

## Encouraging Women in Mathematics Through an Interdisciplinary Course Joint Mathematics Meetings, January 6, 2021

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This talk describes (and provides resources for) an interdisciplinary course grounded in the biographies and work of nine women mathematicians (Hypatia to Emmy Noether) and one statistician (Florence Nightingale). The course aimed to engage students in mathematical topics related to the women's mathematical work and to address gender equity in mathematics education and mathematics-related careers in the US. Many of the themes that emerge from examining the lives and work of these historical figures remain relevant today. The course encouraged students, some of whom were future K–12 teachers, to adopt a more expert view of mathematics as a study of patterns, as opposed to numbers. The students also encountered 21st century role models for women doing mathematics and the future teachers gained knowledge of equitable classroom practices and resolve to incorporate these into their teaching. A follow-up study of those who became teachers prompted questions about undergraduate teaching practice and teacher preparation programs that will be shared. In addition, an accounting of the number of individuals affected through volunteer outreach opportunities associated with the course suggests an ongoing impact beyond the classroom. Support from the TENSOR-MAA Women and Mathematics grant program allowed the course originator to team-teach the course with three other colleagues in 2008, 2010, and 2012, respectively.

### Studies or Reports of Outcomes of the Course

- Dewar, J. (2008). What is mathematics: Student and faculty views. *Electronic Proceedings for the Eleventh Special Interest Group of the Mathematical Association of America on Research in Undergraduate Mathematics Education Conference on Research in Undergraduate Mathematics Education, San Diego, CA 2008*. Available at <http://sigmaa.maa.org/rume/crume2008/Proceedings/Proceedings.html>.
- Dewar, J. (2017). Women and mathematics: a course and a scholarly investigation. *BSHM Bulletin: Journal of the British Society for the History of Mathematics*. doi: 10.1080/17498430.2017.1319160.
- Dewar, J. & Vig, R. (2012). Future teachers' intentions for gender equity: How are these carried forward into their classroom practice? Paper presented at 15th Annual Conference on Research in Undergraduate Mathematics Education, 2012, Portland, OR. Available at <http://jdewar.lmu.build/files/Dewar-VigRUME2012.pdf>.

### Selected Bibliography on Other Types of Courses about Women and Mathematics

- Dewar, J. & Greenwald, S. (2017). Teaching Students About Women and Mathematics: An Interview with Two Course Designers. In J. Beery, S. Greenwald, J. Jensen-Vallin, and M. Mast, M. (Eds.) *Women in Mathematics: Celebrating 100 Years of the Mathematical Association of America*. New York: Springer, 2017, pp. 343-358.
- Köse, E. & Johnson, A. (2016). Women in Mathematics: A Nested Approach. *PRIMUS* 26(7), 676–693. doi: 10.1080/10511970.2015.1132802.
- Greenwald, S. (2000). Women in Math Class. *AWM Newsletter*, 30(4), 12–13.
- Greenwald, S. (2005). Incorporating the Mathematical Achievements of Women and Minority Mathematicians into Classrooms. In R. Jardine and A. Shell-Gellasch (Eds.), *From Calculus to Computers: Using the Last 200 Years of Mathematics History in the Classroom*, MAA Notes no. 68, 183–200. Washington, DC: MAA.
- Gulati, S. (1994). Female Voices in Mathematics: A New Course. *Humanistic Mathematics Network Journal*, issue 10, article 4, 13–21. <http://scholarship.claremont.edu/hmnl/vol1/iss10/4>. Accessed 28 Dec 2020.
- Kellermeyer, John. 1998. Addressing Eurocentrism and Androcentrism in Mathematics: The Development and Teaching of a Course on Mathematics, Gender, and Culture. In K. Conway-Turner, S. Cherrin, J. Schiffman, & K. Turkel (Eds.), *Women's Studies in Transition: The Pursuit of Interdisciplinarity*, 239–251. Newark, NJ: University of Delaware Press.

### Selected Bibliography on Role Models

- Charleston, L., Adserias, R., Lang, N., & Jackson, J. (2014). Intersectionality and STEM: The Role of Race and Gender in the Academic Pursuits of African American Women in STEM. *Journal of Management Policy and Practice*, 2(3), 17–37.
- González-Pérez, S., Mateos de Cabo, R., & Sáinz, M. (2020). Girls in STEM: Is It a Female Role-Model Thing? *Frontiers in Psychology*. doi: 10.3389/fpsyg.2020.02204.
- Wiest, L., Sanchez, J., & Crawford-Ferre, H. (Eds.). (2017). *Out-of-School-Time STEM Programs for Females: Implications for Research and Practice Volume I: Longer-Term Programs*. Charlotte, NC: Information Age Publishing.

More information about the course is available at: <http://jdewar.lmu.build/wam>

## Course Description for Mathematics & Women

This upper division mathematics elective is an interdisciplinary elective that is sometimes cross-listed with Honors and/or Women's Studies. Studying the biographies and mathematical contributions of women mathematicians from the 1st through the 20th centuries sheds light on historical and current equity issues in mathematics education and math-related careers. Students investigate mathematical topics such as prime numbers, conic sections, special curves, congruence arithmetic, infinite series, polyhedra and group theory and examine facets of equitable K–12 mathematics instruction. There is a focus on 3 recurring mathematical themes:

- The distinct and vital roles of inductive and deductive reasoning in mathematics
- The occurrence and value of multiple representations in mathematics
- Mathematics encompasses much more than “a study of numbers.”

### Overarching Course Goals (fall into four categories):

#### *W: Women Mathematicians in History*

To examine the lives and contributions of women mathematicians from the 4<sup>th</sup> to the 20<sup>th</sup> centuries

#### *G: Current Gender Issues in Mathematics Participation*

To investigate current gender issues related to women's skills and participation in mathematics from elementary school through graduate school and their participation in math-related careers

#### *M: Mathematical Reasoning and Communication*

To provide students an opportunity to experience “doing mathematics” in a supportive and cooperative environment and to encourage students to be more aware of their own mathematical thinking

#### *R: Research Component*

To undertake a deeper investigation that explores one or more of the above areas

### Learning Outcomes (matched to goals, by letter):

Students will be able to

- W1. Describe the life and work of 10 women in mathematics/statistics who lived before the 21<sup>st</sup> century, and at least one modern woman mathematician
- W2. Synthesize from these women's biographies common experiences/obstacles faced by women who wished to participate in mathematics and identify factors that enabled their success
- G1. Discuss the current situation in the United States regarding women's participation and achievement in mathematics in K–12, higher education, and industry
- G2. Read critically articles in journals, newspapers, and digital media dealing with gender issues in mathematics or science education
- M1. Make and investigate mathematical conjectures, develop arguments in support of or counterexamples for those conjectures
- M2. Communicate their mathematical thinking clearly to others (peers and teachers) using mathematical language
- M3. Analyze and evaluate the mathematical thinking of others
- R1. Demonstrate the ability to conduct an interdisciplinary research project

### For Future K–12 Teachers, there is an additional goal and learning outcome:

Goal

#### *P: Pre-professional Development for a Future Teaching Career*

To develop expertise in addressing equity issues related to mathematics education at the level you plan to teach

Learning Outcome

Future Teachers will be able to

- P1. Prepare and share mathematics teaching resources and lesson plans (including appropriate assessments) that reflect equity principles