Gender in the Classroom – Does it Matter?

Katie J. Blue
(Data Analysis by Dr. Steven Condly)

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Background

The growing concern for the future of America and her ability to remain competitive in a highly technological age has prompted much research over the number of students pursuing degrees in Science, Technology, Engineering, and Mathematics (STEM) at the undergraduate level. As a female, I was curious as to the reason behind the lack of females in my field of Computer Science. The problem is commonly referred to the pipeline shrinkage problem where the ratio of women to men involved in computing shrinks from early student years to working years [6]. Much research has been conducted to attempt to determine the reason behind the sharp drop-off of women in the field and also to increase the number of women in computing. I was interested to see how, if at all, I could apply techniques in the classroom to get women thinking about pursing an education in computer science.

The low number of women majoring in computer science has been a problem for many years. Low enrollments in computer science programs have resulted in low percentages of women in the IT workforce. The reasons for low enrollment are varied and have been widely documented [1]. Some reasons include lack of computer confidence, negative stereotypes of the field of computer science and limited programming experience [1].

Studies show that girls lose interest in computer science at a very early age. According to a Literature Review on Women in Computing done by the Association for Computing Machinery – Women [6], basic gender differences between girls and boys leave girls frustrated with computers at a very early age. Also, girls are sometimes less exposes to computers. From a very early age, in a computing environment, boys take control while the girls sit back – even though they’re entirely capable. Society also has a negative impact on how females see males depicted as computer scientists. Most depictions of computer science are not glorified in nature and negatively imply that computer science is only for geeks and nerds.

To combat the fact that girls are conditioned at a young age to let the boys take charge, schools have begun experimenting with same sex classrooms. Research has shown that environments that are all female can produce higher confidence levels in math, science and engineering. Intimidating perceptions that males are better in these subjects is eliminated in a same sex classroom [8]. Some schools have adopted same sex classes as a strategy to enhance the learning experience of either girls or boys with positive results for girls [4]. Could the perceptions of computer science be more positive for females in a same sex classroom? Using previous research and building on the existing survey, I attempted to assess the perceptions of women in the classroom and whether or not the sex of the instructor impacted her perception.
Purpose

I really wanted to get a better understanding on why women are not drawn to the field of computer science and what measures I could possible take to change the attitude toward some of the stereotypes associated with computer science.

As the course director for Introduction to Technology (IT105/IT155), the Plebe Core Computer Course, I was able to increase the number of female students with female instructors. I was curious to see if, based on my survey results, having a class with a higher concentration of women as well as a woman instructor changed the perceptions of what it means to be a computer scientist as well as on one’s ability to pursue a degree in computer science.

This study examines perceptions of students IT105/IT155. The first assessment was based on a normal distribution of women across all sections with male and female instructors. The second assessment was based on classes with almost a 50/50 female/male ratio with most females being taught by a female instructor. I assessed whether perceptions of computer science differed by the gender of the student and if the gender of the instructor had an effect on student perceptions.

Method

All freshmen at the United States Military Academy are required to take IT105/IT55 regardless of their academic major. Students learn web design/programming using XHTML, Java programming using the flow charting tool Raptor and basic IT knowledge in the one semester course. IT155 is the honors version of IT105 and is comprised of students that demonstrate proficiency in their computer skills. IT155 differs from IT105 in that students cover topics more rapidly and work additional in class exercises. However, both courses have the same graded requirements.

A total of 555 students were participated in the first survey (Spring Semester 2009). There were 89 female and 466 male students. Students are taught in sections of 18 students. Sections with female students would have at least 2 females in a section and not more than 6. There were 13 instructors for IT105/IT155. Three of the instructors were females. There were 35 sections and 24 of the sections had female students.

In the second survey (Fall Semester 2009) a total of 492 students took the survey. There were 81 female students and 411 male students. There were 36 sections total but only 2 female instructors out of 14 total instructors. Sections with female instructors had significantly more female students (sometimes a ratio of 50/50). There were 15 sections that had females.

Students were given a 12 question survey at the end of their 40 lesson semester. The survey is shown in Table 1.
Table 1. Research Survey.

<table>
<thead>
<tr>
<th>Research Survey</th>
</tr>
</thead>
</table>
| 1. What is your gender?  
   a) Female  
   b) Male |
| 2. What is the gender of your IT105/155 Instructor?  
   a) Female  
   b) Male |
| 3. What is your average grade in Mathematics?  
   a) A  
   b) B  
   c) C  
   d) D or below |
| 4. What is your average grade in IT105/155?  
   a) A  
   b) B  
   c) C  
   d) D or below |
| 5. How do you think your computer ability compares to that of your male classmates?  
   a) Very advanced  
   b) Somewhat Advanced  
   c) About the same  
   d) Somewhat lacking  
   e) Quite Lacking |
| 6. How do you think your computer ability compares to that of your female classmates?  
   a) Very advanced  
   b) Somewhat advanced  
   c) About the same  
   d) Somewhat lacking  
   e) Quite Lacking |
| 7. Do you think it is possible to major in IT/CS without any computer experience before college?  
   a) Yes  
   b) No  
   c) Not sure |
| 8. Do you think you have enough computer skills to major in IT/CS?  
   a) Yes, I definitely do  
   b) Yes, I maybe do  
   c) I might  
   d) No, I probably don’t  
   e) No, I definitely don’t |
| 9. Do you think you would be interested in IT/CS?  
   a) Yes, definitely  
   b) Yes, maybe  
   c) No, probably not  
   d) No, definitely not  
   e) Already interested |
| 10. What do you use your computer for other than homework? (Select all that apply)  
   a) Internet/E-mail/Instant Messaging  
   b) Gaming  
   c) Music/Video Downloads  
   d) Programming/Web Design  
   e) I am not interested in computers |
| 11. Do you think that professionals in the IT/CS field mainly work alone or interact with others?  
   a) Alone  
   b) With others  
   c) I don’t know |
| 12. Do you think that you would be interested in an IT105/155 section that had a majority of students of your same gender?  
   a) Yes, definitely  
   b) Yes, maybe  
   c) No, probably not  
   d) No, definitely no |

Results

For the purpose of analyzing the results, the next section will pertain directly to the spring semester from the academic year 2009. There were no significant differences between the two semesters except for the trend toward a higher Math grade in the fall semester. This can be explained by the fact that plebes taking the lower level math classes are also taking IT105 in the spring.

There was no meaningful difference in math grade or IT105/IT155 grade between males and females and there were no significant achievement differences between the sexes. However when considering the sex
of the instructor, male students that had a female instructor (MSFI) scored the highest in IT105/155 while female students with a male instructor (FSMI) scored the lowest.

Table 2. Effect size of group differences on IT105/155 Grade.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>p-value</th>
<th>Cohen’s d</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSMI</td>
<td>51</td>
<td>3.18</td>
<td>.842</td>
<td>.033</td>
<td>-.485</td>
<td>Nearly Medium</td>
</tr>
<tr>
<td>MSFI</td>
<td>107</td>
<td>3.55</td>
<td>.676</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The results of comparing computer ability to fellow students had significant differences between groups. Male students had the highest perception of ability compared to other male students. Female students had the lowest perception compared to other male students. Male instructors had a positive effect on male students and a negative effect on female students.

Table 3. Compare computer ability to that of male classmates.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>p-value</th>
<th>Cohen’s d</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSFI</td>
<td>38</td>
<td>3.03</td>
<td>.753</td>
<td>.093</td>
<td>-.388</td>
<td>Small-Medium</td>
</tr>
<tr>
<td>MSMI</td>
<td>359</td>
<td>3.34</td>
<td>.843</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSMI</td>
<td>51</td>
<td>2.90</td>
<td>.831</td>
<td>.058</td>
<td>-.427</td>
<td>Small-Medium</td>
</tr>
<tr>
<td>MSFI</td>
<td>106</td>
<td>3.27</td>
<td>.900</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSMI</td>
<td>51</td>
<td>2.90</td>
<td>.831</td>
<td>.005</td>
<td>-.526</td>
<td>Medium</td>
</tr>
<tr>
<td>MSMI</td>
<td>359</td>
<td>3.34</td>
<td>.843</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The perception of student’s abilities compared to that of female classmates was similar to the above findings; however, male instructors had a positive effect on male students while female instructors had the least positive effect on female students.

Table 4. Compare Computer ability to that of female classmates.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>p-value</th>
<th>Cohen’s d</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSMI</td>
<td>51</td>
<td>3.24</td>
<td>.737</td>
<td>.050</td>
<td>-.353</td>
<td>Small-Medium</td>
</tr>
<tr>
<td>MSMI</td>
<td>348</td>
<td>3.53</td>
<td>.899</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSFI</td>
<td>38</td>
<td>3.18</td>
<td>.563</td>
<td>.007</td>
<td>-.467</td>
<td>Nearly Medium</td>
</tr>
<tr>
<td>MSMI</td>
<td>348</td>
<td>3.53</td>
<td>.899</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Female students rated themselves very slightly below the median when comparing themselves to male classmates but not significantly so. They rated themselves to be above average when comparing themselves to other female classmates.

Table 5. Descriptive statistics for female students (N=89).

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>sd</th>
<th>Cohen’s d</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compare computer ability to that of male classmates</td>
<td>2.96</td>
<td>.796</td>
<td>-.341</td>
<td>Small-Medium</td>
</tr>
<tr>
<td>Compare computer ability to that of female classmates</td>
<td>3.21</td>
<td>.665</td>
<td></td>
<td>Medium</td>
</tr>
</tbody>
</table>
The male students rated themselves superior in ability to male classmates and much more superior to female classmates. However, both sexes had minimal differences in course achievement making the perception of superiority unwarranted. However, it is not known whether such perceptions of superiority have beneficial motivational side effects.

**Table 6.** Descriptive statistics for male students (N= 465/455).

<table>
<thead>
<tr>
<th>Item</th>
<th>Mean</th>
<th>sd</th>
<th>Cohen’s d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compare computer ability to that of male classmates</td>
<td>3.32</td>
<td>.856</td>
<td>-.191</td>
</tr>
<tr>
<td>Compare computer ability to that of female classmates</td>
<td>3.49</td>
<td>.924</td>
<td></td>
</tr>
</tbody>
</table>

When asked if whether they had enough computer skills to major in IT/CS? Male students had more self-efficacy regarding their computer skills but by only by a small-to-moderate amount.

**Table 7.** T-tests of sex differences on Item 8.

<table>
<thead>
<tr>
<th>Sex of Student</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>p-value</th>
<th>Cohen’s d</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>89</td>
<td>3.09</td>
<td>1.094</td>
<td>.008</td>
<td>-.307</td>
<td>Small-Medium</td>
</tr>
<tr>
<td>Male</td>
<td>465</td>
<td>3.43</td>
<td>1.122</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The sex of the instructor had no effect on the student’s computer self-efficacy.

**Table 8.** T-tests of sex of instructor differences on Item 8.

<table>
<thead>
<tr>
<th>Sex of Instructor</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>p-value</th>
<th>Cohen’s d</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>145</td>
<td>3.38</td>
<td>1.143</td>
<td>.998</td>
<td>.000</td>
<td>None</td>
</tr>
<tr>
<td>Male</td>
<td>409</td>
<td>3.38</td>
<td>1.118</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Male student efficacy was high regardless of the sex of the instructor. For female students, there was no significant effect with a female instructor however the presence of a male instructor seemed to have a slightly depressive effect but only when comparing female students to male students not within either sex.

**Table 9.** Effect size of group difference on Item 8.

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Mean</th>
<th>SD</th>
<th>p-value</th>
<th>Cohen’s d</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSMI</td>
<td>51</td>
<td>2.96</td>
<td>1.076</td>
<td>.022</td>
<td>-.438</td>
<td>Small-Medium</td>
</tr>
<tr>
<td>MSMI</td>
<td>358</td>
<td>3.44</td>
<td>1.113</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FSMI</td>
<td>51</td>
<td>2.96</td>
<td>1.076</td>
<td>.074</td>
<td>-.412</td>
<td>Small-Medium</td>
</tr>
<tr>
<td>MSFI</td>
<td>107</td>
<td>3.42</td>
<td>1.158</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Female students highly used computers for internet use /email/IM. Music and video downloads were nearly as popular. There was little use of gaming and programming.

Male students had a similar response to computer usage for internet/email/IM and Downloads. Males used computers for gaming much more than females but did not use computers much for programming.
Table 11. Student Response to Item 11.

There was no significant difference among male students which is the rightmost columns within each response category in regards to whether IT/CS professionals work alone or with others. However, the sex of the instructor has some effect on their response for female students depicted in the leftmost columns. Female students with female instructors were more likely to express confusion regarding the social nature of IT/CS. They were less likely to see IT/CS as social and were also less likely to see it as a solitary endeavor.

Discussion

Within the population of this study there was no difference in math or computer science grades among sexes. Both sexes performed adequately. Based on performance I could project that both sexes could potentially equally succeed in an IT/CS Major.

Males were more confident in their abilities than females. Males rated their abilities superior to other males and much more superior to females. Female students rated themselves slightly below males but not significantly so and above average when compared to other females. This was inconsistent with other studies of computer confidence where females had much lower confidence levels than males [2]. The strong confidence level of our female population may be attributed to their previous academic success. The freshmen in our study are from an Ivy League equivalent college. The college also requires students to participate in athletic activities which may boost their confidence level and self esteem.

Computer usage between the sexes was similar by category except for gaming. More males used computers for gaming than females and this was not a surprise [7]. However, it was surprising that both males and females used computers for programming about equally which was relatively low compared to the entire population.

The sex of the instructor had limited effects on the students. Male students scored highest with female instructors while female students scored lowest with a male instructor. Male instructors had a positive effect on male students and a slightly negative effect on female students. Female instructors did not have a noticeably positive effect on female students.
Conclusion

Understanding student perceptions of computer science may help to gain a greater understanding as to the reasons the enrollment in the computer science field are low for women. The ability to manage those perceptions to achieve positive outcomes is the goal.

In this study, both sexes did not use their computers for programming outside of homework requirements in IT105/IT155. They had similar computer usages with music and email. However, males also used their computers for gaming. Males had a higher perception of superiority in their computer skills. Perhaps this perception is achieved through playing video games where levels are achieved with skills or points are awarded for mastery of a skill. The higher perception did not result in higher course achievement. Both sexes had minimal differences in course achievement.

Personally, I think that by doing this study, I was more aware of the perceptions I was trying to get across to all of the students in the class – not just the females. I used myself as an example. I had no previous experience with computers, but I thought it sounded interesting so I decided to major in the field. I think that’s the biggest deterrent – that most students (both sexes) – believe that you have to have some background in computers to pursue a degree in the field. Hopefully, through my own awareness, I was able to share my own thoughts and feelings with the class.

References