How Does Presence of Women in Computer Fields Affect Perception of the Gender Gap?

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Abstract

In her thirty-year career, the author has addressed the gender gap in Engineering and Computer fields in a variety of ways, most recently by incorporating a Problem-Based Learning team assignment into a required Computer Ethics course. The assignment, used for the first time in Spring 2014 in a class of both women and men, gave results that appeared promising in positively affecting student attitudes. However, the outcomes in this mixed class led to the question as to whether similarly positive results would have been accomplished if the class had not included women: was the presence of women in the teams a critical factor? The goal of this paper is to compare the quality and originality of student work in two classes, one all-male and one mixed, and compare the conclusions on the seriousness of the gender gap and what action should be taken, reached by the two groups.

Keywords

Gender Gap, Problem-Based Learning,

Background

All Computer Science and Computer Engineering students at the University of Tennessee at Chattanooga (UTC) are required to take CPSC 3610, "Ethical and Social Issues in Computing." According to the *2013-14 Undergraduate Catalog*, the purpose of this course is to examine " the ethical and social issues arising from advances in computer technology and the responsibility that computer professionals and users have with regard to computer use by focusing on the intrinsic link between ethics and the law, how both try to define the validity of human actions, and on the moral and ethical dilemmas created by computer technology that challenge the traditional ethical and moral concepts."[1] The course uses readings and discussions of classic and current ethical theories, as well as current news coverage related to computer issues, to inform, explore, and shape student attitudes toward state-of-the-art ethical issues which arise in computer professions.

One outcome assessed in this course is awareness of complex social issues such as the gender gap in computer professions. In this context, gender gap may be defined as the disproportionate under-representation of females in computer professions compared to their representation in the general population and in the population of college students. According to the report "Why So Few? Women in Science, Technology, Engineering, and Mathematics" published by the American Association of University Women,

> In elementary, middle, and high school, girls and boys take math and science courses in roughly equal numbers, and about as many girls as boys leave high school prepared to

> pursue science and engineering majors in college. Yet fewer women than men pursue these majors. Among first-year college students, women are much less likely than men to say that they intend to major in science, technology, engineering, or math.... By graduation, men outnumber women in nearly every science and engineering field, and in some, such as physics, engineering, and computer science, the difference is dramatic, with women earning only 20 percent of bachelor's degrees. Women's representation in science and engineering declines further at the graduate level and yet again in the transition to the workplace. [2]

Also, while the number of women in most Science, Technology, Engineering and Math (STEM) fields is increasing slowly but steadily, the percentage of bachelor's degrees in computer science granted to women peaked around 1986, and has been steadily decreasing ever since.[3]

A variety of methods has been used in UTC's CPSC 3610 to address awareness of the gender gap, including standard lectures, use of an assignment and reflection based on the Harvard Gender-Science Implicit Association Test,[4] and most recently, a team project using Problem-Based Learning to aid students in exploring both their own attitudes about gender roles and the complex issues surrounding the under-representation of women in computer fields. The assignment, used for the first time in spring semester 2014 in a class of 4 women and 22 men, gave results that appeared promising in positively affecting student attitudes. At the end of the project, all teams concluded that the gender gap was, in fact, a problem which all were ethically compelled to address, and all groups gave reasonable suggestions as to ways that the gap could be addressed, with the most common suggestion being engaging young girls in STEM related play activities. As these positive results were generated in a class including both men and women, the author wondered whether similar results would be produced in a class of only men, or if the presence of women in the class would have an effect on the project results. The sections below briefly describe the assignment and the results in two sections of CPSC 3610 in the fall semester of 2014, one of nineteen male students (no females), and one with six female and twelve male students--a relatively high proportion of women.

The Assignment

The assignments included multiple parts: a preliminary assignment to gauge student attitudes before the team project, a two-week team project based on Problem-Based Learning, a student rating of team members, and a follow-up assignment to judge whether student attitudes had been changed by the team experience.

The initial assignment, detailed in a previous paper,[5] asked students read a relevant chapter of the course text; write a paragraph on why they think that there are so few women in engineering, the sciences, computer sciences, etc., paying special attention to whether they think there is any bias involved; complete the Harvard Gender-Science Implicit Association Test; and then write their reactions to the Implicit Association Test results, addressing whether it was what they had expected or not.

After completing the initial assignment, the students were divided into teams of four or five. In the class with female students, each team included at least one woman. The teams were given the assignment as follows:

> Now that you have done a baseline assignment to determine your initial thoughts on the gender gap in Computer Science, Engineering, and Science, you will be investigating this issue in groups of 4 or 5.
>
> Your goal is to determine
> - Whether the gender gap in technical fields is really a problem;
> - If so,
>   - Are we ethically compelled to address it?
>   - How?
>
> You should also address possible causes for under-representation.
> Your research should include, but is not limited to,
> - Demographics, government studies, social science studies, etc.;
> - Interviews with local businesses and women currently in technical fields;
> - Relevant current events.
>
> Each group will give an oral presentation of your results in two weeks.
>
> Your individual grade will be based on the inclusion of all required materials, your classmates' evaluation of your team's content and presentation, and your team's assessment of your personal contribution to the project.[6]

The 20 minute presentations were graded based on inclusion of required materials, originality, whether the presentation made the audience think, whether conclusions matched evidence, presentation, and proper referencing. Individual student grades consisted of a possible total of 50 points: 40 points based on the work of the team, and 10 points from the team's rating of the student work.

Following completion of the team project and presentation, each team member was rated by his or her team based on participation, contribution, leadership, and timeliness of contributions. Each student was also asked to identify the one person, other than him or herself, who was most critical to the success of the project, and why.

As a follow-up to the team project, each student was asked to write a discussion of the following questions:

- What is the most interesting (and/or transformative) thing that you discovered in researching your own team's project?
- What was the most interesting (and/or transformative) thing that you heard in one of the other team's presentations?
- What was the item (in your project or another team's) that surprised you the most?
- What was the possible solution to the gender gap that you believe to be the most promising? Why?

- Based on your ethical viewpoint (rather than just your opinion), are we ethically compelled to address the gender gap?
- Has this project changed your views on the gender gap at all, and if so, how?[6]

The Results

In the preliminary assignment, in the all-male class, 53% of the students regarded the gender gap as a problem that should be addressed; in the mixed class, 44% of the men and 80% of the women did so. This was the baseline against which conclusions in the follow-up assignment were to be measured.

Some of the student comments before the project were troublesome:

- "men tend to think more logically than women,"
- "women aren't interested in technical things," and
- "it all boils down to the distractions that females may cause in the workplace."

A common conclusion in the preliminary assignment was that "time will solve the problem;" however, since the participation of women in computer science has been decreasing since 1986,[3] time alone is no solution in this case.

Overall, the quality of the group presentations in both classes was disappointing. Of the eight total groups, four in each class, four totally omitted one or more of the required elements, the most common being the omission of relevant current events. Also, in the previous semester, the one activity that the majority of students found most transformative was interviewing female students and women in industry. Although the instructions for the assignment were identical in both semesters, and listed interviews with women in technical fields as a required element, in this semester, two groups in the all-male class interviewed only a single woman; in the mixed class, one group interviewed a single woman, and one interviewed none. The lack of interaction with women in the field may have contributed to the conclusions reached by the groups. In the all-male class, two groups concluded that the gender gap is a problem that we are ethically compelled to address; the other two groups didn't actually state a conclusion as to whether the gender gap is a problem, but gave some suggested solutions. In the mixed class, three groups concluded that the gender gap is a problem; the fourth didn't state a conclusion, and also suggested no solutions. This result is in comparison to the previous semester, where every group concluded that the gender gap is an ethical problem, and all suggested reasonable possible solutions, such as engaging young girls in play related to STEM fields.

The group oral presentations were, themselves, problematic in some cases, and this did not seem to be a function of the gender composition of the team. One group found a statistic that indicated that the gender pay gap in STEM fields is 14%, compared to 21% in other fields, and used this to conclude that there was no significant pay gap in STEM.[7] Another group stated that women in only home roles "is a genetic factor that we can't quantify," and a third concluded that discrimination against women isn't a problem because it "isn't malicious." Even a student

making a statement supportive of women in computer science included in his remarks "when a chick comes into a room...."

The quality of solutions suggested was generally poor in both classes compared to the previous semester's students, although several did reference groups such as Girls Who Code, to increase visibility of females in computer fields. Some of the solutions suggested actually contained stereotypes, as in the case of the group which suggested that universities offer separate sections of introductory computer courses for women, as, presumably, they would come to college with less computer experience than their male counterparts. Note that what was suggested was not that separate classes be provided for students, of whatever gender, with less coding experience than their peers, but for women specifically.[7]

The individual conclusions expressed by the students in the follow-up assignment were similar in both classes. In the all male class, 72% of the students regarded the gender gap as a problem that should be addressed; in the mixed class, 60% of the men and 67% of the women did so. It is interesting to note that the percentage of men regarding the gender gap as a significant issue increased in both classes, while the percentage of women regarding it as a problem actually *decreased* after the group project.

The most surprising comment on the follow-up was the following from a female student:

> During the project I spoke to several women who had terrible experiences, and I was pretty upset and worried that I was wrong, and that problems in the STEM field were more dramatic than that—that when I graduated I would simply be dismissed as being no good because of being a woman, or only hired because of it, but never taken seriously.
>
> Then after hearing the other teams' presentations, it seems that it is unlikely I will have any such problems and if I do, they should be few and far between.

So in this case, this female student regarded her classmates' presentations as more reliable than testimony of women with direct personal experience in the field.

Some of the other comments from students on the follow-up assignment were just as concerning as those on the preliminary assignment:

- "I was most surprised by the lack of negative side effects of [the gender gap]."
- "I think that male-supremacy has always been, and will most likely continue to be, a naturally occurring phenomenon."
- "The gender gap is not a problem unless someone wants it to be."

It is interesting to note that of the four men of color in the two classes, all concluded at the end of the project that the gender gap in computing is a problem that we should be ethically compelled to address, and three of the four said that they had already known that it was an ethical issue before the project began. Comparing these results to the conclusions of the group as a whole leads the author to speculate whether presumably having been exposed to prejudices and

inequities themselves as people of color has made these men more sensitive in perceiving similar issues related to other groups.

Student feedback was sought at the end of the project, but the prevailing theme of the comments expressed frustration with group projects in general, or team members in particular, rather than providing information on this project in particular. However, perhaps a different means of selecting teams, rather than the current assigning of teams by the professor would be helpful.

Concluding Thoughts

While the results of the team project were disappointing in both classes, there were no observable differences in quality or conclusions between the all-male class and the male/female mixed class; thus it may be possible to increase understanding of gender issues even in classes that include no women. One improvement that will be made on the next iteration is the imperative that students include conversations with female students in STEM fields, as this seemed to be particularly enlightening in the previous semester's projects. Also, additional methods of assigning teams will be explored. However, based on the student presentations and comments, there is definitely still a need for a way to increase student awareness of gender related issues, especially those related to female students in the undergraduate programs at UTC.

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