A Mathematical Mindset:
Overcoming Obstacles in Mathematics Education

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Throughout history, mathematics has often been characterized as a male discipline. The names of notable male mathematicians throughout history are numerous and easily identifiable to mathematicians everywhere. Numbers of female mathematicians throughout history, however, are notably lacking in comparison to that of males.

These female mathematicians, while exceptional in their abilities, have faced the rule rather than the exception when it came to acceptance of females into the field of mathematics. During the time of female mathematicians such as Sophie Germain, Sophia Kovalevskaya, and Emmy Noether, there was virtually no place for women to become serious mathematicians.

The obstacles that female mathematicians face in today’s society are nowhere near those faced in centuries past, yet, the numbers of women in mathematics is still staggeringly disproportionate to that of men. According to a study published by Girls Inc., a nonprofit organization designed to promote women’s achievement in the sciences, mathematics PhDs consisted of only 1% of the total number of doctoral degrees earned by women in 2000. It was also reported that women constitute only 12% of the total science and engineering jobs in business and industry. In elite academic institutions, women continue to be highly underrepresented. For example, as reported by the Association for Women in Mathematics, of the total of seventy-four tenured, untenured, and tenure-track positions available at the University of California, Berkeley, only five are female, and only two of those female faculty are tenured. The smaller mathematics department at Yale has only twenty-four positions, none of which are occupied by women.

Some might contend that the disparity that can be seen between the number of men and women choosing mathematics as a career is simply because mathematics is predominantly a male domain. Yet, one must look at all possibilities. Certainly females are capable of doing mathematics. As reported in Time magazine, the village of Sandgerdi, Iceland, provides a strong counterexample to the claim that women cannot do mathematics. In Sandgerdi, females overwhelmingly outperform male students in mathematics. Moreover, males tend to quit school early while females continue to pursue degrees in math and the sciences. It was also noted that Sangerdi is primarily a small fishing village, and males often choose to become fishermen.

Since females are indeed capable of doing mathematics, there must be other factors that hinder them from choosing to pursue mathematics as a career. One might then look to current trends in discrimination of females in mathematics. Discrimination today is not as outright as it was, but it still affects women to some extent. A study conducted by MIT, the Massachusetts Institute of Technology, showed that over a period of ten years, female faculty made up only 20% of its available faculty positions. Moreover, it reported that the quality of professional life between male and female faculty was, indeed, different. Aside from a difference in salary, female faculty noticed that often they were allocated less access to space as well as resources. In interviews, many of them noted that they felt “invisible” and “excluded from a voice in their departments and from positions of any real power (8)”

One should also note that stereotypes against women in mathematics still pervade society to some degree, as is evident in a
study conducted in the late 1980s. According to that study, the top three stereotypes about female mathematicians were that they were unattractive, masculine, and cold or distant. Unfortunately, this attitude is implicitly passed down to younger female students and in turn discourages them from exploring mathematics not only as a career option in the future, but also as a class option in the present.

A study on the positive or negative effects of stereotyping on mathematics performance was published in *Sex Roles: A Journal of Research* in 2002. In particular, this study tested three types of stereotypes: the implicit stereotype, the explicit stereotype, and the nullified stereotype. The implicit stereotype deals with the beliefs and biases each person possesses, either consciously or subconsciously, before he or she enters the study. In this study, the implicit stereotype regarded participants’ preconceived notions about gender and mathematics. The explicit stereotype was that which was declared overtly to those participating in the study. Finally, the nullified stereotype was that which attempted to invalidate any negative implicit stereotypes about women in mathematics each participant may have possessed going into the study.

In the study, a total of 143 students were divided into three groups and given the same math test. The control group for this study was only exposed to the implicit stereotype and was simply given a set of directions about the test before they proceeded. This group was exposed to only the implicit stereotype. The next group was exposed to the explicit stereotype, i.e. that females often perform worse on that particular test than their male counterparts. The third group was given the nullifying stereotype, which was that there existed evidence that both men and women did equally well on the test. The study found that women did worse when exposed to the explicit stereotype and better when the stereotype was nullified.

Thus, it is my contention that this negative notion of women mathematicians, or, more generally, females with a natural mathematical mindset, can and must be counteracted in the mathematics classroom, by encouraging all students to participate equally in the subject. As a future educator, I believe that all classrooms should be environments that foster a love of knowledge through the learning experience. As such, teachers should do their best to minimize stereotypes and biases to the best of their abilities.

The first step toward minimizing gender discrimination in the classroom and encouraging more female participation and success in mathematics is for teachers to recognize their own biases when teaching. Although teachers may not notice any bias on their part, it is highly possible that he or she exhibits that bias subconsciously through his or her teaching. In her article “Uncovering Bias in the Classroom – a Personal Journey,” Maryanne Wickett an elementary school teacher, describes how she, by videotaping several of her class lessons, discovered that she tended to call on boys more than girls. After discovering her own biases, she made a conscious effort to change her teaching methods, which has proven to be successful. Hence, a teacher can only address a problem properly after he or she recognizes that one exists.

Another step teachers can take to encourage participation in the mathematics classroom is to make discourse less confrontational. As Suzanne K. Damarin notes, in her essay “Teaching Mathematics: A Feminist Perspective,”

Vocabulary reflects goals of mastery and mathematical power. We teach students to attack problems and to apply strategies. Our instructional strategies include drill and the use of many forms of competition. We
are advised to *torpedo* misconceptions and to build concept hierarchies. (145)

In continuing to use this sort of masculine vocabulary in teaching, teachers implicitly reinforce the idea that mathematics is a masculine subject. Furthermore, using drills and competitions as learning activities, though oftentimes rather effective for the competitive student, can push away the timid student, female or not.

To reduce this competitive atmosphere, teachers should implement collaborative learning techniques into their classroom. Collaborative, or small group learning allows student to talk openly with their peers, sharing ideas and getting feedback simultaneously. In doing so, students are allowed to formulate their own ideas and think about problems on their own terms rather than being evaluated by the entire class during an in-class discussion. Thus, the more timid student who is less likely to share during a large group discussion is more likely to participate in a small group activity. Furthermore, as noted by Crabill,

> The best way to learn a subject is to teach it, and small-group learning allows students to experience the other side of the learning process – teaching. By his or her own trial and error, by hearing peers make mistakes and recover, the student begins to understand the process of learning. (204)

Hence, it is easy to see why collaborative learning environments not only affect higher problem-solving achievement for students, but also foster self-confidence among girls in science and math.

To help both male and female students better understand material and improve their problem solving strategies, teachers should also incorporate writing into their lessons. One teaching method that is being used more frequently in the math classroom is a learning log, or math journal. Journals give students a better understanding of how to approach and solve various problems. Forcing students to write a step-by-step explanation allows them to “reflect on what they are learning and learn while they are reflecting on what they are learning (McIntosh, Draper 554).” Next, journals allow teachers a more accurate assessment of their students’ understanding of the topic at hand. Journals allow teachers “to know [their] students better, to understand their thinking better, to communicate individually with students through written word, and to reevaluate [their] instruction on the basis of students’ responses on learning logs (McIntosh, Draper 556).” When students are forced to write out step-by-step to explain how they got the answer, they are not only more likely to remember how to approach a similar problem the next time they come across it, but they are also demonstrating their understanding of the approaches and methods used to solve the problem. Writing, then, not only helps the student but also helps the teacher in his or her assessment of students’ work.

Two teachers, Nancy B. Williams, and Brian D. Wynne, of Thomson High School in Georgia, tried the use of math journals as an assessment tool in their own classrooms. In their article “Journal Writing in the Mathematics Classroom: A Beginner’s Approach,” they explain that implementing the journals was not an easy decision. They, as many others, had to take into consideration both the class time and grading time the project would consume. Moreover, they had to consider what students should write, how often they would write, and how to grade what students had written. Once they implemented the math journals, they were met with resistance from some of their own students, who “declared that writing should not be part of the mathematics class (134).” Regardless of the initial hesitation and opposition, however, the math journals proved to be successful. Students reported that “they learned to explain themselves better mathematically; and that [the teachers’]
comments on the journals gave them immediate feedback on their understanding of the material (135).

These are only a few suggestions in improving mathematics education for both genders. By eliminating the masculine pedagogy of mathematics and making small changes in the classroom, such as implementing collaborative groups and writing should help to foster female interest in the subject and open doors for them that would have otherwise remained closed.

References