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# Female Voices in Mathematics: A New Course

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## SUMMARY:

For the last two January terms, I have offered a new college level course: Female Voices In Mathematics at St. John's University and the College of St. Benedict, Collegeville, MN. This paper is an attempt to share with others not only the content and syllabus of the course, but also the experience of teaching it so far. My hope is that this paper will not only help me get in touch with colleagues who are offering similar courses in their institutions so we can exchange ideas, but also prompt others to offer similar courses. I also wish that more courses of this nature would be offered everywhere so as to help raise awareness of the trials and tribulations of women in mathematics.

The thought of offering a course on women in mathematics occurred to me at the MAA Summer Conference at Boulder, CO, in 1989 when I attended Prof. Miriam Cooney's workshop on women and mathematics.<sup>1</sup> I felt that such a course was vital not only to underscore the contributions of the women mathematicians, but to make our students aware of these women's uphill struggles to study mathematics in spite of the social and cultural discriminations of their times. It is often said that women have contributed little to the field of mathematics, but when we read the stories of the few women mathematicians who did, we can not but help wonder how they ever contributed at all! In comparison, it would be difficult to find even a single male mathematician who faced as many difficulties as these women and still persisted in developing his passion for mathematics.

This course also seemed an ideal place to talk about the contemporary gender issues such as the supposed differences in mathematical ability, social and cultural stereotyping of sex-role attitudes, and subtle sexism in the classrooms—displayed sometimes by teachers and present in some text books. To make our students aware of the societal attitudes that supported discrimination against women's education in mathematics in Europe and

America even up to the 19th century, I decided to bring in the stories of the struggles of women through the centuries to get education. This provided them with an excellent perspective to appreciate the discrimination faced by Christine Ladd Franklin when Johns Hopkins University in 1882 refused to grant her a Doctorate in mathematics—a degree which was eventually awarded to her when she was 74 years old.<sup>2</sup> Looking at the continuum of women's struggle to get education helped create in the students a sensitivity to how much women in the United States had achieved in the last one hundred years. It also made it easy for them to understand that even a century later in 1980, highly qualified women Ph.D's were still facing problems getting jobs and especially tenure at highly prestigious mathematics departments.<sup>3</sup> The nature of barricades restraining women's entry into a male-dominated field such as mathematics simply seemed to have shifted with the times, but they were still there! And yet in the 1990s, the struggle was not completely over—there still existed a glass ceiling preventing women from attaining prestigious positions in the Ivy League Institutions, probably one of the very last frontiers challenging women in mathematics!<sup>4,5</sup>

## COURSE DESCRIPTION:

This is a college core curriculum course that is offered with a gender flag for two credits at Saint Johns University and the College Of Saint Benedict, Collegeville, MN, during the short three week January Term—2 hours of class every day for 3 weeks. (Total 30 hrs.)

The Course Catalogue listed the objective of the course as—

- (i) To discuss topics such as is math anxiety due to social and cultural stereotypical images and is there really a



gender gap in the mathematical abilities of boys and girls.

(ii) To build appreciation of women's struggle to contribute to the field of mathematics and especially to help students debunk the stereotypical image that women can not do math.

The course has no prerequisites and the enrollment is limited to 30 students. In January '92 when the course was first offered, the class consisted of about 16 men and 12 women, whereas in January '93 there were 17 men and 8 women registered for the course. In retrospect I can say that to facilitate more meaningful discussions and dialogue on gender-based issues, it would be ideal to restrict the class to about 15 men and 15 women.

The course content is covered using informal lectures, videos, and group discussions on assigned readings. The three weeks are planned approximately as follows:

Part 1 (12 hrs.) - Math and Gender: Biology or Culture?; Math anxiety in women; Sexism in language, media, textbooks and classrooms.

Part 2 (8 hrs.) - History of European women's struggle (up to the 18th century) to educate themselves in mathematics: Societal attitudes towards women's studying of mathematics - an excellent background to talk about the life stories of Mary Somerville, Sonya Kovalevskaya, Sophie Germain and others.

Part 3 (8 hrs.) - American women's struggle to get education, and life stories of some American women mathematicians of the 20th century.

Student evaluations are based on participation in group discussions in the class on assigned materials, a paper on math and gender at the end of the first week, a research paper and presentation (by pairs of students) on the life story of a woman mathematician not covered in class, and a final examination consisting of short essay type questions.

#### COURSE:

On the first day I acquaint the class with the story of my career in mathematics and collect data from the students on (i) the number of math courses

taken during school and college; (ii) attitude toward mathematics along with reasons for their attitude; (iii) people who helped shape this attitude—parents, teachers, peers, etc.; (iv) names of men and women mathematicians they had heard of; and (v) attitude towards women math majors that they knew (if any).

During both January '92 and '93, the class had a maximum of two or three math majors only. The rest of the students were from a variety of majors such as accounting, psychology, economics, management, biology, etc. On the average most of them had a fair attitude towards mathematics, had parents who mostly had encouraged them to study math, and of course, they had not heard of any women mathematicians in any of their courses (the math majors had heard of Emmy Noether only!). Most did not view women math majors differently, but the only two women math majors in the class in Jan. '93 did not think so. One wrote that whenever she informed other women students about her major, "...they would wrinkle up their nose and say, 'Oh, I could never do that - I'm not good with numbers.'" The other wrote, "I was identified as the brain in my high school. My classmates thought I was so smart. This made me afraid to ask questions for they would then tend to emphasize the fact that I was the one asking questions. It was okay for any one else but me to ask questions." To my question if they had ever noticed any sexist attitudes on the part of their teachers, they all gave a clear negative answer on the first day. This perception however changed by the end of the first week during which we talked about the subtle gender inequities present in many math class rooms from the grade level upwards, not excluding the discrimination by teachers (both male and female) towards women students.<sup>6,7</sup> Some women students in their papers on math and gender at the end of the first week remembered instances such as:

"In high school I took an Algebra II class and the teacher gave everyone a hard time, but I seem to remember him encouraging the men to get more involved and ask more questions, whereas if you were a female you didn't want to ask questions because there was a good chance that you'd be ridiculed. The teacher's ego was incredible."

"My sister told me a story once of a friend of hers who had a most humiliating experience her first day of math class at a large university. She had



just walked in and sat down in the front row with four other female students. The professor walked in soon after and asked the five students to sit in the back because they obviously weren't going to learn anything in the class and (that) they would take the other male students' attentions."

"I had negative experience in math in (the) 9th and 11th grades and my freshman year in college. In 9th grade, my teacher wasn't willing to help me because I didn't ask my question while he was up at the board. I was a nuisance to him. In 10th grade, my teacher showed no interest in girls unless they played basketball and were mathematically gifted. The freshman year my professor seemed scolding to me and made me feel like a peon."

"During my freshman year of high school, the male (math) teacher was extremely intimidating, and gave out hours of detention like they were candy. He would then become upset with the class if we did not ask questions about what we did not understand, but when we did, he would ask us how to do the problem. We obviously did not know. He, then, would become frustrated because we did not know how to do it. It was a horrid class."

Next I start the class with discussion on the controversy about genetic ability in mathematics as provided by Benbow and Stanley's study and the resulting hoopla in the media.<sup>8-13</sup> Fennema and Pat Rogers' articles on sex-related differences in mathematical ability and achievement are discussed in small groups.<sup>14,15</sup> Other articles, books, and videos provide excellent resources for thought-provoking discussions.<sup>16-21</sup> I share Fausto-Sterling's view with the class that in spite of the growth in the literature devoted to the measurement of sex differences, on close examination the material appeared to be empirically bankrupt.<sup>22</sup> And

yet, even in Aug. '92, the media still made juicy headlines such as: "Female brain smaller..."<sup>23</sup>

I use some excellent videos to emphasize how language and culture draw such subtle images of stereotypical gender roles in any society.<sup>24-26</sup> These videos provide not only a relevant alternative to lecturing, but also lead to a good exchange and sharing of related personal experiences. Group discussions are followed by each group sharing with the class some examples of how mostly subtle and at times not so subtle messages are given out to women as to what is expected of them.

Next we discuss sexist representations of gender roles and professions in elementary math text book illustrations and problem sets.<sup>27-29</sup> We look for examples of sexist bias in the form of illustrations, professions depicted as performed by women, and problem sets. I share with them some old mathematics text books, very similar to the text I had used in my elementary school.<sup>30,31</sup> Most of the illustrations show little boys doing some activity and little girls always watching—giving the impression that male figures were strong, silent, active and assertive. In most of the problem sets either males were depicted as farmers, doctors, shoemakers, or owners of shops etc., or characterized by distinguished activity like buying property, whereas women were categorized either by physical characteristics such as brown hair, blue eyes, etc., or shown to be doing sewing, shopping and other womanly chores. The class is given an assignment to leaf through elementary text books in the education department or the school libraries and come up with an evaluation using Kepner's format which is shown below. For each specific text at any grade level, they are asked to record not only the frequency of male/female representation in illustrations and problems, but also the type of activities and occupations listed.

Textbook:				
	Illustrations		Problems	
	Male	Female	Male	Female
1. Frequency				
2. Occupations				
3. Activities				
4. Exs. of sexually neutral language				
5. Exs. of sexually blatant language				



Students share, compare and discuss their findings first in small groups and then with the class. One male math/ed. major in Jan. '93 expressed that he was first surprised by even the mention of this topic and confessed that as a student he had never given any thought to the subtle sex stereotyping in math texts. I also share with the class the findings of Kuhnke and Kepner which have reported that the elementary math text books of today were very different from those of the 1940s. An all out effort had been made in the 1970s to eliminate sexist bias

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and discriminatory sex-role stereotyping from the curriculum. The sex role stereotyping had continued to change in the text books between 1975 and 1980. Women were being shown in active roles and capable of achievement and men making mistakes and doing household tasks. Though gender neutral language was being used more often than in the past, very few models for aspiring female scientists and mathematicians had yet appeared.<sup>30-31</sup> The publishers seemed to choose a safe nonsexist route but not an openly antisexist route. That the situation in sciences had not been all too different was reported by a student who shared Nilsen's findings with the class.<sup>32</sup> I can think of a similar evaluation activity that students may engage in for the college level math and science text books to find out how women scientists and mathematicians had fared in them.

We end the first segment of the course by looking at the psychological determinants of educational and occupational choices, and discussing two 1980 appraisals of female mathematicians and their personalities.<sup>33-35</sup> I share recent data regarding participation of women in mathematics and sciences with the class and make them aware that the situation has greatly improved today, but even in 1993 the National Council of Teachers of Mathematics (NCTM) sometimes has to raise its voice against the general perceptions portrayed to

little girls by Barbie dolls that mathematics is tough.<sup>36-58</sup>

At the end of the first part of the course, students are given an assignment to write a paper on mathematics and gender using any of the readings, videos, and/or discussions in the class. I encourage them to do their own search for other materials. I have listed below some of the topics they have written on:

- (a) Sexism in language/ media / elementary math text books.
- (b) Math anxiety in women.
- (c) Teacher's role in a math class room.
- (d) Women and the nature of mathematics.
- (e) Are women less mathematically able?

Both in January '92 and '93 when I have taught this course, I have felt that the amount of literature/videos available on math and gender is quite exhaustive, and provides more material for thought and discussion than can be handled in 12 hours of class time. Students need time to ponder over these issues and one suggestion to keep track of their individual thoughts might be to ask them to keep a daily journal of reflections during this part of the course. Some other lively activities that can be developed to conclude this topic can be as follows:

- (a) Class dialogue on some current stereotypes in our culture concerning women and mathematics (or science).
- (b) Class debate on "Should professional women be like professional men?" (I have tried this with great success both times. Students became quite excited and enjoyed challenging their opponents. Thanks to Ruth Hubbard's paper for the topic.)<sup>40</sup>
- (c) Class skits on teacher/student interactions in the mathematics classroom (Leder, Berson).<sup>41,42</sup>

The second part of the course moves on to sharing stories of women mathematicians. We start from the golden era (c.3000 - 1000 B.C.) when "a wave of feminine genius passed over the fragrant valleys and the vine-clad plains of ancient Egypt. Never in any other place or time..was there a more perfect flowering of female intelligence of the highest order".<sup>43,44</sup> The story is unfolded in a sequential fashion so as to give the students a perspective of women's struggles through the centuries. From the classical times of Aspasia, and Hypatia we see a gradual decline in the status of women through



the middle ages to the Renaissance to more modern times. Immanuel Kant's, "All abstract speculations, all knowledge which is dry, however useful it may be, must be abandoned to the laborious and solid mind of man.... For this reason women will never learn geometry", or De Lamennais' sharing of Kant's opinion concerning woman's inferiority, "I have never met a woman who was competent to follow a course of reasoning the half of a quarter of an hour—un demi quart d'heure, but, in the matter of reason, logic, the power to connect ideas, to enchain principles of knowledge and perceive their relationships, woman, even the most highly gifted, rarely attains to the height of a man of mediocre capacity." Mozan expressed attitudes that clearly reflected existing prejudices against women's studying of math or science for many centuries. Hypatia's cruel death, Mary Somerville's "saving Euclid for the night", Sophie Germain's "M. le Blanc", Hilbert's "Meine Herren,....the Senate is not a bathhouse" in support of Emmy Noether's employment at Gottingen, and Sonya Kovalevskaya's marriage of convenience, all provide us with some very touching stories that inform and inspire students and fill them with awe at the courage, determination, and strength of character of these women to persist in their studies in spite of the great odds against them.<sup>46,47</sup>

The struggle of the British ladies of the 18th century to acquaint themselves with the happenings in mathematics and science through the Ladies Diary, magazines, visits to the museums, and the public lectures is also very well documented.<sup>48,49</sup> Students are surprised to learn of a precursor of today's feminist ideology as reflected in a "Lady Of Quality" writing in 1721—"I think it is high time to

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**"Most Americans of the 1790s and early 1800s considered educated women a threat rather than an asset to society," wrote M. Rossiter.**

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look about us, and to vindicate Our sex; to let them know the value we ought in justice to set upon ourselves; to rouse up our courage, and fire our Breast with a worthy Indignation, and Resentment against such inhumane Treatment as we daily meet with that we may no longer give Pre-eminence to

such vain, thoughtless, and ungovernable Animals, as Men of what Denomination soever". This historical scenario offers an excellent insight into the life sketches of Ada Lovelace, Mary Somerville, and Caroline Herschel.

Moving on to the period of colonization in U.S. history, students are shocked to learn about the prevailing antifeminist attitudes of the times. "Most Americans of the 1790s and early 1800s considered educated women a threat rather than an asset to society," wrote M. Rossiter.<sup>50</sup> Emma Willard's "Republican motherhood strategy" to make school education accessible to women under the pretext of making them "better mothers and wives", the establishment of women's colleges in 1830s, the struggle for co-education and eventually for graduate admission to prestigious research universities in the late 19th century surely surprised my students.<sup>51</sup> Most of them had never heard about these struggles so close to home and they expressed a feeling of being enlightened to learn that the education today that they take so much for granted had become available to women after such long struggles.

Armed with this knowledge of the history of women's efforts to get education, I let students work in pairs to prepare life sketches of women mathematicians (and scientists) not covered in class. Each pair submits a paper and gives a presentation on these autobiographies. Students have mentioned enjoying this assignment since it gave them a chance to really understand the character and idiosyncrasies of some of these mathematicians. These presentations also helped cover in class some recent biographies of Mary Rudin, Cathleen Morawetz, Julia Robinson and others.

Moving onto the 1970s, I introduce to students the Association For Women In Mathematics [AWM] and its role in encouraging participation of women in mathematics through different activities.<sup>52-54</sup> Lastly we look at some recent data from the 1980s and talk about the glass ceiling as experienced by women professors in getting jobs and tenure at some of the prestigious Ivy League institutions even today.<sup>55-57</sup> The Dec. '92 CNN video 'Beyond The Glass Ceiling' really opens their eyes to the prejudices women still face in today's corporate world and shows them how these women at the frontier are fighting to shatter this glass ceiling.<sup>58</sup>



On the last day of lectures I have invited one or two female colleagues to share with the class their experiences of first being students and then professors of mathematics. Students have enjoyed listening to these stories of struggle and survivals in the context of the current world scenario. One can also invite women math majors working in business and industry to talk to the class.

## CONCLUSION:

This course has been taught twice so far and the organization of the course as described above provides a comprehensive story of female voices in mathematics. Discussing women mathematicians' struggles in the context of the over all struggle of women over the centuries to get education draws a very compelling picture. The earlier part of the course discussing the sexist biases prevalent in society, culture and language, classrooms, etc. helps to quickly involve the students into the course, since they are able to relate to what is discussed in class. Some of the comments I have received on the course evaluations have asked for more discussions, group projects and class activities. With the time constraint for a January term course I am limited in how much can be done in three weeks, but I do look forward to comments and suggestions from the readers that will help me expand this course into a full semester course.

I am delighted by the enthusiastic support this course has received so far:

"I have really enjoyed this course. It brings a lot of hidden facts out front."

"There is a need to see where women fit into math and how sexism plays a role in society, and there are no other courses that address all these topics."

"Before the course began I was not looking forward to it. I thought that it was going to be boring. But after it began, I really started to enjoy it. It amazes me that there is so much discrimination in the field of mathematics. I was never aware of this. I definitely think that this course should be offered again."

In closing, I take the following comment by a male student as a compliment to the success of this course in projecting the voices of women in mathematics:

"My reaction to this course is a sense of accomplishment. I came in apprehensive because of the subject matter, but I enjoyed it. Sure offer it again—the more knowledge that can be spread about this topic, the more educated us dumb men can get!"

## NOTES

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\* I am extremely thankful to Professor Miriam Cooney, Saint Mary's College, Notre Dame, Indiana for her constant guidance and encouragement.

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