Improving The Retention and Success Rates of Female Students in Computer Science Through
The Alice and Media Computation Course

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One of the most alarming occurrences over the last 20 years is the fact that females are becoming more and more underrepresented in computer science. This is occurring in spite of the fact that females are a key element of the workforce, and are playing a bigger role in society than they did at the same time 20 years ago. There are many reasons for this attrition of the female population from computer science classes, and the field in general. Amongst these are the existence of stereotypes about computer science in general, the gender bias that is present within the environment of computer science courses, the method in which computer science concepts are presented, as well as the gender of the faculty (Beyer, et. al., 2003; West, et. al., 2002; McGrath Cohoon, 2001). In this paper, some of these causes for the decrease of female interest in the computer sciences, as well as previous efforts to combat the problem, are analyzed. It is hypothesized that a course which integrates storytelling with picture manipulation, in order to teach computer science concepts (hereinafter referred to as the Alice and Media Computation course) will have a positive effect on retention and success rate of female high school students in computer science. The following three literature reviews aim to enlighten the reader to the validity of this hypothesis.

In a research article by McGrath Cohoon (2001), one key research question was the basis for the study. The question asked why it was that some computer science departments retained female students at comparable rates to men. It focused first on 34 interviews with the chairperson, faculty and students at five Virginia computer science departments. The schools varied by size, location, institutional selectivity (how selective the school’s admissions process was), and “gendered
attrition\(^1\) rates. The interviews were used to develop a survey targeting faculty and chair people at all of the Virginia computer science departments, as well as the biology/life science (hereinafter referred to as “biology”) departments at the same institutions. According to the authors, the latter was included since biology and computer science share many characteristics and requirements (111). It was hypothesized that gender composition, faculty attitudes and behaviors, and the environment in which the college exists could have a substantial effect on whether women leave the undergraduate computer science major at higher rates than men leave.

The results of the study support the hypothesis that the gender composition of the students within the department could influence gendered attrition within that department. First, it shows that Virginia’s female attrition rate in the biology departments was only 1% greater than the male attrition rate, while in Virginia’s computer science departments it was 9% greater. This is significant, as the study determined that 58% of the majors in biology were female, as compared to 28% of the majors in computer science. The results also indicate that very positive evaluations of female students’ abilities relate to equivalent retention rates for male and female students, as well as the fact that computer science departments where the department received a greater level of support in comparison to other departments, retained female students at comparable rates to males. In both cases, however, there is a lack of significant statistical evidence to support the findings (McGrath Cohoon, 2001).

Even though the entirety of the hypothesis is not proven by the statistical analysis presented in the results of the study, a key element is proven, in terms of the relationship between gender composition and gendered attrition. Additionally, while statistical evidence did not exist in terms of a correlation

\(^1\) The article defined male or female attrition as the “annual number of declared majors who switched to another major relative to the total number of declared majors (110)”, and gendered attrition as the difference in these two rates.
between faculty attitudes and gendered attrition, the fact that evidence did exist at all points to a possible link between the two. This correlation could have been more significant if the study had been extended to cover schools in various states, other than Virginia.

The question now lies as to what efforts have been made to conquer such levels of gendered attrition at the college level. An example of such was presented in a research article by Graham and Latilupe (2003). The article was centered on the question of whether the J.W. Graham Computer Science Seminar (hereinafter referred to as “the Seminar”) for 9th and 10th grade girls could improve female interest in computer science, and change their opinions of same. The study focused upon the Seminar, which was designed for 40 female participants, recruited from various locations within Canada. The seminar also included a majority of female presenters, as well as male presenters who went against the common “geek” stereotype that has been commonly associated with computer scientists. It was hypothesized that the Seminar would successfully increase female interest in computer science amongst the participants, and debunk previously held stereotypes about computer scientists. Participants were surveyed as to their opinions on computer science at the start and conclusion of the Seminar.

The results illustrate that the Seminar did, in fact, increase female interest in computer science. At the start of the seminar, 30% (12 out of 40) of the participants stated that they would take computer science. This compares to 55% (22 out of 40) of the participants that answered similarly at the end of the Seminar; producing a statistically significant increase. Additionally, participants stated that they “no longer thought of computer scientists as geeks”, and found the presenters to be “interesting” (Graham & Latilupe, 2003). This supports the hypothesis that the Seminar would change previously held stereotypes on computer scientists.
Even though the Seminar appears to be successful, the fact remains that the study was conducted within Canada. While one may infer that the cultural environment surrounding Canadian students is similar to the culture surrounding students in the United States, it could still be considered to be somewhat of a confounding variable. To eliminate this limitation, a similar study should be conducted with a similarly-designed Seminar within the United States. Another limitation is how there is a lack of quantitative data for student stereotypes on computer scientists before and after the Seminar. In the future, surveys should be designed following interviews with a smaller sample of the study participants.

While creating positive stereotypes of computer scientists, and increasing interest in computer science courses for females could be considered to assist in reducing female attrition rates in computer science, consideration should be given to the existence of gender bias within current computer science classes. In a research study by West and Ross (2002), the study was based around the question of what were the actual causes of a drop in the success rates of females in computer science. The study focused upon a total of four female students enrolled in two different computer programming courses as well as one female student who had completed a third introductory-level computer programming course. It was hypothesized that gender bias within the curriculum, as well as within the classroom environment, amongst other factors, influences female success in computer science. The study was qualitative, and designed using a “phenomenological approach\(^2\)”, using standard, open-ended interviews.

\(^2\) According to West and Ross (2002), phenomenology “declares that multiple ways of interpreting experiences are available to each person through interaction with others and that it is the meaning of experiences that constitutes reality.”
The results supported the hypothesis that gender bias in the classroom environment does affect female success in computer science. Participants stated that the large number of male students within the class affected their learning, self-efficacy in computer science, or both. They also reported that the male students congregated with each other, and often times excluded the female students from their discussions. The hypothesis that gender bias within the curriculum exists was also supported, as the participants stated that they could not see the relationship between the mathematics and computer science concepts presented. This relates to the authors’ statement that “formal mathematical methods are not appropriate in teaching female students in beginning computer programming courses” (5).

As enlightening as this research study was, in terms of outlining how gender bias exists in the computer science classroom, it contained many severe limitations. First, the sample size was incredibly small, at a mere four female students. The study should have been conducted in an environment that would provide a much larger sample size of female computer science students. Also, while the study is outlined as a qualitative study from the outset, the “phenomenological approach” utilized by the authors may have introduced a number of confounding variables. Amongst these variables is the personality of the individual participants. If the participant was less likely to voluntarily interact with others, or had difficulty interacting with members of the opposite sex, this could have influenced their inability to interact with the male students in the class. The study could have just as easily asked additional background questions, to possibly eliminate these confounding variables, or conducted a survey based upon these interviews.
Action needs to be taken to decrease the female attrition rate in CS. While there are many environmental factors that should be considered when analyzing how to solve the problem, the first steps taken to address the problem should occur at the high school level. As Graham, et. al. (2003) illustrated, it is best to eliminate the various stereotypes that exist about computer science at an early age. It is also important, as Ross, et. al. (2002) indicated, to develop a curriculum that involves some aspects of the humanities or the arts to cater to the female population. This could include storytelling, as well as picture modification. These facts could possibly improve upon the retention and success rate of females in computer science.
References


