FUTURE TEACHERS' INTENTIONS FOR GENDER EQUITY: HOW ARE THESE CARRIED FORWARD INTO THEIR CLASSROOM PRACTICE?

Jacqueline M. Dewar and Rozy Vig
Loyola Marymount University

Mathematics teachers at all levels are called to promote gender equity in their classrooms. During a college course on mathematics and gender, future K-12 teachers indicated their intentions to foster gender equity in their own classrooms. To investigate whether, and how, this resolve for equity persisted and influenced their own classroom practice, we present case study data of four former students from this course. Using a grounded approach (Glaser, 1992) to analyze classroom observations and semi-structured interviews, we report how closely the former students' current descriptions of an equitable classroom aligns with their classroom practice, and with NCTM's call for equity. We find that these teachers' self-assessment of their success in achieving equitable classrooms appears to be accurate. We also highlight the learning experiences they feel most contributed to their views and practice regarding equity and equitable teaching. The results suggest possible implications for mathematics teacher preparation programs.

Key words: [K-12 teacher preparation, gender equity, classroom practice, role model, case study]

Teachers are called to play a role in ensuring gender equity in mathematics instruction (Secada, Jacobs, Becker & Gilman, 2001; National Coalition for Equity in Education, 2003). The phenomenon known as stereotype-threat (Steele, Spencer, & Aronson, 2002) makes excelling in mathematics more challenging for female and minority students. Enlightening future teachers about the facts and fallacies that underlie the widely held idea that boys are simply better at math than girls (Halpern et al., 2007; Hyde, Lindberg, Linn, Ellis, & Williams, 2008) is one way to empower teachers to confront these stereotypes personally so that they can then help their students to do so in their own lives. Providing information about role models by fostering awareness that women have contributed to the development of mathematics is another important strategy for encouraging underrepresented groups in mathematics (Marx & Roman, 2002; Leonard, 2008; Bonetta, 2010). These ideas informed the design of the course on women and mathematics, which prompted the study of how future teachers' intentions to teach equitably are carried forward into their own classrooms.

A Brief Description of the Course

The course was originally developed and taught by the first author.[1] It was inspired by the publication of the book *Math Equals* (Perl, 1978). Like the book, the course examines the lives of nine women mathematicians from Hypatia in the fourth century to Emmy Noether in the twentieth century. It engages students in mathematical activities related to the work of those women, which allows for discussion of mathematical topics ranging from conic sections to functions to elementary group theory. To bring structure to the wide variety of mathematical topics, the course emphasizes three mathematical themes:

[1] Three rounds of funding from the Tensor-MAA Women and Mathematics grant program have supported the first author in team teaching this course in 2008, 2010, and 2012, each time with a different junior faculty member from her department. As part of the dissemination effort for this grant, a course webpage (http://jdewar.lmu.build/wam) provides more information about the course.

1. Mathematics, at its heart, is a study of patterns and not numbers.
2. Inductive and deductive reasoning play distinct and vital roles in mathematics.
3. The use of multiple representations for a given concept can be valuable in learning and teaching mathematics.

The course attracts students in the elementary school credential program who want to concentrate in math but have had little or no calculus as well as students majoring in mathematics who have taken a number of upper division math courses. To accommodate the range of students' math backgrounds, the instructor strives to approach these topics in novel and accessible ways. For example, when discussing conic sections in conjunction with Hypatia, all students can comprehend and appreciate the Dandelin sphere proof (of the equivalence of the "cutting-the-cone" and the "distance-focus" definitions of the ellipse) and rarely have students seen it prior to the course. The course also examines research on gender differences in mathematics participation and achievement as seen in the 1970s and today. In addition, it asks how the experience of contemporary women mathematicians, particularly those of color, intersects with the experiences of the nine women from history.

Research Questions

A previous study of the course (Dewar, 2008) focused on the change in students' views of mathematics. In an end-of-term portfolio the future teachers voluntarily pledged to encourage all their students equally in the study of math. This was significant because the reflection prompt they were addressing dealt with mathematics and not with equity. This prompted a new study of the course, which sought to determine:

- How does future teachers' resolve for an equitable classroom get carried forward into their classroom practice?
    - As teachers, what are their current views and actions toward gender equity?
    - What courses, learning experiences or pre-professional opportunities fostered these views or actions?
    - What factors support and hinder them in achieving gender equity in their classrooms?

Research on equity highlights two differing views with respect to classroom practice (Streitmatter, 1994). One is to provide equal opportunity (at the outset) with the assumption that differences in outcomes are a function of individual differences. The other is to aim for equal outcomes. Here the teacher provides additional resources to try to meet special needs or to compensate for disadvantages. Streitmatter (1994) acknowledges problems with both of these approaches. The first takes no account of different backgrounds, motivations, or beliefs resulting from past educational experiences or inequities, societal biases, or stereotype threat. The second, some feel, can result in reverse discrimination. NCTM comes down on the side of the second as seen in the Equity Principle in *Principles and Standards* (2000) and in the *Changing the Faces* series (2001). In this paper, we will show that the teachers in the study also come down on the side of the second view, aiming for equal outcomes in their teaching.

Methods

Subjects

We were able to identify and contact four former students who were teaching in the local area. They all agreed to participate in the study. All had taken the women and mathematics course in 2008 from the first author, a mathematics professor. All four are women, two are white, and two are Hispanic. One student majored in liberal studies and minored in mathematics. She was pursuing her elementary teaching credential, while seriously considering getting a secondary math credential. This was her second year of teaching first grade in a private Catholic elementary school. The other three students majored in

mathematics and were each teaching at the high school level. One taught in a private Catholic school and the other two taught in public charter schools. The high school teachers were all in their third year of teaching. For the remainder of this paper, each teacher will be referred to as Instructor #1 (I#1), Instructor #2 (I#2), Instructor #3 (I#3), and Instructor #4 (I#4), with I#1 denoting the elementary school teacher.

Classroom Context

In the classrooms of I#1 and I#3, females comprised the majority of the students, while in the classrooms of I#3 and I#4, females were in the minority. Although the types of schools, grade levels, and the gender ratios varied across the four observed classrooms, all four schools had a student population consisting almost entirely of Hispanics and African-Americans. On the day of observation, all the classrooms were populated by either Hispanic or African-American students. The three secondary teachers were each observed teaching a geometry lesson. Table 1 contains a summary of the school and instructor characteristics, the gender data for each classroom, and the ethnicity data for each school.

Level of Instructor	**#1 first grade, #2, #3 and #4 secondary**			
	#1	**#2**	**#3**	**#4**
Private/Catholic School	**x**	**x**		
Public/Charter School			**x**	**x**
High School Geometry		**x**	**x**	**x**
1st Grade Math	**x**			
Teaching Experience	**2**	**3**	**3**	**3**
Classroom: Gender count	**12F:6M**	**13M:3F**	**15F:5M**	**15M:7F**
School: Ethnicity data[2]	**H: 99%**	**H: 28% AA: 62%**	**H: 99%**	**H: 96% AA: 3%**

Table 1 Characteristics of Instructor, School, and Classroom

Data

Each classroom was observed once. Notes were taken on classroom pedagogy, classroom discourse, and materials posted on the walls. The classroom pedagogy was observed for an overall sense of the learning environment as being more or less teacher-centered or student-centered. With regard to classroom discourse, to the extent possible, notation was made of the genders of the students who volunteered answers or were called on by the teacher. Based on these notes, a gender response ratio (the gender ratio of students who volunteered answers or were called on directly by name) was computed for each lesson and compared to the gender ratio of students in the classroom. We caution that care must be taken in interpreting such a comparison. As we will see in the actual data, the gender response ratio can appear to be fairly favorable to one gender while the actual gender count of responders differs from the actual gender count in the classroom by a single response. The materials posted on the classroom walls were observed for references to gender equity. For example, notes were taken of posters depicting male and/or female mathematicians and of the type of student work on display.

Semi-structured interviews, approximately 45 minutes in length, were conducted after each classroom observation. During the interview, the instructors were asked to describe an equitable classroom and discuss what factors supported and hindered their ability to achieve equity in their classrooms. All the instructors were asked: How important is it for you to

[2] This ethnicity data for the 2011-12 academic year was obtained from internet sources.

create an equitable classroom, very important, important, somewhat important, not at all important, or you never think about it? This question was followed by an open-ended question to inquire about the instructors' views of gender equity: What comes to mind when you think of an equitable classroom? The instructors were then given a series of follow-up questions: Would you say equity means *equal* or *something different*? How are you attending to issues of gender equity in your classroom? Do you feel you have been successful in creating a gender equitable classroom? Why or why not? These conversations led naturally to the questions: What factors support your ability to achieve equity in your classroom? What factors hinder your ability to do so? What educational and pre-professional experiences have shaped your views on equity?

Data Analysis

All four interviews were audiotaped and transcribed for analysis using grounded theory with open coding (Glaser, 1992). Both authors independently read one transcript and identified similar themes. The first author then developed a coding scheme and coded all four transcripts to arrive at the constructs of student voice (SV) and role models (RM). Below is a description of the analytic process used to arrive at the SV and RM constructs.

Following a thorough reading of all the transcripts, participation, confidence, and engagement emerged as the most frequently mentioned themes. These themes were developed into a coding scheme. Codes P, C, and E were used to denote references to student behavior related to participation, confidence, and engagement, respectively while the codes IP, IC, and IE referred to strategies the instructors used or could use to promote these behaviors. Statements about behavior in the service of verbal participation and strategies that promote verbal participation were coded P and IP, respectively. Statements referring to gender differences in attitudes and beliefs about oneself as a doer of mathematics were coded C. References to strategies for addressing such differences were coded IC. Statements about interests in and motivation to work were coded E, while any mention of strategies for promoting interest and motivation were coded IE. Below are examples for each of the codes:

P - "The girls raise their hands less."

IP – "I consciously make an effort to call on a girl, call on a boy."

C – "The girls weren't positive, they always questioned their answers".

IC – "I make a very strong point that girls can do math in my class."

E – "You could tell he was into his work."

IE – "Teaching students to self-assess gets them more engaged."

Codes were chunked when appropriate. For example, if an instructor made two back-to-back statements about promoting verbal participation with little to no difference in content, both statements were chunked together and received a single IP code. If however, the second statement introduced a new strategy or new idea with respect to participation, the two statements each received an IP code. Finally, all of the above codes were gathered into a single construct called "Student Voice" (SV) which was used to frame the results.

The importance of Role Models (RM) emerged as another frequently mentioned theme and was considered a second construct of interest. The instructors referenced RM across a number of contexts: as a recognition of how few RM the instructors themselves had encountered, as a concern that their students should have RM, as a thought that they themselves might serve as a RM for their students, and/or as a strategy to promote equity.

The codes mentioned above are by no means exhaustive with respect to the data. Both I#2 and I#4 made reference to giving equally challenging problems to males and females as a strategy to promote equity. This was one theme that emerged from the data but did not fit into either the SV or the RM construct. Because the themes specific to SV (i.e., participation,

confidence, and engagement) and RM were the most commonly mentioned by all four instructors, we focus our attention on those for the remainder of the paper.

The constructs of SV and RM that emerged from the interview data were compared with what was observed in their classroom practice. In addition, physical manifestations of SV were noted in the classroom (student work displayed, motivational sayings or posters, and posters showing applications of mathematics) as were physical manifestations of RM (posters of female or minority mathematicians).

Results

In what follows, we will report on classroom observation data and interview data for each instructor. The classroom data will highlight the pedagogy and discourse used in the classroom as well as the materials found on the walls. The interview data will bring to light influences that prompted each instructor to strive for equity, factors that supported and hindered their success, and self-assessments of their achievements.

Instructor #1 Classroom Observation

I#1, the first grade teacher, employed a combination of age-appropriate teaching methods that involved whole group recitation, and individual work using hands-on manipulatives and worksheets. There was also some Socratic-type discourse with the whole class. She used a range of classroom management techniques to engage her students and keep them on task. For example, a song was used to transition between lessons. On some tasks, students (early finishers) were asked to help other students in their group. I#1 also incorporated reading into the math lesson. She used an informal assessment technique at the end of the lesson, called an "exit slip," which on this day consisted of a single subtraction problem. Females outnumbered males 2 to 1 in this class, and the gender response ratio 2.4 to 1 favored females. However, the gender response count (12 female voices to 5 male voices) only differed by one from the student gender count in the class (12 females to 6 males). The student work and progress charts displayed in the classroom represented a physical manifestation of SV. There were no physical manifestations of RM.

Instructor #1 Clinical Interview

I#1 indicated that equity was very important to her and stated, "An equitable classroom means each child has an equal opportunity to learn. To achieve that may require the instructor to parcel out time and attention unequally." She mentioned the woman and mathematics course as influencing her desire to achieve gender equity, in that it made her aware of mathematical role models for females, especially for herself. She cited the statistics on women's participation and achievement in mathematics discussed in the course as raising her awareness of gender inequities in mathematics. She had used teaching materials derived from the course once, but found that while the lesson on math as patterns was meaningful to her first grade students, they could not grasp the connection to a particular woman mathematician (Sonya Kovalevskaya). She also mentioned the math methods course as helping her develop equitable teaching methods. Regarding hindrances to achieving equity, I#1 noted that gender stereotypes held by some parents had led to complaints about her classroom policy that all students use wheeled bags rather than backpacks, but these were unrelated to mathematics instruction. She stated that she was generally satisfied with what she was achieving in her classroom in terms of equity.

Instructor #2 Classroom Observation

In I#2's secondary classroom the "discourse" was based on the Socratic method with the teacher asking many questions (more than two dozen) during her presentation, and calling upon students to answer, mostly from those who volunteered, but not entirely. There were

4.3 times as many males as females in this classroom, but they answered only 3.8 times as often, so the gender response ratio favored the females. However, because the females were so few in number in this classroom, despite the favorable ratio, it seemed the female students had little voice. There were a few instances during which the instructor had students working alone, in pairs (using think-pair-share), and whole group. The instructors' method of classroom management was effective in keeping all students on task. The instructions and directions were clear, and the entire lesson was well organized. The exit slip assessment used by this instructor was a three-question mini-quiz that included a written prompt asking students to reflect on what they had learned in class that day. Regarding physical manifestations of SV, student work and motivational sayings were posted on the board and walls. There were no physical manifestations of RM.

Instructor #2 Clinical Interview

When asked how important it was to her to create an equitable classroom I#2 replied, "I think it is important," and stated, "An equitable classroom provides an equal chance to participate in class. This may require something different or more encouragement for girls in class." She cited the women and mathematics course as influencing her desire for equity. She valued the course for making her aware of female mathematics role models for her students. I#2 mentioned two other courses that influenced her to work towards gender equity: a special education course taken as part of the credential program, and a course on coaching/mentoring taken while pursuing a graduate degree. As factors hindering her ability to achieve equity she mentioned two types of time limitations: finding time within the constraints of the curriculum to do more with women in math, and finding time to prepare special materials or lessons on women and mathematics. When asked if she felt she had been successful in creating a gender equitable classroom she replied, "I don't think so." She stated that felt she needed more pedagogical tools/skills related to equitable discourse at her disposal.

Instructor #3 Classroom Observation

In her classroom, I#3 employed teaching methods that included a constructivist approach and some lecture using the Socratic method. The class opened with a hands-on guided discovery activity leading students to conjecture that the sum of the angles in a triangle is the same as a straight line. I#3 typically addressed questions to the entire class. Sometimes multiple individuals answered at once. While females answered the majority of the questions, the female to male gender response ratio of 1.2 to 1 fell well short of the 3 to 1 female to male ratio in the class that day. The small group work included a round-robin task that had students move in randomly assigned groups of three or four from one station to another to do problems. Due to effective classroom management, transitions from one mode of work to another were seamless. For the most part, all students seemed engaged and on task. The exception was during a round-robin activity when some students seemed disengaged while they waited for others in their group to catch up on the task. Again, the instructor made use of an exit slip to check understanding of the material presented along with a question about what they learned. Student work and motivational sayings posted on the walls comprised the physical manifestations of the SV. RM appeared in a single poster from the National Women's History Project (NWHP) featured a group of women mathematicians.

Instructor #3 Clinical Interview

I#3 stated that equity was very important to her and stated, "An equitable classroom requires pushing girls more toward participation and confidence." She cited the women and mathematics course as influencing her to strive for gender equity because it made her aware of female mathematics role models for both her students and herself. I#3 said she has made

repeated reference to the women she learned about in the course and has used materials/lessons from the course with her own students on multiple occasions. I#3 noted two other influences that led her to strive for an equitable classroom. She described how she felt safe to contribute ideas in her senior seminar in mathematics because of how the instructor treated the students. According to her, he "gave equal attention to the males and females" and she felt "warmth in that class." He served as a powerful role model for equitable teaching, one she felt was difficult to come by in upper division math courses. The second experience had to do with a feeling of "belonging" during an undergraduate mathematics summer research experience. I#3 described how she had focused her classroom efforts on "pushing her girls." She was not fully satisfied with her achievement of an equitable classroom climate. She felt that she had been successful with the girls in one of her class periods (not the one observed), but was concerned that her strong emphasis on the girls' participation with statements like, "Come on girls, don't let me down!" might not be the best method to produce the results she wanted (equity for all). Next year she vowed to extend her equity focus beyond just girls to all her students, especially her English language learners and low math ability students.

Instructor #4 Classroom Observation

I#4 conducted the most student-centered and egalitarian discourse. She modeled her pedagogical approach after her mentor in the education department, the math methods teacher. Questions were directed to all students, a single student was never called on. Hand signals or answers written on small individual white boards were used to elicit participation and check understanding. Students were frequently directed to discuss a question or problem with a neighbor or to tell the meaning of a term to a neighbor, and students did so. I#4 seemed to be the most successful in achieving the SV equity markers of participation, confidence and engagement. The instructor circulated, answered questions and offered encouragement such as "You're on the right track." If she observed students not providing justification appropriately, she stopped to model for the whole class how to do so. A gallery walk was another method she employed to elicit participation among all students. This method entailed students moving about different stations (individually, in pairs, or small groups) to work problems posted on the wall. In I#4's class, there was no gender response ratio to be counted due to the nature of the discourse. It is worth noting that this instructor had more contact with the math methods teacher than the others. More specifically, she participated in a professional development program for in-service teachers, directed by the math methods teacher, which reinforced the student-centered discourse observed in her classroom. She too used an exit slip to assess comprehension. Of the three secondary instructors, I#4 had the most interesting student work (e.g., student "mind maps" for logic and reasoning and student depictions of Zeno's paradox) and motivational materials (college pennants and posters in addition to motivational sayings) on display in the classroom. She had the same women and math poster from NWHP as I#3, but she also had posters of specific male (Newton and Einstein) and female (Sonya Kovalevskaya and Sophie Germaine) mathematicians and posters showing applications of mathematics.

Instructor #4 Clinical Interview

For this instructor, having an equitable classroom is very important. She described it as, "100% of students in class engaged, not just listening but participating. The focus is on individual needs, so it does not mean equal attention to each student." Influencing her to strive for equitable practice, I#4 cited the women and mathematics course for making her aware of mathematical role models for her female students. The statistics presented in the course on women's participation and achievement in mathematics had also raised her

awareness of gender inequities in mathematics. She said she has made repeated reference to several of the women she learned about in the course and has used materials/lessons from the course in her own classes on multiple occasions. She gave credit to her math methods course for helping her develop equitable teaching methods. She mentioned that it was a struggle to find time within the constraints of the curriculum to do more with women in math, but followed up with a remark that she was confident she could figure out a way to do it. Of the three secondary instructors, she seemed the most positive about her current level of success in achieving an equitable classroom.

Conclusions

All four instructors' interpretation of the meaning of equity matches the position taken by NCTM, namely that equity and equitable instruction requires them to do "something different" depending on what they perceive to be individual or group needs.

In regard to gender equity, there is alignment between how important they say it is to them, how they characterize it in terms of student voice and role models, and what they do, strive to do, or wish they knew how to do to achieve it. To elaborate, the instructors said equity is important to them, and that it is characterized by having an equal opportunity to learn that is taken advantage of by both males and females. For them, markers of gender equity will show up in the SV, where both genders participate, have confidence in their ability, and engage with the work. What the instructors do, try to do, or wish they were better equipped to do is to promote the SV of all. Each instructor identified areas where they felt they were or were not meeting their own standards and expressed frustration about the latter.

What we observed the instructors doing or having available in their classroom largely confirmed that their self-assessments are accurate. I#1, the first grade teacher, was generally satisfied with what she was achieving in her classroom in terms of SV and not too concerned about RM given the age of her students. Certainly, her teaching methods (whole group recitation, use of hands-on manipulatives, individual and small group work, Socratic-type discourse with the whole class, and incorporating reading into the math lesson) appropriately supported the SV of her young students. While her gender response ratio favored the males, the actual gender count of the responses was only off by one from the gender count in her classroom. Of the three secondary instructors, I#2 seemed the least positive about her current level of success in achieving an equitable classroom. Her classroom "discourse" was the most traditional, primarily relying on the Socratic method, with a small amount of think-pair-share. During this class period the gender response ratio favored the females, but there were so few females, it seemed they had little voice. The student work on display showed computations of area and perimeter for floor plans generated by the students but did not provide insights into student thinking. There were no role models for doing mathematics on display. Thus, it seems this instructor gave a realistic assessment of her own situation relative to SV and RM. I#3 was not fully satisfied with her current level of achievement with regards to an equitable classroom climate. Although females answered the majority of the questions asked during the observation, the gender response ratio favored the males in this predominantly female classroom. There was one RM poster for women in mathematics on the wall. In one class (not the one observed) her exhortations to the girls to be more like the boys produced positive results but she was uncertain about the effects of her methods on other groups (e.g., boys, English language learners, etc.). I#4 was the most positive in her assessment of her success in achieving an equitable classroom. The classroom observation certainly supported her assessment as she had achieved the most equity in SV through her pedagogical methods that elicited participation, confidence, and engagement among all students through hand signals, white boards, and pair and group discussions. Her classroom also had the most SV and RM material on display.

The instructors described a number of positive influences that promoted and supported their desire to achieve equitable classrooms. The women and mathematics class was successful in raising awareness of gender equity for all four instructors, either by providing access to role models or to statistical data about inequities. The course also gave them knowledge and materials they can use in their teaching (two of the four were actively using these materials). In addition to being in the same women and mathematics class, all four instructors had also taken the secondary mathematics methods course together. The influence of the math methods course on aspects of their teaching was confirmed by the observations. The fact that they adopted many of the strategies introduced to them by their math methods teacher (e.g., exit slips) provides strong evidence that the math methods course can play a key role in supporting equitable teaching. Finally, while three of instructors did not identify any role models for equitable teaching practice, I#3 discussed the significance of having found one such role model in a math content course.

Regarding hindrances to achieving an equitable classroom, the most cited factor was time: finding time to insert material on women and mathematics, and finding time to prepare special materials. One instructor wished she had more effective pedagogical tools at her disposal and another thought she needed to tone down rhetoric aimed at "pushing her girls" or she would be labeled 'sexist' and that could interfere with her rapport with her students.

Limitations of the Study

Whether one can or should draw broad implications for practice from case studies based on close examination of an unusual course, such as the course on women and mathematics, is questionable. This study was limited by the fact that only a single lesson was observed for each instructor. These lessons were not video-taped and therefore no analysis could be conducted of the types of questions asked of each gender, analysis commonly found in studies of gender equity and classroom discourse. Factors cited as influencing the instructors' views or practice were self-reports. The interview was conducted by the former professor from the women and mathematics course and that may have influenced the instructors' answers. Finally, due to time constraints, the coding was done by a single person. Still, common themes emerged from the interviews.

Implications for Practice

A number of implications for practice can be drawn. However, given the particular nature of this case study, it seems most appropriate to phrase these implications as reflective questions for college faculty and their programs:

- How well are our teacher preparation programs helping future K-12 teachers develop the necessary skills to achieve equitable classrooms?
- Is gender equity or diversity addressed in our math or teacher prep curricula, or coordinated in any way between them? Should it be? If so, how? By whom?
- How is "Student Voice" experienced in our own mathematics classrooms and in classrooms across our departments? Are math faculty encouraging participation, promoting confidence and achieving engagement among all students? How can equitable practice be highlighted and made more explicit in the women and mathematics course?
- Are role models available for *all* students in our collegiate mathematics departments? If they are not among our faculty, can they be found in posters in our hallways and common spaces, in our invited colloquia speakers, or in our career panels?
- Are gender and diversity concerns in STEM fields discussed in our departments or on our campuses? Do these discussions address both theory and practice? Do they engender change or action?

- What is the value in having collegiate math faculty visit the K-12 classrooms of former students and converse with them about their practice? Could those observations and conversations lead faculty to reflect on how to improve teacher preparation programs or encourage them to consider the environment in their own classrooms? If so, how?

References

Bonetta, L. (2010). Reaching gender equity in science: The importance of role models and mentors. *Science Careers*. Retrieved from http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2010_02_12/science.opms.r1000084

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*. Retrieved from http://mathed.asu.edu/crume2008/Proceedings/Proceedings.html

Glaser, B. (1992). *Basics of grounded theory analysis*. Mill Valley, CA: Sociology Press.

Halpern, D., Benbow, C., Geary, D., Gur, R., Hyde, J. & Gernsbacher, M. (2007, Fall). Why do men dominate the fields of science, engineering and mathematics? *Scientific American.* Retrieved from http://www.sciam.com/article.cfm?id=sex-math-and-scientific-achievement

Hyde, J., Lindberg, S., Linn, M., Ellis, A. & Williams, C. (2008, July). Gender similarities characterize math performance. *Science. 321*(5888), 494-495.

Leonard, J. (2008). Women in aviation and space: The importance of gender role models in mathematics education. Chapter 6 (pp. 107-126) in *Culturally specific pedagogy in the mathematics classroom*. New York: Routledge.

Marx, D. & Roman, J. (2002). Female role models: Protecting women's math test performance. *Personality and Social Psychology Bulletin*. *28*, 1183-1193.

National Coalition for Equity in Education. (2003). Perspectives on equity. Retrieved from http://ncee.education.ucsb.edu/perspectives.htm

National Council of Teachers of Mathematics. (2000). *Principles and standards for school mathematics*. Reston, VA: NCTM.

National Council of Teachers of Mathematics. (2001). *Changing the faces of mathematics* (Series). Reston, VA: NCTM.

Perl, T. (1978). *Math equals.* New York, NY: Addison-Wesley.

Secada, W., Jacobs, J., Becker, J., & Gilmer, G. (2001). *Changing the faces of mathematics: Perspectives on gender*. Reston, VA: NCTM.

Steele, C., Spencer, S., & Aronson, J. (2002). Contending with group image: The psychology of stereotype and social identity threat. In M. Zanna (Ed.), *Advances in Experimental Social Psychology Vol. 37.* San Diego, CA: Academic Press.

Streitmatter, J. (1994). *Toward gender equity in the classroom: Everyday teachers' beliefs and practices.* Albany: State University of New York.