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"Gender Stereotypes and Mathematics Lab Performance"

Abstract

I investigated whether gender stereotypes at a conscious and non-conscious level are causing women to perform worse than men in their mathematics classes. Gender stereotypes that favor men and lower women's self-confidence are attributed to several factors including the classroom environment, lack of support from instructors and interaction with peers. I conducted an observation study of a mathematics class at the University of Michigan to measure the differences in participation between males and females. I found that overall, males participate more in class by asking questions and voluntarily answering questions, while women need to be called upon to answer questions. However, there were no significant differences between gender and student participation.

Introduction

It is generally assumed that women have more trouble than men in the classroom, specifically in subjects like mathematics, science and engineering. Gender stereotypes, at both a conscious and non-conscious level, exist in our society and may be contributing to females' behaviors, interest, motivation and performance in the classroom. Each individual male and female uses their own self-perceptions of their gender's success in particular domains in making their academic and occupational choices. Women tend to acknowledge their success in English and difficulty with mathematics (Eccles, Jacobs and Harold, 1990). As a result, college-aged women are not pursuing these male-dominated fields because of their lack of self-confidence, inequitable classroom environment, need of support from instructors and negative interactions with peers.

In college, women are even more vulnerable than men to lower self-esteem and therefore need attention, support and encouragement (Allen and Niss, 1990). Women are usually the minority in mathematics, science and engineering classes, causing their thoughts, opinions and therefore their success to be taken over by their assertive male classmates. In addition, women are more hesitant than men and need a comfortable and unbiased environment to succeed.

Montgomery and Barrett (1997) found that faculty are interacting and responding more positively toward male students. Male students are receiving more attention from their instructors through nonverbal behaviors such as greater eye contact, nodding and gesturing to male responses, allowing men and women to segregate themselves in classroom seating arrangements and standing near the male section of the class (Allen and Niss, 1990). In addition, research has noted numerous detrimental instructor verbal behaviors like discussing females' physical attributes and appearance, using sexist humor, interrupting women, referring to males as

"men" but females as "girls" and using the generic "he" to represent both sexes (Pines and Maslach, 2002). Sex bias is apparent through these subtle cues and has a negative effect on female students.

Not only are women lacking support from their instructors, but also from their peers. Research shows that women feel resented by their male classmates and isolated in the classroom. As a result, women hide their talent and success in the field to avoid hostility (Montgomery and Barrett, 1997). My observational study strived to better understand how unconscious gender stereotyping affects math performance in the hopes of offering suggestions to students and instructors to help alleviate gender bias in the classroom and create a comfortable and fair learning environment for both males and females.

An observational study was conducted to examine if conscious and non-conscious gender stereotypes affect females' mathematics performance. The study investigated the effect of gender stereotypes through the student's behaviors and participation in class. I hypothesized that females would participate less in class than their male peers because of gender stereotypes.

The constructs of interest were operationally defined. The classroom observer observed the number of students of each gender who asked a question, voluntarily answered a question and answered a question after being called upon. These constructs measured the students' participation in the class where "asked a question" demonstrated the most motivation in the most vulnerable situation, followed by "voluntarily answered a question" and lastly by "answered a question when called upon." In terms of these operational definitions, I expected men to ask more questions and voluntarily answer questions more often, while both men and women would answer questions when called upon.

Method

Participants

The observation study took place in a Math 115: Calculus I classroom in the Dennison building at the University of Michigan in Ann Arbor, Michigan. The observation took place on November 17, 2005 from 8:40-10:00 a.m. All 22 undergraduate college students and one graduate student instructor in the class participated in the observation study. The sample of 22 students consisted of 10 male and 12 female students. The graduate student instructor was female.

Procedure

The classroom observer contacted the graduate student instructor earlier in the semester asking for permission to observe her Math 115 class. The students were informed of the visitor ahead of time but were unaware of the purpose of the study. They were told to behave in the same manner they would any other day in class. On the day of the study, the classroom observer attended the Math 115 class and counted the number of male and female students present. A tally system was used with an "m" for male and "f" for female, in order to count the number of times a student of each gender performed a construct being observed. The classroom observer tallied the constructs: students asked a question, voluntarily answered a question and answered a question after being called upon.

The classroom observer scheduled a feedback session with the observed graduate student instructor to share a report of the study: the previous research, hypothesis and results as well as a discussion on positive feedback, suggestions and preventing gender bias in the classroom.

Results

There were a total of 22 participants; 10 male and 12 female students. The construct "asked a question" had m = 0.182 responses and sd = 0.395 responses; the construct "voluntarily answered" had m = 0.682 responses and sd = 1.524 responses; the construct "answered when called upon" had m = 0.146 responses and sd = 0.351 responses; and the total of the constructs had m = 1.00 responses and sd = 1.773 responses.

An independent samples t-test was conducted to investigate whether the categorical variable gender and the continuous variable measured by the constructs of the students' participation in class are associated. Assuming there are equal variances, the independent samples t-test showed if there was or was not a statistical difference between two groups.

The independent samples t-test found that gender and each of the constructs and gender and the total of all the constructs are not statistically different. With 20 degrees of freedom and assuming there are equal variances, I can conclude that there are no significant differences between gender and the construct "asked a question" since $t(20) = 1.303$, $p > 0.05$. I can conclude that there are no significant differences between gender and the construct "voluntarily answered" since $t(20) = 1.498$, $p > 0.05$. I can conclude that there are no significant differences between gender and the construct "answered when called upon" since $t(20) = -0.435$, $p > 0.05$. Lastly, I can conclude there are no significant differences between gender and the total of the three constructs since $t(20) = 1.491$, $p > 0.05$. Therefore, the analysis does not support my hypothesis because gender did not have an effect on any of the constructs or the total of the constructs. I accept the null hypothesis at a 5% significance level and conclude that gender had no effect on student's participation in class.

Figure 1: Student's Participation in Class, below, displays the total tallied results of the observation study. However, the sample of observations is small, therefore it is difficult to make strong conclusions. Note that in the chart, for the "asked a question" construct, the chart indicated the number of questions asked by male and female students during the 80-minute class time. But in addition, the classroom observer noted the number of questions asked by students before and after the class*.

Figure: Student's Participation in Class

	Asked a Question	Voluntarily Answered	Answered When Called Upon	Total
Male	3*	12	1	16
Female	1*	3	2	6

*Questions asked before class: Male – 0, Female – 2. Questions asked after class: Male – 1, Female – 3.

Discussion

While the sampling of the constructs in the observation study of the Math 115 class was not sufficient, the results do appear to be consistent with previous research on women's performance in mathematics. The results measuring both male and female participation in class in terms of asking a question, voluntarily answering and answering when called upon, found that men are more involved and vocal in the classroom. In addition, it appears that female students felt more comfortable asking the instructor questions privately before or after class in a more personal and intimate environment, thus avoiding the vulnerability associated with speaking in front of the entire class. The classroom observer also noted that rather than asking the instructor questions, many female students asked questions to their male classmates at their tables, who responded in a positive manner. This observation contradicts Montgomery and Barrett's (1997) findings that women feel begrudged by their male peers.

Figure 1: Student's Participation in Class shows that 12 male and three female students were tallied under the "voluntarily answered" construct. However, the classroom observer noted that one specific male in the class made-up most of these voluntarily responses whereas the three women who spoke voluntarily were different students. This created a bias in the data sample since one male student was an outlier and therefore overrepresented the male genders participation.

In conclusion, these observations suggest that women are participating less than men in the mathematics classroom and receiving less encouragement from their instructor. Therefore, it is important that instructors create a comfortable classroom environment, free of sexist attitudes. Montgomery and Barrett (1997) made several suggestions for instructors to encourage women to raise their confidence in their mathematics skills including acknowledging women's individual achievements and encouraging them to apply for workshops, internships and graduate school in their field. Female guest speakers also serve as role models for women and demonstrate female success in male-dominated fields (Montgomery and Barrett, 1997). In addition, if females are hesitant to participate in class, instructors should request answers from specific "quiet" tables with a mixture of males and females. In the observation study, the classroom observer found that this instructor technique was effective and helped the female students.

There were many flaws in this study in terms of participants, setting and operationalization of constructs, which should be considered and accounted for in future research. First, there may have been a bias because the instructor in the classroom was female. Future research should investigate whether female students receive different support and encouragement from male instructors. The setting of the observation study was also less than ideal since the college course was taught so early in the morning, beginning at 8:40 a.m. The

lack of participation from students may have been influenced more by students' exhaustion than by gender, especially since the classroom observer found that students' participation increased as class continued when students appeared more awake and alert. In addition, the data sample was much too small to perform any real efficient statistical analyses. Therefore, it would be necessary to observe the same class on multiple occasions in order to obtain more data to make reliable and valid statistical conclusions.

In the future, researchers should examine if racial stereotypes have an effect in the mathematics classroom. Researchers should divide the sample into White males, White females, non-White males and non-White females and examine which group is the least comfortable and does not receive support and encouragement from instructors and peers, thus putting them at greater risk for failure in the mathematics field. It would be interesting to see if the trends of race are similar to the sexist bias that exists in the mathematics classroom.

References

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