/collections/worklife/Walbypaper.pdf, 2002.

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