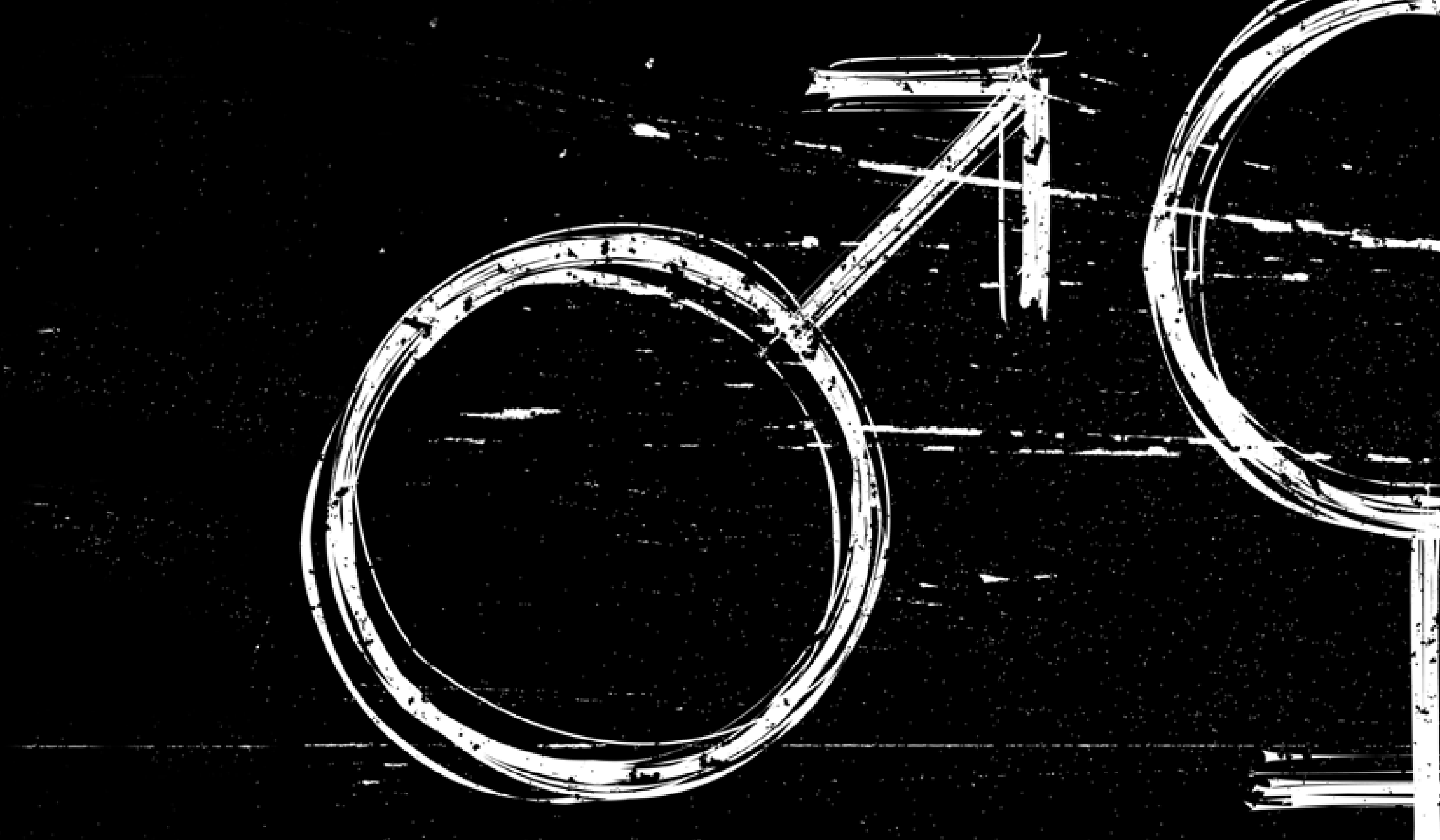
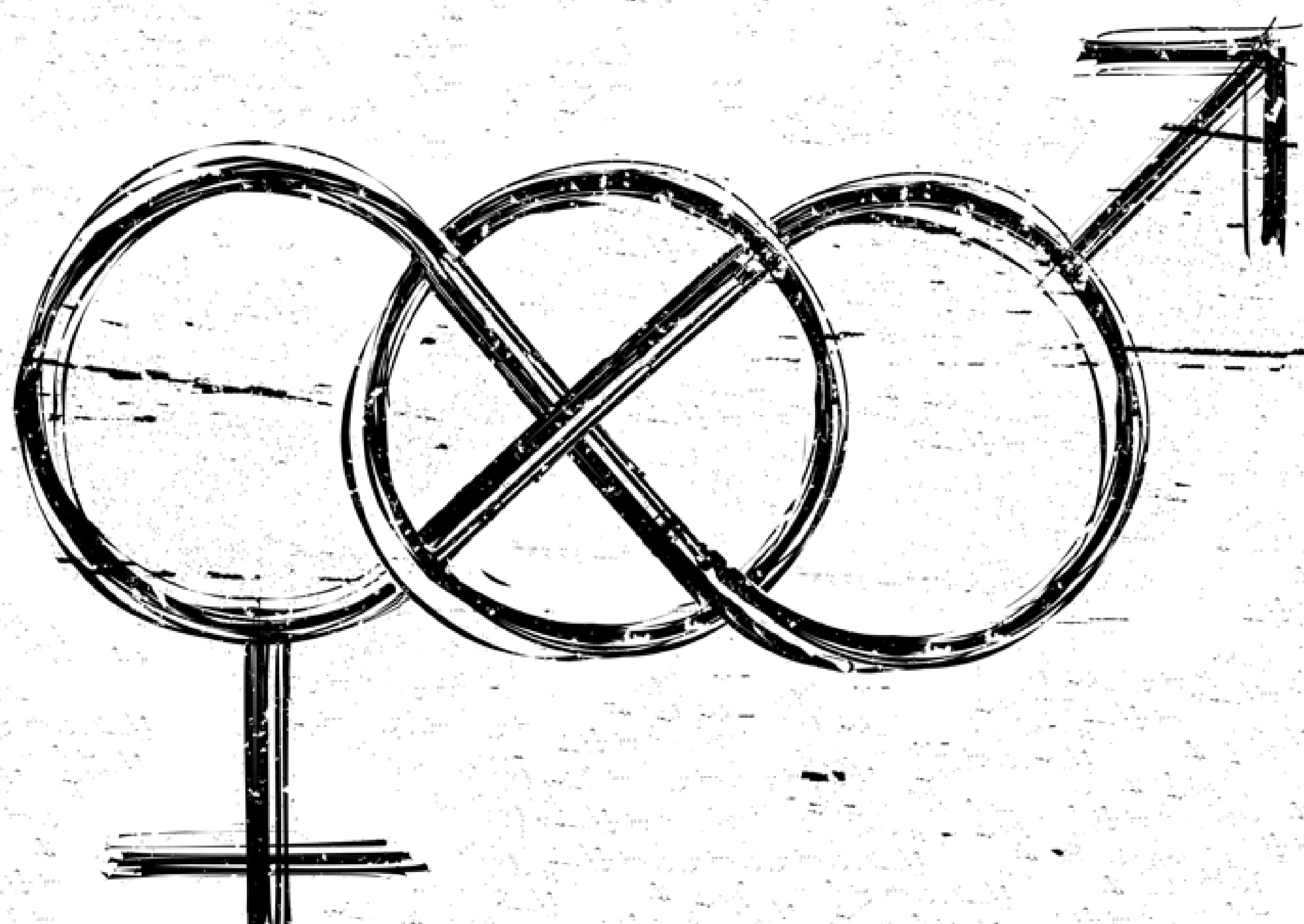
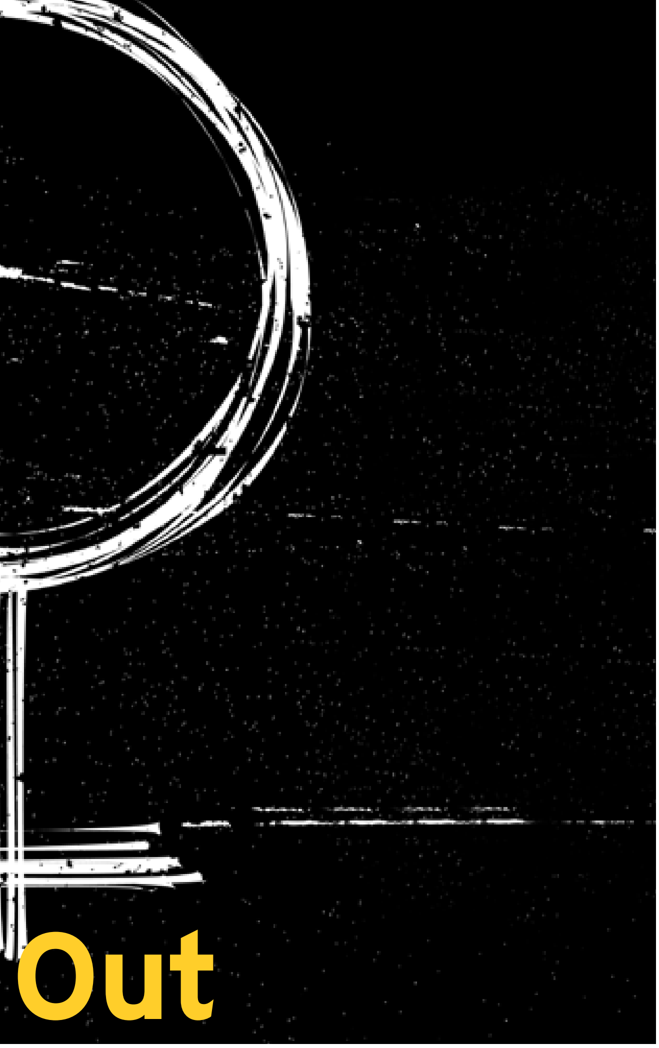


Speaking Up and Speaking





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Out about Gender in Mathematics

Laurie H. Rubel

Expand the focus on diversity and equity to discuss the importance of gender and sexual identity for mathematics education.

Readers are likely familiar with an old riddle, recently brought back to popular attention in the *New York Times*:

> A young boy and his father are in a car accident. The father dies at the scene. The boy is transported to the hospital, taken immediately into surgery . . . but the surgeon steps out of the operating room and says, "I can't operate on this boy—he is my son!" Who is the surgeon? (Old riddle, recently republished by Coontz [2013]).

About twenty years ago, when I was a novice mathematics teacher, I included this question as part of a unit on proof and logic for my ninth-grade geometry class. I was teaching at a boys school, and the students were competitive about getting perfect scores on their mathematics tests. This question proved to be a stumper! Many gave creative responses to try to resolve the riddle, and most did not arrive at the possibility that the surgeon could actually be the boy's mother. At the Back-to-School Night that year, several students' mothers thanked me for inserting this riddle into the logic unit because it pushed their sons to examine their assumptions about gender roles. Yet in revisiting this riddle twenty years later, I realize now that our experiences with this riddle reveal more than just assumptions about gender roles. Could not the surgeon be the boy's other father?

Diversity and equity are stated priority areas across the field of mathematics education, from the ivory towers of the academy, across teacher education programs, to school districts, schools, and individual classrooms. The talk surrounding diversity and equity is usually framed around categories of race, cultural background, language, disability status, sex, or socioeconomic status, mostly one category at a time. In general, sexual orientation and gender identity remain largely absent from these discussions (some exceptions are included in the bibliography). This article looks more closely at the connection of gender and sexual identity with the teaching and learning of mathematics.

SEX OR GENDER?

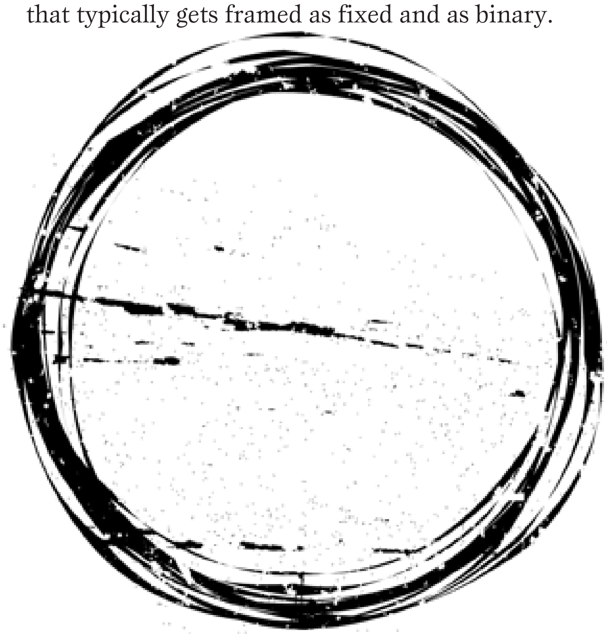
Gender and sex are variables created and developed by society, often used interchangeably without distinction. For example, when I was pregnant, people would ask me if I knew the baby's gender. I would answer that I knew the baby's sex but not its

Some efforts encourage girls to be more successful in mathematics by being more like boys.

gender and would receive quizzical looks. Sex and gender are not equivalent. Sex refers to a biological variable and is usually expressed in terms of male or female. Gender refers to a social variable and is usually expressed as girl or boy or as woman or man. Despite the difference in meaning, gender and sex are typically used interchangeably. For example, in school performance data or research reports, students (and teachers) are typically described in terms of sex or gender, interchangeably, without language or nuance about any distinction between the two, with some exceptions (e.g., Barnes 2000).

The conflation of sex with gender is problematic for a variety of reasons. First, conflating sex and gender reinforces three false premises: (1) that individuals are born either male or female; (2) that sex and gender are fixed qualities; and (3) that gender is always in correspondence with sex (Esmonde 2011). We can look to our schools, our families, and our communities to see counterexamples to these premises.

A second problem with conflating sex and gender is that doing so contributes to *gender normativity*—the idea that there is one way to be male, or a boy, and another, different way to be female, or a girl. Gender is not about being but about doing (Damarin and Erchick 2010), and gender identity is not fixed but, rather, an ongoing process (Butler 1990). Gender normativity links gender identity and sexual orientation. Like gender, sexual identity is another variable created and developed by society that typically gets framed as fixed and as binary.



Heterosexuality is an essential aspect of conforming to gender norms.

GENDER AND MATHEMATICS

Mathematical ability and participation in mathematics are associated, both historically and statistically, with masculinity (Damarin and Erchick 2010; Mendick 2006). At the risk of being overly simplistic, if mathematics is framed as masculine, then from a worldview that has a binary perspective on gender, mathematics, by default, is then *not* feminine. In other words, girls might feel that they have to choose between being gender-normative as girls and doing mathematics (see Nosek, Banaji, and Greenwald [2002] as an example of psychological research on this idea). One response to this construed mismatch between mathematics and girls is to try to change girls to make them fit better with mathematics. Efforts such as encouraging girls to be more persistent, more vocal, or more confident are aimed at changing girls to be more successful in mathematics but to do so by being more like boys.

Danica McKellar's popular book series takes a second, contrasting approach to the problem of mathematics being framed as masculine. Instead of trying to change girls so that they can be more successful in mathematics, McKellar's tactic is to align mathematics with femininity and the feminine gender norm of heterosexuality. McKellar's book series is geared toward middle school girls and has been met with wide success. Her three books—*Math Doesn't Suck* (2008), *Kiss My Math* (2009), and *Girls Get Curves* (2012)—include mathematics questions organized around situations or stories that might interest some girls. But beyond the new word and story problems, the messaging in and around these books conflates gender with sexual (i.e., heterosexual) identity. The Web and print advertising of these books questions girls with "Do you hide your smarts, especially around guys?" and further calls to girls, "We're in this together, and remember: Smart is sexy!" These messages convey that mathematics is for girls but wrap that claim in heterosexuality by placating girls that they will not be any less attractive to boys if they are interested or successful in mathematics. This approach might be a way to entice some girls toward mathematics but undermines its own message with this emphasis on mathematics for girls as "sexy."

A third approach to taking up gender in mathematics is known as gender-complex education. As described by Rands (2013), *gender-complex education* means directly acknowledging gender diversity by making our curriculum and pedagogy reflect the existence of transgender and gender nonconforming people. Mathematics can be used to analyze gender privilege and oppression, such as analyzing gender salary gaps, rates of harassment and violence targeting transgender people, or other injustices that occur with respect to gender identity or sexual orientation. In addition, gender-complex mathematics education includes examining the ways that mathematics tasks present gender and rewriting story problems to better reflect gender diversity.

Gender-complex education would clearly support our gender-nonconforming and transgender students—support that is, in itself, an imperative for our society. Further, a gender-complex approach to mathematics education would create opportunities for all students to develop more sophisticated understanding of gender and, in so doing, learn how to use mathematics to better understand complex and real situations.

In the next section, I build on these ideas about gender-complex mathematics education to share an analysis of story word problems with a focus that includes gender identity and extends to sexual orientation.

GENDER AND SEXUALITY IN MATHEMATICS RESOURCES

In a 1975 article in *Mathematics Teacher*, Rogers presented an analysis of story problems in algebra textbooks. One of her findings was that, on the basis of the ways that women were positioned in these story problems, women and their activities "are comparatively quite dull and insignificant" (p. 288). In the forty or so years since, mathematics textbooks have been updated to reflect women and girls or men and boys in more diverse ways. However, comparable attention has not been paid to address diversity in mathematics education as it relates to the intersection of gender and sexual identity (Esmonde 2011), evidenced by the following familiar examples.

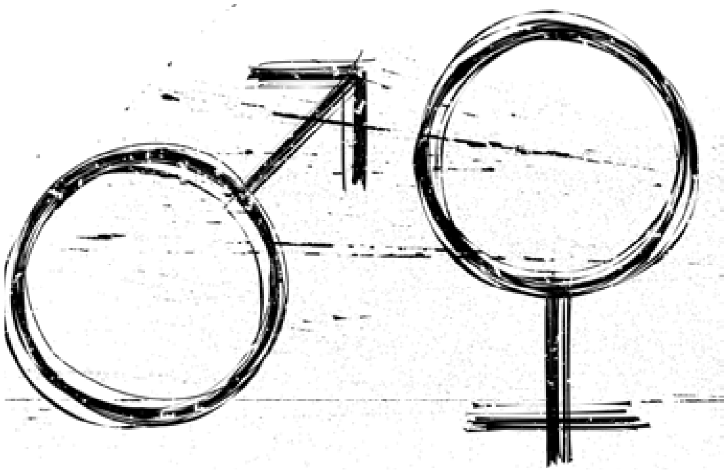
Example 1: Married Couples

Perhaps the very setup of this classic problem no longer fits with the target mathematics because the story introduces complexity that goes beyond the mathematical point of the multiplication principle:

> How many ways are there to pick a man and a woman who are not married to one another from a group of n married couples? (Source: http://www.math.uiuc.edu/~ash/Discrete/213Ch1.pdf)

Some readers might quickly answer, "Easy! The solution is $n(n - 1)$. For each of the n men, there are $n - 1$ women who are not their spouse." However, that solution is correct only if the married couples are all composed of one man and one woman. If we allow for the possibility that a man can be married to another man or that a woman can be married to another woman, as well as men being married to women, or that the entire binary categorization of people as men or women might be problematic, then what is the solution to this question?

Skeptical readers would be mistaken to write off this concern as political correctness or only a matter of labels, but the next example drives the point home.



Example 2: Matched Pairs

Gale and Shapley's "Stable Marriage Problem" (1962) presents an algorithm to generate a set of stable matchings between college applicants and colleges. Each applicant ranks a set of colleges, and each college has a quota of the number "a set of n applicants is to be assigned among m colleges where q is the quota of the ith college" (p. 9). To investigate the general problem, Gale and Shapley began with a special case of the value of q being 1.

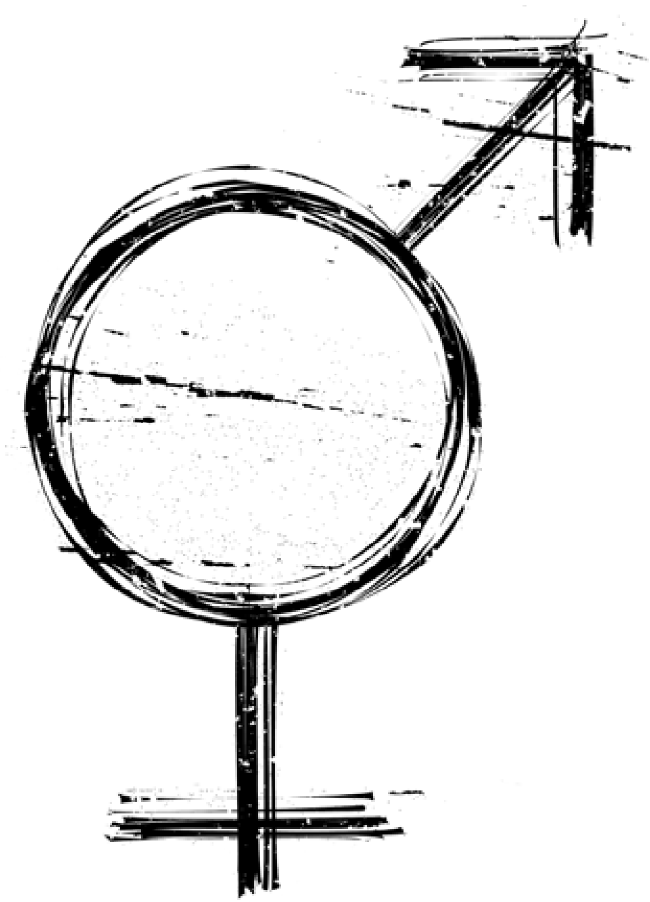
Because having a quota of size 1 would no longer fit the story about the colleges, they substituted another story to fit these parameters, as follows: There are n men and n women. Each person ranks those of the opposite gender for marriage. The goal is to find a way to create a set of stable pairings. In other words, the set of marriages is unstable if there exist a man and a woman who are not married to one another but who prefer to be married to one another instead of being married to their spouses. Gale and Shapley's algorithm to create a set of stable pairings became known as the deferred acceptance algorithm and was later applied to matchings of medical residents to hospitals and to matchings of New York City school students to high schools.

The Stable Marriage problem was introduced in the February 2014 issue of *Mathematics Teacher* as part of a classroom activity for school students. The authors frame the task in terms of choosing a husband for each woman: "It is your job to choose a husband for each woman, taking into consideration

What spaces do we make in our mathematics classrooms and in our research to acknowledge and value diversity across gender identity and sexual orientation?

the preferences of each prospective bride and groom" (Greenwell and Seebold 2014, p. 447). In their explanation of how to explore the problem with secondary school students, the authors caution a teacher audience that, as part of simulating an algorithm to solve the problem, "there may be some initial awkwardness, but with college students, at least, it disappears rapidly. Teachers of younger students may need to work harder at making the students feel comfortable. Have the female students stand around the room, not too close together. Group the male students together in another part of the room" (p. 449).

When I was a beginning teacher and in my twenties, I attended a professional development course for mathematics teachers, in which the Stable Marriage problem was explored as an example of a problem that can be modeled with graph theory. The facilitator, a professor of mathematics, led an activity similar to the one described above. He handed pink cards with fictitious names to the people he identified as women in the room and blue cards to the men. He told the women, holding the pink cards, to create rankings of their marriage preferences. If you were a woman, you were holding a pink card, and you were allowed only to rank your choices of men as spouses.



I remember feeling uncomfortable with this arrangement. When I voiced an objection to this constraint, I was told that this is the set-up of the problem. In other words, this problem is not really about marriages. The problem refers to a particular kind of mathematical pairing between set A and set B. The story about men and women and marriages is just a story to lead us to a particular mathematical model. The story is supposed to help clarify the parameters of the mathematical model. "Just focus on the mathematics," I was told, even though I was being handed a pink card and thereby being placed in a particular location on a gender binary. Not only that, but heteronormativity was being reinforced with the statement that, in this model, all women have to want to marry men.

In the *Mathematics Teacher* article, Greenwell and Seebold are forward-thinking enough to suggest that "if the idea of males doing all the proposing seems old-fashioned, try repeating the process with the roles switched so that the female students propose to the males" (p. 449) but not forward-thinking enough to consider that the heterosexuality assumption in the set-up of the problem itself might not be appropriate for a classroom activity. It will likely make students uncomfortable, much in the way that my participation in such a simulation of the Stable Marriage algorithm did not welcome me, as I am, to mathematics. Beyond making mathematics seem incompatible with realities of people's lives, by imposing binary structures on gender and requiring heterosexuality, this activity and others like it demonstrate how mathematics can be used to reinscribe already-oppressive formats.

Greenwell and Seebold take additional care to caution teachers to be sensitive about bringing in a dating context into the classroom, but there is no mention about sensitivity around assigning genders to students on the basis of perceptions of their sex or around directing students, within a mathematics problem, to be heterosexual. Story problems such as the Stable Marriage problem are used because they are tidy and compact and the binary categories simplify the mathematics. But these kinds of story problems are outdated and do not reflect what we know about gender identity or sexual orientation—that they are not binary categories; that gender, sex, and sexual identity are not equivalent; and that they are not fixed variables assigned at birth. It is difficult to speak up and speak out about these matters because, for the most part, they remain part of the unspoken in mathematics education.

BURDENS AND OPPORTUNITIES IN DAILY INTERACTIONS

Classroom teachers and mathematics education faculty who themselves do not conform to gender normativity or heteronormativity might not feel safe about being open about these issues with their students or their school communities. Consequences of being out in places where being gay is not a civil right can result in losing one's job, harassment, or even violence. Or such openness can feel too personal or maybe seem irrelevant to the teaching of mathematics. The burden cannot be placed only on gay or transgender individuals to come out in mathematics education but is a challenge meant for all. What spaces do we make in our mathematics education work, in our classrooms, in our teacher education, and in our research and with our colleagues to acknowledge and value diversity across gender identity and sexual orientation?

We need to cease any pretending that mathematics is neutral, color-blind, or gender-blind. LGBTQ (the acronym indicating lesbian, gay, bisexual, transgender, and questioning people) and gender-nonconforming students need to be explicitly considered as part of our considerations of diversity and equity in mathematics education. Support needs to be articulated through our daily classroom interactions with students and through our pedagogy; support needs to be reflected in our curriculum and in our work with mathematics teacher candidates. Additional benefits will come to students whose family members are LGBTQ or gender-nonconforming as well.

Gutiérrez (2002) teaches that in discussions about equity, we often operate under an assumption that marginalized people can benefit greatly from better access to mathematics, not the other way around. In other words, an assumption might be that girls, LGBTQ, or gender-nonconforming people need mathematics to improve the quality of their lives and to increase the opportunities available to them. Although this may be true, Gutiérrez (2002, p. 147) explains that such an outlook misses the converse perspective: Imagine what the field of mathematics stands to gain "from having these people in its field." Both factors are compelling for *Mathematics Teacher* readers.

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